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Catalysing climate resilience

An analysis of the UK's strengths in the innovation of adaptation technologies and services

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Summary

The UK is experiencing increasing impacts from climate change, including more frequent and severe floods, heatwaves and storms. It needs to prepare more for these impacts. It also needs to honour its pledge to support climate adaptation efforts in developing countries. The UK should maximise the opportunity from an increase in the demand for adaptation goods and services, including flood defences, climate-resilient building materials and crops, innovative insurance products and treatments for vector-borne diseases, both at home and globally. There is an economic, social and environmental imperative to scale up and innovate in adaptation-related goods and services, especially in those areas where the UK has an existing and potential comparative advantage.

While the UK has an established market in adaptation goods and services, it is underdeveloped relative to the scale of domestic and international climate risk. There is far less economic activity in climate change adaptation activities than there is in mitigation, i.e. the net zero economy. Investments flowing into climate change adaptation activities are relatively low and the innovation ecosystem is dominated by small and medium-sized enterprises (SMEs) that face deep-rooted barriers to commercialisation.

Our exploration of patent data reveals that the UK has clear strengths in climate change adaptation technologies (CCATs) overall, ranking second in the world for revealed technological advantage in CCATs, a measure of specialisation. We also found that the UK is particularly specialised in sectors relevant to specific adaptation technologies:

- engineering (fifth globally): includes adaptation at coastal zones, in water systems and in infrastructure
- life sciences (second globally): includes innovation in agriculture and health, such as drought resilient crops and vaccines against vector-borne diseases
- 'indirect' adaptation technologies (third globally): includes technologies such as weather forecasting, climate simulation, assessing water resources and monitoring invasive species.

This suggests the UK is well placed to compete in global markets for adaptation technologies, and that targeted industrial policy support could help translate existing technological leadership into commercial and export advantage. Overall, comparing aggregate technology categories, we found that the UK is more specialised in adaptation technologies than in mitigation technologies.

The UK also has strengths in areas of professional and business services that will experience increasing demand as the climate changes and is already host to global leaders in this space. These services include engineering consultancy, environmental advisory and climate risk management. The UK is therefore well placed to meet growing demand as regulatory requirements, infrastructure investment cycles and corporate demand for adaptation advisory services expand.

Insurance and financial service activities, which are highly transferable to climate change adaptation applications, are also British strengths. However, policy support will be needed to translate these strengths into adaptation-specific products and instruments. The current regulatory frameworks have yet to generate the demand signals needed to unlock private capital at scale to fund these products. Getting this right will create the market conditions to support climate-resilient growth.

Recommendations for policymakers

1. **Highlight climate change adaptation as a key aspect of resilience in the UK's Modern Industrial Strategy.** The UK's industrial strategy sets out a plan to drive growth across eight sectors where the UK has comparative advantages and growth potential, alongside boosting resilience and supporting environmental goals and the net zero transition. Climate change adaptation technologies, products and services map to existing industrial strategy sectors, including advanced manufacturing, life sciences, professional and business services, and financial services. Identifying areas where demand is increasing due to the need to adapt to a changing climate offers a new lens for considering growth opportunities in sub-sectors. These opportunities have implications for policies within the scope of the UK's industrial strategy, including support for innovation, skills and building innovation clusters across the country.

2. **Support commercialisation and scale-up for innovators in adaptation technologies and services.** The UK's innovation ecosystem in climate change adaptation technologies and services is growing, but with many small firms operating in these markets, policy is likely to need to play a role in developing commercialisation pathways and enabling scale-up of these technologies and services. Creating networks or clusters that connect small innovators with larger industrial partners and end-users (particularly in the construction, infrastructure and utilities sectors) could help bridge the gap between innovations and their deployment. Given the concentration of adaptation innovation in coastal and flood-exposed regions, support for such firms presents an opportunity to drive regional growth at the same time as directly helping to build local resilience.

3. **Develop a dedicated adaptation investment strategy.** Investment flows to adaptation sectors remain significantly lower than those directed towards the net zero economy, despite growing domestic need and international demand for adaptation technologies and services. A strategic framework, comparable to those that have successfully mobilised investment in low-carbon technologies, would provide the demand-side signals for a pipeline of demand for adaptation technologies and services, especially as adaptation action is largely driven by the public sector. This should be complemented by enabling regulation, and consideration of the skills required for the UK to both adapt to climate change and become a competitive provider of adaptation technologies and services globally.

4. **Build further evidence on the UK's strengths in sectors relevant for adaptation.** In this report, we map the current landscape of firms operating in climate change adaptation goods and services sectors. Further work is needed to understand the UK's export advantage in these goods and services, and the spillover effects of innovation in the adaptation economy.

1. Introduction

Globally, there is an urgent need for substantial investment in climate change adaptation. By 2030, the global investment required to adapt to the impacts of climate change is expected to reach up to US$1.3 trillion annually, with the UK projected to need to invest over £10 billion each year. The UK is strategically positioned to meet this growing demand, leveraging existing strengths across relevant sectors, including the life sciences, engineering, climate science, and financial and professional services. In this report, we identify where the UK can be most competitive in adaptation technologies and services, using patent data, case studies and company analysis to inform policy decisions that could generate economic growth and support domestic and global climate resilience.

Context, motivation and objectives

The urgent need for increased investment in climate change adaptation technologies and services

Countries around the world are already experiencing the physical impacts of climate change. These are set to increase globally, even in a scenario where all greenhouse gas emissions stopped tomorrow. Regions will experience more frequent extreme weather events, higher temperatures, rising sea levels and more extreme precipitation patterns (Intergovernmental Panel on Climate Change [IPCC], 2023).

Climate change adaptation is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as the adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures to moderate potential damages or benefit from opportunities associated with climate change (UNFCCC, 2025). It follows that alongside behaviour change, the speed of innovation and adoption of adaptation technologies and services will be a key determinant in how resilient the global economy is against future climate change.

Adaptation requires significant investment

The 2025 UN Adaptation Gap Report estimates the cost of adaptation finance needed in developing countries, which are the most vulnerable to the impacts of climate change, at US$310 billion per year by 2035, 12-14 times the current US$26 billion. If we include developed countries that total requirement increases to between US$0.5 and US$1.3 trillion per year by 2030. It will likely grow thereafter. At the conference of the parties in 2021 (COP26), developed nations agreed under the Glasgow Climate Pact to provide US$40 billion in climate adaptation funding for developing nations by 2025. This goal was missed, with adaptation finance flows reaching US$26 billion in 2023 (UN Environment Programme [UNEP], 2025). The public sector is expected to account for a large proportion of this required investment (Organisation for Economic Co-operation and Development [OECD], 2025). However, the private sector will also need to invest directly to enhance the resilience of assets, operations and supply chains. Insurance companies are reinforcing this trend by incorporating adaptation measures into their pricing structures, incentivising businesses, as well as homeowners and policymakers to invest in climate resilience measures.

As countries increase their investment in climate adaptation, there will be economic opportunities for those with the capabilities to develop and deploy adaptation technologies and services competitively. In this report, we explore the UK's current and future capabilities in innovating in adaptation technologies and services. Our aim is to identify where the UK is leading innovation and has the potential to capture domestic and global markets, while contributing to building resilience.

The UK's strategic position in addressing a domestic and global challenge

The UK has existing strengths in many sectors that provide adaptation goods and services, including:

- **The life sciences:** for example, producing vaccines against diseases that will become more prevalent in a warmer climate
- **Engineering:** for example, producing sea walls and flood defences
- **Climate science and modelling:** for example, providing early warning systems for extreme weather events
- **Financial services:** for example, in developing innovative financial products.

A number of these are in sectors identified by the government as being key drivers of economic growth in the UK's industrial strategy (Department for Business and Trade [DBT], 2025). In this way, the UK is well placed to support domestic and global action on climate adaptation and resilience. It also highlights that there are clear competitive benefits for firms in the UK, and for the economy as a whole, from serving climate adaptation markets.

Domestically, the UK faces serious risks from the impacts of climate change. The amount of investment needed to adapt the UK to a changing climate has been estimated at over £10 billion each year by the UK's Climate Change Committee (CCC, 2023). In the 2025 Spending Review settlement, the government prioritised some investment in adaptation, particularly focusing on resilience against flooding. But the CCC estimated that more public and private investment will be needed to address the growing impact on the UK from other climate-related risks (CCC, 2023).

Many countries, particularly those in Northern Europe, are facing similar physical climate-related risks to the UK. These economies represent export markets that are set to grow, which the UK is well positioned to tap into if it is able to build a competitive advantage in adaptation technologies and services.

According to the Notre Dame Global Adaptation Initiative's Country Index, a measure of a country's exposure, sensitivity and ability to adapt to the negative impact of climate change, the UK ranks as the sixth least vulnerable country in the world (University of Notre Dame, 2024). In effect, that means that more vulnerable countries around the world will have a greater need for climate change adaptation technologies and services. Some climate-adaptation technologies, for example, engineering solutions against flooding and coastal erosion, will be less suitable for export due to the specificity of the landscape where they are deployed. Nevertheless, most climate-adaptation solutions, including advanced monitoring and forecasting systems, climate-resilient building materials, water conservation technologies and nature-based solutions, will have applicability across global regions facing climate risks.

Project background

This report is a partnership between the Centre for Economic Transition Expertise (CETEx), the Grantham Institute at Imperial College London, the Grantham Research Institute at the London School of Economics and Political Science (LSE), the Centre for Economic Performance (CEP), the Programme on Innovation and Diffusion (POID) and the Productive & Inclusive Net Zero (PRINZ) programme at LSE. It is the latest in a body of work looking at the UK's strengths in relation to capturing sustainable growth opportunities. Previous reports focused on climate mitigation technologies, providing analyses of the UK's comparative advantages drawing on data on trade and innovation activity across a range of clean technologies (e.g. see Curran et al., 2022 and Serin et al., 2024), as well as more granular analyses on specific technologies, including zero-emission passenger vehicles (Unsworth et al., 2020), carbon capture, usage and storage (CCUS) (Serin et al., 2021), tidal stream energy (Serin et al., 2023) and geological carbon dioxide removal (Serin et al., 2025). This report is the first dedicated analysis from these institutions focused on climate related-adaptation technologies. It is also the first to explore the UK's strengths in adaptation services using in-depth case studies.

Objectives and approach

In this report, we identify climate-adaptation technologies and services where the UK is currently, and has the potential to be, a competitive provider on the world stage. We aim to shed light on areas where building further domestic capacity has the potential to generate growth in the UK and catalyse global climate adaptation. The report does not analyse domestic deployment strategies of the adaptation goods or services discussed; nor does it reflect on the potential benefits of investing in adaptation measures to avoid the economic costs from a changing climate.

As such, our analysis provides a new policy lens that is relevant for the Government's industrial strategy, where resilience is a key high-level objective. Moreover, the technologies and services highlighted as being relevant for adaptation span a range of industrial strategy sectors, from advanced manufacturing and life sciences to financial, professional and business services, all areas where the UK has existing strengths.

Insights from this report could be particularly timely as the Government heads into the next period of adaptation planning. The fourth UK Climate Change Risk Assessment (CCRA4) will be published by the UK Climate Change Committee in May 2026, with the Government's own assessment to be published in 2027. The next National Adaptation Plan (NAP4) will follow in 2028. The report will be important for informing which adaptation technologies and services may lead to UK growth and for identifying supply chains which are critical for realising this growth. Policy decisions required for realising this support include investment decisions through policy banks, such as the National Wealth Fund and the British Business Bank; the allocation of the July 2025 spending review settlements within relevant departments, particularly the Department for Environment, Food & Rural Affairs (Defra) and the Environment Agency; and the Government's budget for 2026.

In the report, we draw on multiple sources of evidence to identify the UK's strengths in relevant technologies and services. These include:

- Patent data: we analyse historical trends and global comparisons of adaptation-related patenting activity to shed light on the UK's capabilities relative to other countries.
- Case studies: we provide a qualitative assessment of the UK's strengths in key adaptation-related services, for example, in insurance and financial services sectors.
- The Data City: this analysis uses text on registered companies' websites to classify firms across sectors and technologies. This gives us a snapshot of firms currently active across adaptation goods and services, and where they are in the UK.

This report uses patent analysis with the explicit objective of informing the targeting of the UK's policy support into adaptation-related domestic capabilities that are most likely to create growth opportunities for the country.

While some analysis of patent data in the context of adaptation exists (e.g. Auci et al., 2021; Elsen and Tietze, 2024; Hotte and Jee, 2022; Fernandes et al., 2020; Dechezleprêtre et al., 2020; Olazabalet et al., 2019; Climato and Mullan 2010; Adenle et al., 2015; and Probst et al., 2021), the focus of these analyses tends to be global or on other countries, offering limited specific insight for the UK.

Many economic activities relevant to improving adaptation and resilience lie in service sectors. We use a case study approach to build evidence on service sector strengths, given these are less likely to be captured in patent data, and would also be difficult to identify using other sources, such as trade data, where services tend to be highly aggregated.

Structure of the report

We first analyse the UK's position on the global market for adaptation technologies. We then identify the UK's strengths in innovation relevant for climate adaptation action, before turning to the UK's strengths in services. We then explore the firms operating in climate change adaptation technologies and services, before concluding and providing recommendations for policymakers.

2. Climate change adaptation technologies and services: global market outlook and the UK's position

Innovations in climate change adaptation technologies are vital for managing the risks from a changing climate, including protecting coastal zones, managing water supplies and protecting critical infrastructure. Climate adaptation services, including new insurance products or specialised consultancy services, are also important. Investments in these technologies and services will enable the UK to play a leadership role in protecting domestic and international communities vulnerable to the impacts of climate change, while also capturing potential economic opportunities by serving rapidly scaling global markets in areas of relative strength.

What are climate change adaptation technologies (CCATs) and how are they being deployed?

Climate change adaptation technologies (CCATs) are vital for building global resilience against current and future climate-related impacts (or 'shocks'). They are designed to protect lives, livelihoods, infrastructure and natural resources from the impacts of climate-related hazards. They include technologies for protecting coastal zones and river basins, water conservation and efficient water use and supply, protecting critical infrastructure, adapting agriculture, forestry, livestock or food production, protecting human health, and improving technologies in monitoring and forecasting extreme weather events. Figure 2.1 provides a more detailed breakdown of the subcategories of inventions.

CCATs are widely used around the world today to manage the impacts of climate change. National adaptation programmes combine engineered or infrastructure solutions with nature-based solutions, and data-driven technologies. In the UK, technologies to manage flood risk and coastal erosion include seawalls, urban sustainable drainage systems (SuDS) and sophisticated flood risk assessment and mapping technologies. In other low-lying countries, such as Bangladesh, interventions blend engineered and social measures, including community embankments and early-warning systems.

To improve water conservation and efficient supply, the UK's water utility companies are deploying both hardware and digital behavioural tools. Water companies are accelerating the rollout of smart-meters to help manage demand and using targeted water pressure-management to reduce leakage. These measures will improve drought resilience. In countries at greater risk of drought, such as Australia, investment in water services emphasises managing demand, recycling and diversifying supplies.

To minimise the public health costs from climate-related impacts, governments are using disease surveillance to monitor new vector-borne diseases. They are also deploying early-warning systems for heatwaves, cooling-centre networks (air-conditioned places where people can cool down during extreme heat events), potable water safeguards and strengthened public-health supply chains. Wealthier countries are investing in weather forecast-linked public warnings, cooling systems for hospitals and protection measures for important infrastructure. Less wealthy, more vulnerable countries are investing in community health systems and early warning systems to reduce morbidity from floods, heat and water-borne disease. Overall, public health climate adaptation increasingly relies on cross-sector data sharing (weather, hydrology, epidemiology) to trigger pre-emptive action.

Historically, the UK has invested significantly in its national meteorological services and weather research centres. This investment has supported observation technologies, high-resolution numerical weather prediction, ensemble forecasting and AI-augmented 'nowcasting' – predicting weather in the immediate hours ahead. The UK Met Office Hadley Centre for Climate Science and Services, for example, is investing in AI for numerical-weather prediction models and targeted programmes to improve extreme-weather forecasting; similar investments are being made in Europe and Australia.

Alongside life science technologies, such as innovative agriculture technologies and vaccines, software, or knowledge-based or modular hardware are the most likely CCAT exports for the UK. This may include climate modelling and weather forecasting software, climate and weather sensors, and packaged smart-meter and asset-management solutions. Large civil engineering works, such as sea walls and barriers, are exportable as contractor services, as demonstrated by the Netherlands (Global Centre on Adaptation, 2018), but the physical construction of these works is typically sourced locally. Similarly, bespoke engineering components and many utility upgrades are often procured locally.

Figure 2.1 Categories used in the Cooperative Patent Classification (CPC) Y02A (technologies for climate change adaptation)

Engineering intensive		
At coastal zones; river basins	Water conservation; efficient water supply/use	Adapting or protecting infrastructure/their operation
• Hard structures • Dune restoration • Artificial reefs/seaweed • Flood prevention • Controlling, monitoring or forecasting	• Rainwater harvesting • Water desalination • Using grey water • Leakage reduction or detection in water storage of distribution • Water filtration • Industrial water supply • Protecting water resources	• Extreme weather resilient electric power supply • Improving thermal insulation • Heating, ventilation and air conditioning technologies • Transport (e.g. roads, railways) • Planning/developing urban green infrastructure
Life sciences		**Indirect**
Adaptation technologies in agriculture, forestry, livestock or food	In human health protection, e.g. against extreme weather	Technologies having an indirect contribution to adaptation
• Drought resilient crops • Ecological corridors or buffer zones • Tech for protecting livestock/poultry • Fisheries management (e.g. alternative feeds for fish) • In food processing or handling, e.g. food preservation	• Air quality improvement or preservation • Against vector-borne diseases exacerbated by climate change	• Information and communications technologies supporting adaptation, e.g. for weather forecasting or climate simulation • Assessment of water resources • Monitoring/fighting invasive species

Source: Authors', using Cooperative Patent Classification Y02A

What are climate change adaptation services?

Climate change adaptation services (CCAS) span multiple sectors and domains of expertise, including insurance (e.g. parametric insurance), financial services (e.g. catastrophe bonds), climate risk advisory (e.g. risk assessment and vulnerability mapping, coastal and flood defence consultancy, and water

resource management), climate data analytics and forecasting, engineering, and legal and accounting services (CCC, 2019). The use of artificial intelligence and data analytics is also providing new solutions and opportunities.

Like CCATs, some of these services will be tradeable (e.g. early warning weather systems, insurance products and financial services), whereas others will be targeted for specific domestic markets (e.g. area-specific advisory services).

Global market outlook for climate change adaptation technologies and services

The global impacts of climate change are clear. Temperatures are rising, and as a result, natural catastrophes are increasing in both frequency and severity (UNEP, 2025). In 2024, total global economic losses from natural catastrophes were US$318 billion, $10 billion of which can be attributed to human-made climate change (Swiss Re, 2025). Reflecting this, and due to an increasing understanding of future climate risk across governments, firms and individuals, demand for adaptation technologies and services is increasing, and will continue to expand.

Furthermore, the impact of physical risks from climate change on corporations is substantial and is expected to intensify in the future. Financial costs are projected to reach US$25 trillion globally by 2050 in a scenario where global temperatures rise by 2.7°C by the end of the century, with larger impacts on utilities with high fixed-asset exposure (Hall et al., 2025).

Analysis of corporate communications reveals that mentions of climate-resilience in earnings calls and investor presentations surged by 55% between 2021 and 2025 (Trittipo et al., 2025), signalling growing corporate commitment to protective investments. Insurance companies are reinforcing this trend by incorporating adaptation measures into their pricing structures, incentivising homeowners, businesses and policymakers to invest in resilience. Similarly, national adaptation programmes are becoming more frequently used policy tools for both national and local governments to set out their planned adaptation actions.

Projections for the growth of the climate change adaptation technologies and services market suggest that it will reach between US$40 billion and US$51 billion globally by 2030 (Payiatakis, 2025; Trittipo et al., 2025), around $20-30 billion more than current levels. More broadly, demand for climate resilience technologies could generate opportunities worth US$600 billion to US$1 trillion for private capital by the end of the decade (Trittipo et al., 2025).

The most promising opportunities for growth in adaptation technologies include climate-adapted agricultural inputs, human-engineered flood defences, climate-resilient building materials, active and passive cooling, emergency medical products and services, climate intelligence, urban and industrial water efficiency, and distributed energy solutions (Oehling et al., 2025). These technologies have strong current investment activity and the strongest forward-looking signals for future demand.

Despite this momentum, finance mobilisation for adaptation remains underdeveloped compared to mitigation efforts. Provision of adaptation finance has historically been dominated by development finance institutions and public sources, with only 11% of adaptation finance coming from private capital (Buchner et al., 2023). This is largely due to the challenge of monetising adaptation action, where the financial benefits are hard to measure, diffuse and non-market in nature and are uncertain as they depend on the extent of future climate change. This means there is rarely a clear private return to adaptation investment, which explains why it is predominantly publicly funded. Dedicated climate resilience funds have raised approximately US$8 billion across fewer than 120 funds, dwarfed by the US$650 billion raised across over 1,300 funds focused on decarbonisation and sustainability. However, this disparity suggests significant room for growth as the urgent need to adapt to climate change will be impossible to ignore in the coming decades.

The rationale for investment in the UK's domestic capabilities in adaptation technologies and services

Investing in adaptation technologies and services will enable the UK to be a leader in protecting communities vulnerable to the impacts of climate change both domestically and internationally, while also capturing economic opportunities from rapidly growing global markets where the UK can lead.

Climate adaptation technologies and services map to key sectors identified in the UK's Modern Industrial Strategy, including:

- Advanced manufacturing. Adaptation technologies are integral to agri-tech innovations that enhance food security under changing climate conditions. These technologies advance materials science through the development of heat-resistant and flood-resilient materials, and they ensure that infrastructure built for the net zero transition (e.g. renewable energy installations and heat pump systems) can withstand future climate-related impacts.

- Life sciences. Relevant areas of the life sciences include the development of climate-resilient crops and technologies for managing the health implications of climate change, including new vector-borne diseases.

- Digital and technologies. Digital technologies and AI applications are essential for climate monitoring, early warning systems, smart infrastructure and data analysis for adaptation planning.

- Clean energy industries. Innovation is needed to maintain resilient clean energy infrastructure, especially as energy demand is likely to increase under a changing climate (e.g. for air conditioning). This might involve making the grid resilient to storms and power plants resilient to coastal flooding.

- Financial services. The finance sector will play a significant role in developing innovative risk-sharing mechanisms for climate adaptation, including advanced risk monitoring systems, parametric insurance products that provide rapid payouts based on climate triggers and new financial instruments, such as catastrophe bonds and climate-resilient debt structures.

- Professional and business services. Specialised expertise will be needed to help organisations assess climate risks, develop adaptation strategies and build operational resilience. This includes climate risk consulting, adaptation planning and resilience engineering services. These are all areas where the UK is already a global leader.

In addition, our analysis shows that some of the firms leading innovation in adaptation technologies operate in the defence sector (e.g. British Aerospace Limited). There are likely to be 'dual use' technologies that overlap between defence and climate change adaptation, including AI that enables proactive disaster risk management (Conger et al., 2024).

3. The UK's strengths in innovation relevant for adaptation technologies

In this section, we use patent data to show that the UK holds the second strongest 'revealed technological advantage' (RTA) internationally, indicating that climate change adaptation technologies are an area of British innovation strength, including compared with climate change mitigation technologies. The UK is specialised across all adaptation categories, but it particularly excels in life sciences and 'indirect' technologies, including technologies for weather forecasting, climate simulation and assessing water resources. Our regional analysis shows coastal areas such as Cornwall and East Yorkshire have high concentrations of adaptation patents, likely reflecting local needs for flood and coastal defence technologies.

Approach and methodology

The relevance of patent data for informing growth policy

Patents are a key measure of innovation output. They can shed light on countries' areas of innovative strength, where future economic value is likely to be generated (Curran et al., 2022). Indeed, research literature demonstrates a positive link between patents and subsequent firm-level performance and industry-level growth and productivity, particularly when the quality of the patent is taken into account (see Hall et al., 2005 and Kogan et al., 2017). When an organisation develops or discovers a new technology, they can take legal action to protect this intellectual property to prevent competitors replicating the invention. Patents are only considered for protection when the invention is marketable. In this way, a patent indicates that there are likely to be some economic benefits from an invention. Patenting is also an expensive process, so it is likely that patents are mostly filed where the invention is expected to generate returns. In identifying the relative strengths of countries around the world using patents data, we are able to show where bases of knowledge and innovation relevant for adaptation are located. These areas could be attractive locations for investment in relevant value chains. Previous reports in the series have used patent analysis in this way to inform growth and industrial policies, most recently in the context of geological carbon removal technologies (see Serin et al., 2025).

However, not all innovation is patented, with other methods available to protect intellectual property (e.g. industrial secrecy or lead-time advantages). Innovation is also complex, and patents only capture the beginning of the process (i.e. many patents do not go on to become a product or a service). Despite this, patents are still one of the best internationally available data that can shed light on countries' innovation-focused activities. Indeed, data on patents are commonly used by researchers to make comparative analyses of innovation patterns. These data are available internationally over time and organised under detailed technological classifications. While patents do not capture all innovation activity, with advances in the services sector less likely to be patented, building well-adapted and resilient economies will inevitably require further innovation of physical equipment, for which patents data provide good coverage. Innovation in climate change adaptation services is also likely to be an area of growth for the UK. To start building evidence on innovation in this space, we present some case studies of where innovations might be necessary in financial and insurance service sectors in Section 4.

Introduction to the dataset

Our analysis is based on the 2023 edition of the Worldwide Patent Statistical Database (PATSTAT Global) published by the European Patent Office (EPO). PATSTAT Global contains information on patent

applications filed with patent authorities in various countries and jurisdictions. We consider patent applications filed up to 2022 (inclusive), which is the latest complete year available to us to extract.[1]

PATSTAT Global classifies patents according to the Cooperative Patent Classification system (CPC).[2] The CPC system follows a hierarchical structure and is divided into nine sections (human necessities, textiles, physics, electricity, etc.), which in turn are divided into classes, sub-classes, groups and sub-groups (in that order). A patent can be assigned to more than one classification under the CPC system if the innovation is pertinent in more than one technological context. The lower the hierarchical level in the classification system (where sub-groups make up the lowest level), the more detailed the technological description attached to the classification is. This enables a granular understanding of the potential applications of a given patent classified according to the CPC system.

Our focus in this report is the CPC sub-class Y02A which covers "technologies for adaptation to climate change, i.e. technologies that allow adapting to the adverse effects of climate change in human, industrial (including agriculture and livestock) and economic activities." This sub-class includes six groups, which we aggregate into three categories to facilitate our analysis (see Table 3.1).

Table 3.1. Summary of the CPC sub-class Y02A on climate change adaptation technologies

Code of CPC group	Description of CPC group	Aggregations we use in our analysis
Y02A 10/00	[Technologies for adaptation to climate change] at coastal zones; at river basins	Engineering-intensive
Y02A 20/00	Water conservation; efficient water supply; efficient water use	
Y02A 30/00	Adapting or protecting infrastructure or their operation	
Y02A 40/00	Adaptation technologies in agriculture, forestry, livestock or food production	Life sciences
Y02A 50/00	[Technologies for adaptation to climate change] in human health protection, e.g. against extreme weather	
Y02A 90/00	Technologies having an indirect contribution to adaptation to climate change	Indirect contribution

Source: Cooperative Patent Classification, 2018

The Y02A class captures all innovations that enable adaptation to the adverse effects of climate change in human, industrial and economic activities (CPC, 2025). This does not mean that the innovation is necessarily directly developed with adaptation as its main aim. For example, a vaccine that tackles a vector-borne disease that is likely to increase in prevalence as the planet warms may not have been developed with climate adaptation in mind, but it will be a valuable and required technology under future climate change. In other words, this tagging approach captures not just explicit adaptation innovation, but also innovations from other fields which have transferable functions relevant to adaptation.

[1] This is because patent data get recorded with lags, with each PATSTAT Global edition having complete data up to a few years before it. While not available to us, the latest PATSTAT Global published at the time of writing is the 2023 edition. This could theoretically contain a year or so more of complete data beyond what we have been able to analyse.

[2] The CPC is a result of a joint effort between the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO). Its objective is to harmonise the European Classification system (ECLA) and the United States Patent Classification (USPC), while being compliant with the International Patent Classification system (IPC).

The Y02A classification was published in April 2018, with the definition of adaptation technologies corresponding closely to the UNFCCC's 2005 definition. The categories developed helpfully correspond to the economic sector affected, rather than by climatic threat. They retrospectively tagged patents with the Y02A category after 1995, and we focus largely on the period 2000-2021 in our analysis. This helps to integrate our analysis into wider policy processes, including the UK's Modern Industrial Strategy 2025. To test the quality of the Y02A classification, Dechezleprêtre et al. (2023) examined inclusion and exclusion errors. They cross-checked the technologies against the UNFCCC adaptation framework and randomly selected a sample of 100 patents to confirm their relevance. They found that 89% of the sample were absolutely related to adaptation as described by UNFCCC. They considered this sufficient reassurance as to the quality of the Y02A tagging scheme. While we do not repeat this analysis in this paper, we do select some relevant patents within each of the six categories to provide some tangible examples of the types of innovation undertaken by firms under the Y02A category in the UK.

Defining the scope and key concepts underpinning the analysis

Our analysis of patent data focuses on patent 'families': sets of patents, utility models and other legal instruments that refer to the same invention. We restrict our analysis to patent families consisting of more than one application, using this as a proxy for patents of higher quality (see related discussion under limitations at the end of this section). We refer to these as 'multi-application innovations', or simply, 'innovations' in subsequent discussion. We identify the country/jurisdiction of origin for patent families by mapping them to the current country/jurisdiction of residence of the corresponding inventors.[3] The key concept underpinning our analysis is revealed technological advantage.

Revealed technological advantage

A country/jurisdiction is said to have revealed technological advantage (RTA) in a technology field for a given period if the field's share of the country/jurisdiction's total patenting is larger than the field's share of total global patenting over that period. For the majority of our analyses, we estimate RTA values of countries based on the number of multi-application innovations (of the given country/jurisdiction and the global total) between 2010 and 2018.[4] We adjust RTA values so that they lie between -1 and +1,[5] whereby numbers greater than zero indicate that the given country/jurisdiction has innovative specialism in that field. Accordingly, we use RTA interchangeably with the phrase 'innovative specialism' in subsequent discussion.

We calculate the RTA only for countries/jurisdictions which have recorded a minimum of 200 multi-application innovations in Y02A between 2000 and 2020. When analysing the three subsets of Y02A defined above, we set this threshold at 50 multi-application innovations, recognising the smaller overall quantity of innovation that lies at this level of disaggregation. This approach ensures our results reflect countries/jurisdictions which can be considered substantive innovators in the respective fields.[6]

[3] See Annex 1 in Curran et al. (2022) for further detail on our approach to assigning patent families to geographical locations.

[4] In the rest of the report, we specify if a piece of analysis focuses on a different time period.

[5] As the ratio of a technology area's share of the country/jurisdiction's total patenting to the area's share of total global patenting, RTA can normally take any value between zero and infinity. We transform these raw RTA values so that they lie between -1 and +1 using the following formula: (RTAraw -1)/(RTAraw +1), where RTAraw refers to the untransformed RTA calculated as described.

[6] It should be emphasised that the thresholds only impact what we present, and not the underlying RTA calculations. Namely, the 'total global patenting' component contained in the denominator for RTA calculations takes into account multi-application innovations in all countries/jurisdictions, not just those generated by countries/jurisdictions that meet the thresholds we set.

Limitations

Coverage of patents

The extent to which patents reflect innovation activity varies across different geographies, different types of innovations and different types of innovators.

First, looking at the geographical dimension, patents are largely filed in countries where intellectual property (IP) protection is strong. This is particularly important in the context of adaptation technologies as many of the most vulnerable countries to climate change impacts are low- and middle-income countries, which tend to weakly enforce IP rights.

Second, patents mostly capture technological advances related to goods, not services, which is where many adaptation technologies sit (e.g. insurance products and advisory services). To manage this, we will present some case studies which demonstrate the value of adaptation services to the UK's economy in Section 4.

Lastly, turning to coverage across different innovator types, our patent analysis understates the role of start-ups and small firms in the innovation ecosystem. One reason for this is that our filtering method for patents (focusing on multi-application patents only) may exclude start-ups. Patents have very different roles in start-ups compared to established firms. Patents in incumbents have a strong legal value in that they can be part of large patent portfolios used to maintain a monopoly in key markets. Start-ups, meanwhile, tend to use patents as a signal to investors that their inventions are a worthwhile investment and do not often have the resources to defend their portfolios. We can observe from Orbis Intellectual Property (IP) data that, anecdotally, larger companies have larger patent families and are more involved in litigation than start-ups. Since we filter our data to patent families with more than one application, start-ups appear far less in our data.

Time period

One major limitation of our analysis is that we are only able to capture innovation activity up to the end of 2022, which is the latest complete year of data available to us. Patenting relating to adaptation in more recent years will not be visible. Grey literature, such as policy reports, newsletters and government documents can help fill some of this knowledge gap, providing more up-to-date insights and anecdotal evidence on country activities relating to adaptation in the last four years.

Patent quality

The quality of patents is highly variable. Ideally, we would like to focus on high-quality patents in our analysis. One way to do this would be to use patent citations as a measure of the quality of each patent. In the literature, it is also common to focus on triadic patent families: these are a subset of patent families for which applications for the same invention were filed in the European Patent Office (EPO), United States Patent and Trademark Office (USPTO) and Japan Patent Office (JPO). However, our focus is on the CPC sub-class Y02A. This means the size of the pool of patents available to us for analysis is constrained to begin with. As a result, we use a 'multi-application' filter as a proxy for patent quality as opposed to one of these stricter approaches. Multi-application patent families are those patent families for which more than one application was filed. We assume that these are more likely to represent economically or technologically significant innovations than single-application patent families, which we filter out. This is because applicants will typically pursue broader protection by filing more than one application (across jurisdictions, and/or within the same jurisdiction using different legal instruments) for inventions with greater expected value.

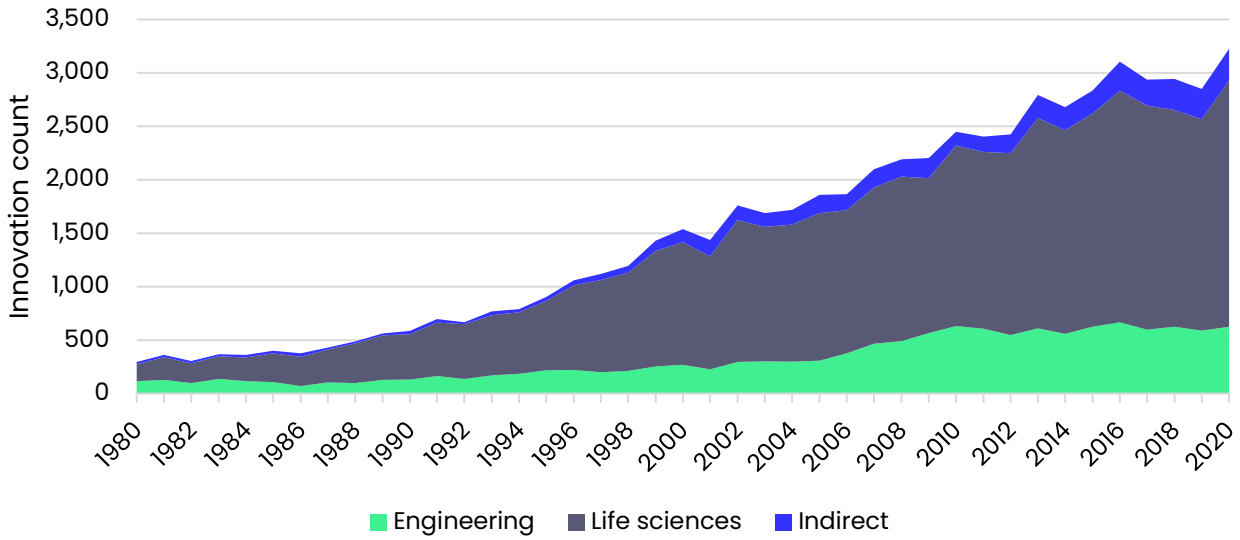
Trends

Setting the stage: Evolution of CCAT innovation globally and in the UK

While global patenting in CCATs has increased in recent years (see Figure 3.1), it remains small relative to other technology groups, particularly mitigation technologies. In 2020, there were over 400,000

patents filed for climate change-related innovations. CCATs made up around 15% of these (Espacenet, 2026).

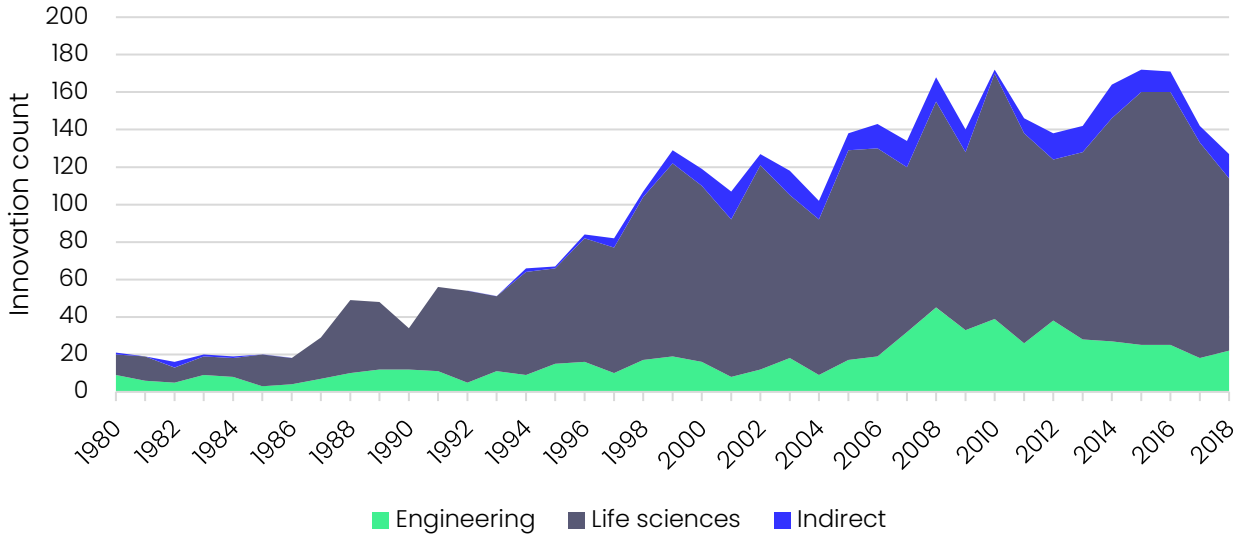
Figure 3.1. Evolution of the global number of innovations in adaptation (1980-2020)



Notes: The y-axis denotes the global number of multi-application innovations, presented per year between 1980 and 2022 along the x-axis. Innovations are broken down into one of three categories: engineering, life sciences and indirect technologies.
Source: Authors' estimates based on PATSTAT Global (2023)

A similar pattern is seen at the UK level (see Figure 3.2), where we also see the largest growth in the life sciences sector, which is unsurprising given the UK's strengths in this area. From a total of 103,449 innovations filed across all technology classes in the UK since 1980, 1,283 were for CCATs (1.24% of the UK's total innovations in the period). Of the UK's CCAT patents, 201 innovations were in our engineering category (16%), 992 were in the life sciences category (77%) and 92 (7%) were in the indirect category.

Figure 3.2. Evolution of the number of innovations in adaptation in the UK (1980-2018)

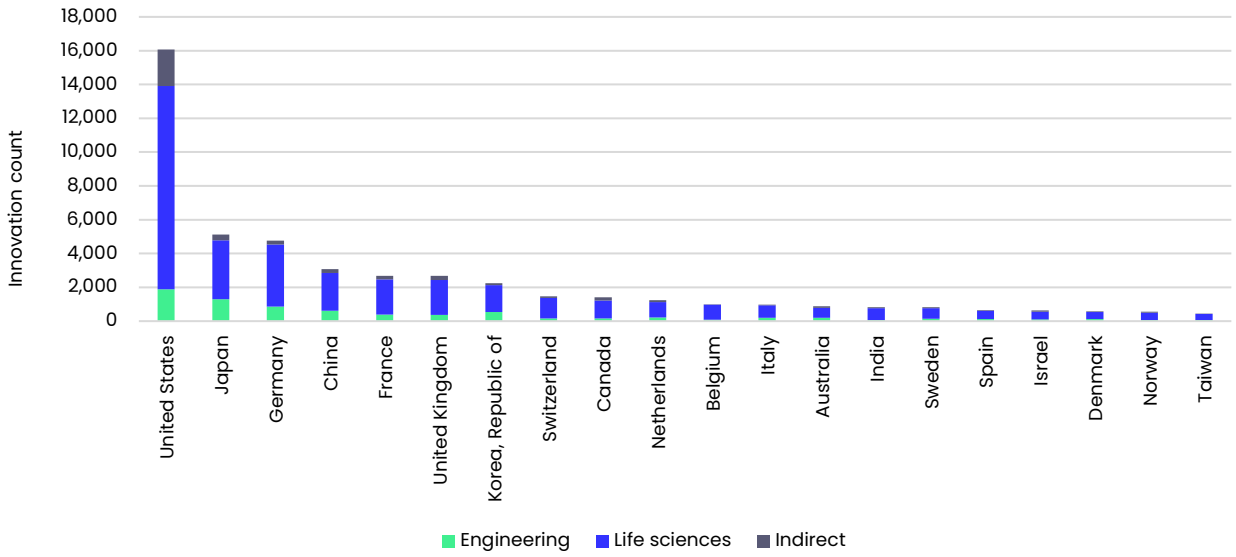


Notes: The y-axis denotes the global number of multi-application innovations, presented per year between 1980 and 2022 along the x-axis. Innovations are broken down into one of three categories: engineering, life sciences and indirect technologies.
Source: Authors' estimates based on PATSTAT Global (2023)

The UK has a relatively high share of cumulative global CCAT innovations (9%), exceeding its share across all types of innovation (5.6%), and its share of 'clean' innovations (mitigation and adaptation combined, at 3%).

Comparing the total number of patents in adaptation technologies since 1980, the UK ranks sixth globally (see Figure 3.3). The US, as with many technologies, is the standout leader in this category, with over six times the number of patents as the UK over this period. This is especially so for innovations in the indirect category of adaptation technologies, where the US has more than 11 times the number of patents than the UK.

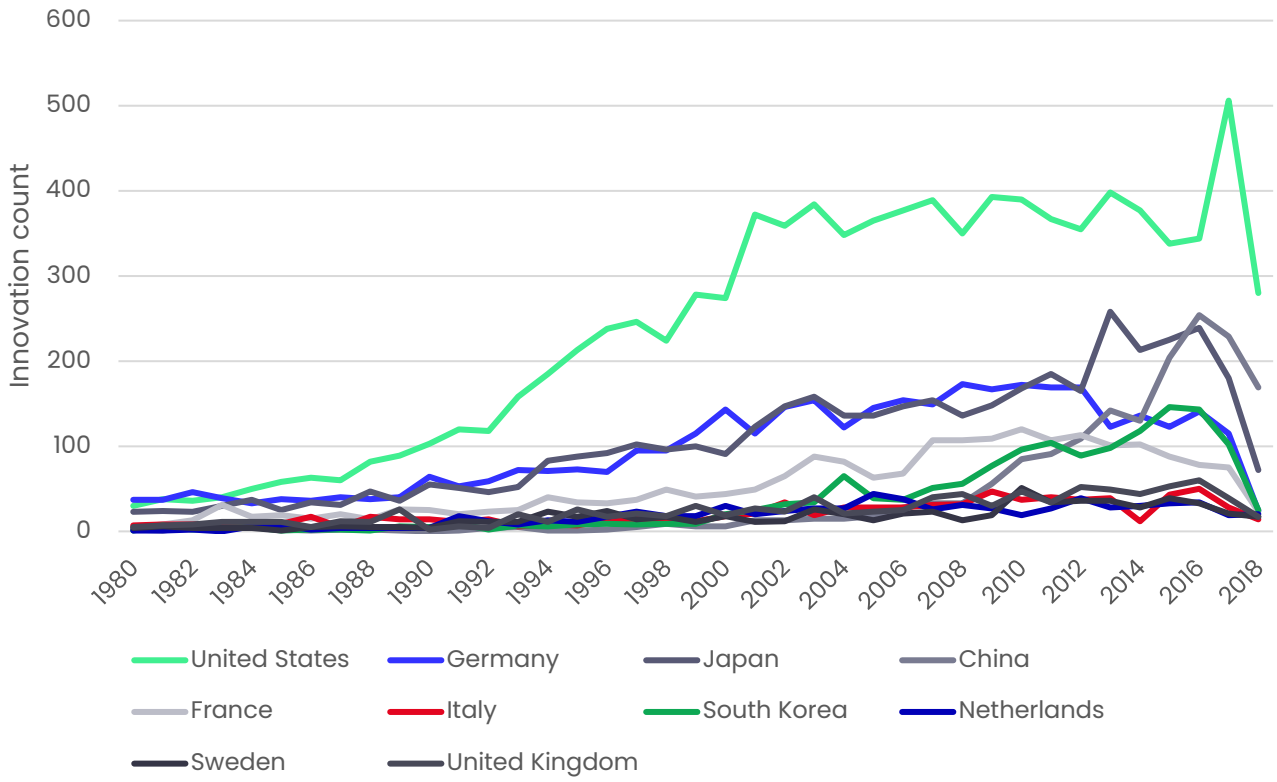
Figure 3.3. Top 20 countries by total number of innovations (2000-2022)



Notes: The y-axis denotes the number of multi-application innovations. Bars are arranged in descending order of number of innovations belonging to each country.
Source: Authors' estimates based on PATSTAT Global (2023)

Figure 3.4 shows the growth in adaptation technologies for the top 10 countries. It shows a clear divide between the US as the top innovating country, and a further five innovating countries (Germany, Japan, China, France and South Korea) and the remaining four (Italy, the Netherlands, Sweden and UK) who have not seen growth on the same scale. All countries saw a decline during the COVID-19 pandemic period. The UK's annual patenting in CCATs continues to be around the same levels to Italy, the Netherlands and Sweden. This may reflect that the UK is relatively less exposed to the impacts of climate change compared to other countries.

Figure 3.4. Annual number of innovations in adaptation of the top 10 countries by total innovations (1980-2018)



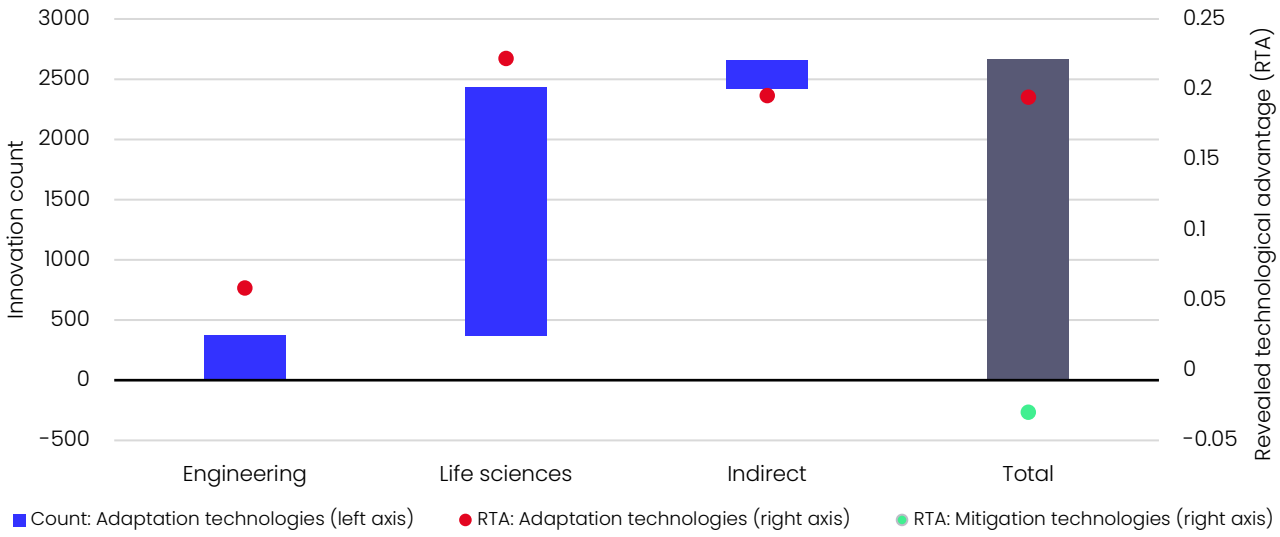
Notes: The y-axis indicates each country's number of multi-application innovations in the field between 1980 and 2018.
Source: Authors' estimates based on PATSTAT Global (2023)

The UK's specialisation in CCAT innovation

In this section, we look at the UK's revealed technological advantage (RTA) in CCATs. The UK holds RTA in all categories of adaptation technologies: engineering, life sciences and indirect (see Figure 3.5). It holds the strongest RTA in the life sciences category. This category and the indirect category are most likely to contain technologies that are suitable for export. As discussed in the introduction, hard engineering technologies are most likely to serve the UK's domestic market.

Relative to the wider Y02 patenting category (excluding Y02A, the adaptation category), which includes all technologies relevant to the mitigation of climate change, the UK has a stronger RTA in adaptation relative to mitigation (see the green dot in Figure 3.5). This is due to differences across mitigation subcategories, with the UK being specialised in areas such as energy and carbon capture usage and storage, but not in areas such as solar energy and low-emissions vehicles (Serin et al., 2023).

Figure 3.5. The UK's revealed technological advantage in specific technology areas within adaptation (2000-2022)



Notes: The left y-axis indicates RTA values (shown in bars and adjusted to lie between -1 and +1, where positive values indicate innovative specialism and a negative value indicates that a country is not specialised in a technology area). The right y-axis indicates the number of multi-application innovations (shown in dots).
Source: Authors' estimates based on PATSTAT Global (2023)

Comparing the UK's performance in CCAT innovation with other countries

If we compare the UK's RTA in CCATs with other countries, the UK ranks second on innovation specialism (see Figure 3.6), only exceeded by Belgium. This ranking is higher than its ranking on absolute patenting volume (shown in Figure 3.3), indicating that it is a strength in UK innovation.

Switzerland, Canada and France make up the other top five innovating countries based on RTA. The US, first in the ranking based on patenting volumes, drops to ninth based on RTA.

Switzerland, Canada and France all join the UK in ranking in the 10 least vulnerable countries to the impacts of climate change. This indicates that those countries most at risk from the impacts of climate change are not necessarily those who are innovating in CCATs. This will be for a variety of reasons, including lower innovative capacity and because the most at-risk countries are low- and middle-income countries, where IP rights are often weakly enforced and patenting is less common.

The UK maintains its second-place position in the life sciences adaptation category, places third in the indirect adaptation category and is fifth in engineering.

Figure 3.6. Revealed technological advantage in all adaptation categories — top 12 countries (2000-2022)

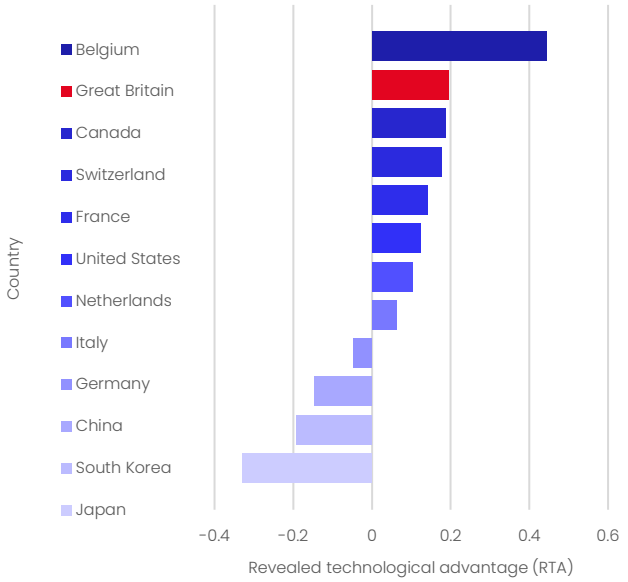


Figure 3.7. Revealed technological advantage in life science adaptation technologies — top 10 countries (2000-2022)

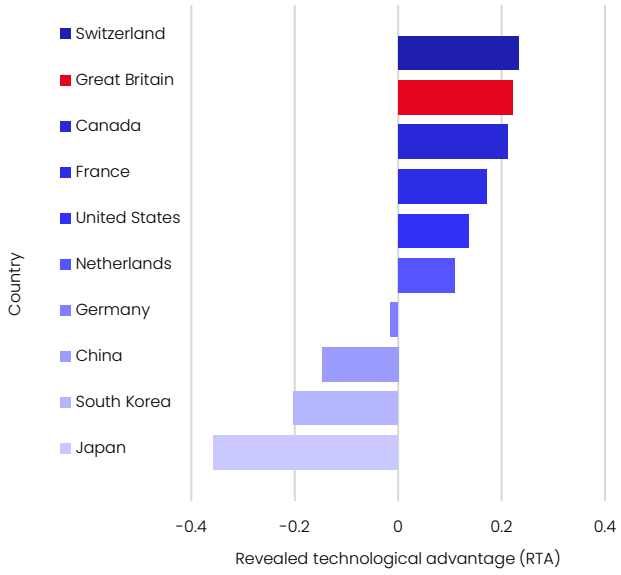


Figure 3.8. Revealed technological advantage in engineering adaptation technologies — top 10 countries (2000-2022)

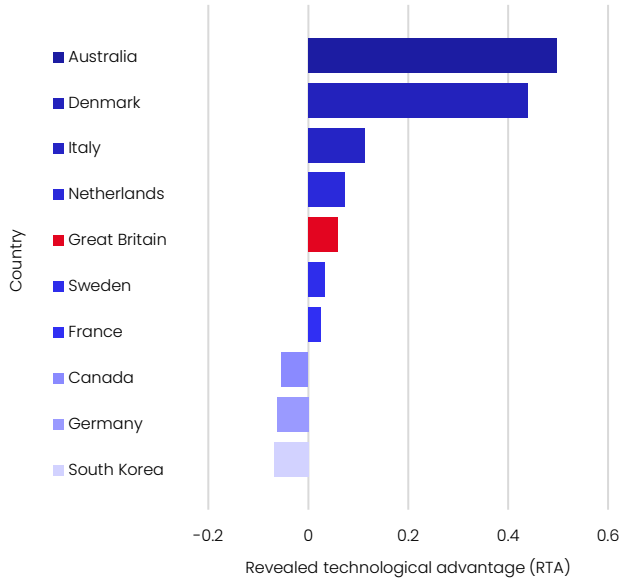
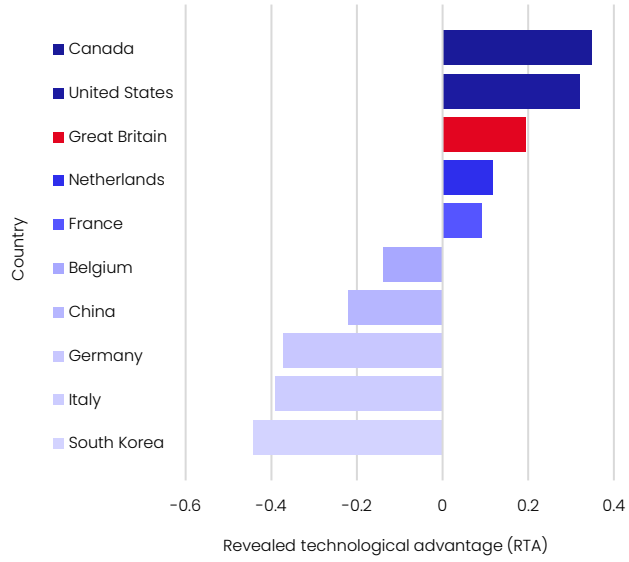


Figure 3.9. Revealed technological advantage in indirect adaptation technologies — top 10 countries (2000-2022)



Notes: The x-axis indicates RTA values (shown in bars and adjusted to lie between -1 and +1, where positive values indicate innovative specialism). Only countries with at least 200 multi-application innovations between 2000 and 2022 are considered.
Source: Author's' estimates based on PATSTAT Global (2023)

Regional insights from across the UK

Our analysis, so far, suggests that at the national level, the UK has comparative advantage in technologies relevant for adapting to the impacts of climate change. However, in the context of both

uneven economic performance and uneven impacts of climate change in different parts of the country, it is important to understand where in the UK these strengths are located. As with any technology, knowledge generated from innovations in CCATs will not automatically translate into local growth and jobs. The extent to which this occurs will depend on the development of relevant supply chains and workforce skills in these regions.

Figure 3.10 shows, as expected, that London and the Southeast hold the highest counts of patents. However, when the share of patents is examined (see Figure 3.11), the strongest areas are outside London and the Southeast. This broad pattern has been found with clean patenting overall (including mitigation technologies, see Curran et al., 2022). What stands out is that many of the areas with the highest adaptation patenting intensity (share of adaptation patents to total patents) are coastal and include East Yorkshire, Northern Lincolnshire, Cornwall, West Wales and Surrey, East and West Sussex. This may reflect the fact that many of the infrastructure categories relate to flood defences and coastal erosion management, which will be most applicable to these regions.

Figure 3.10. Regional count of total innovations in adaptation in the UK (2010-2020)

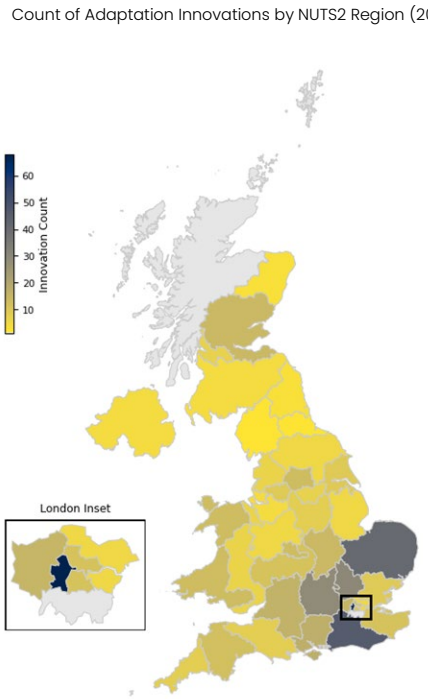
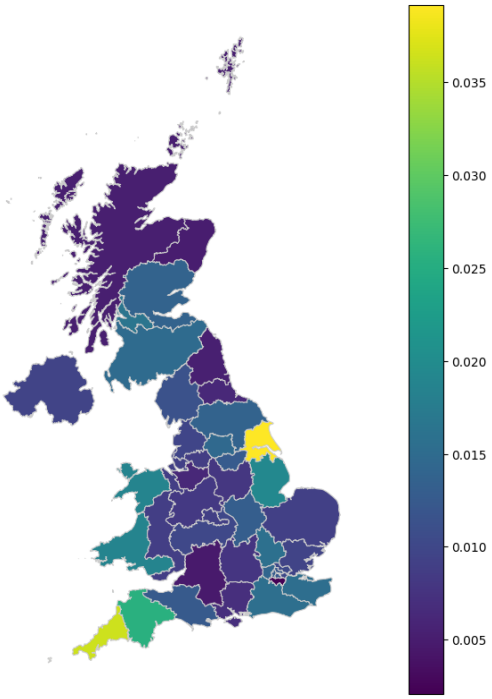


Figure 3.11. Adaptation innovations as a share of total region innovations (2010-2020)



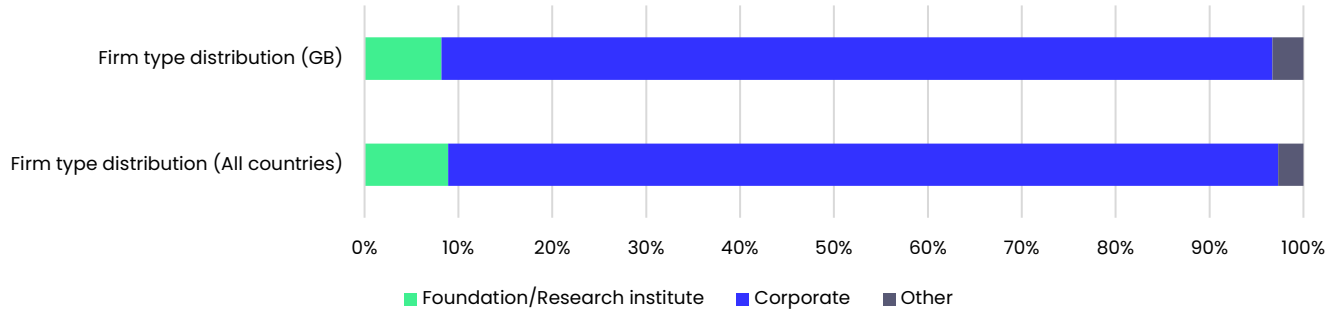
Notes: Percentage share represents adaptation innovations as a share of total innovations within Nomenclature of Territorial Units for Statistics (NUTS) 2 regions between 2010 and 2020 and is used as a measure of patenting intensity in adaptation at the regional level.
Source: Authors' estimates based on PATSTAT Global (2023)

An analysis of the organisations innovating in CCATs in the UK

Our analysis shows that the broad types of organisations innovating in the UK in CCATs relative to all countries is relatively similar, with the corporate group being the largest (see Figure 3.12). A sizeable share of innovations is filed by foundations/research institutes (8.9% globally and 8.2% in the UK).

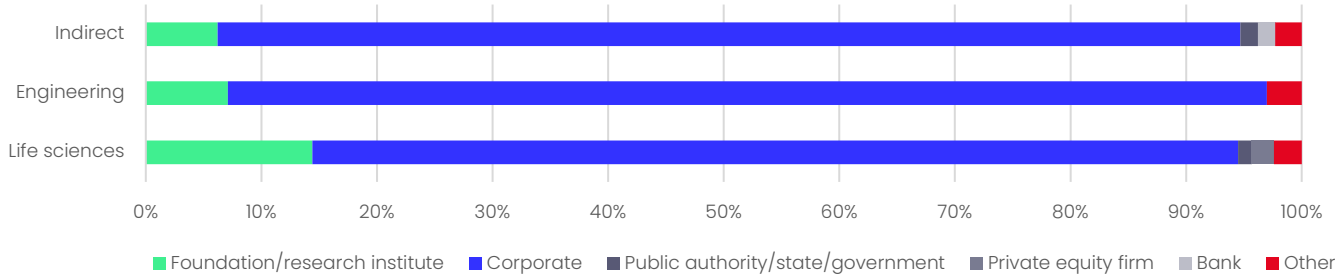
Broadly, the pattern is similar across adaptation technology groupings (see Figure 3.13), though the share of patenting in foundations/research institutes is particularly high for life science technologies.

Figure 3.12. Breakdown of organisations globally and in the UK innovating in CCATs (2000-2022)



Notes: The y axis indicates the proportion of innovators in each country that are foundation/research institutes, corporates or 'other'.
Source: Authors' estimates based on PATSTAT Global (2023)

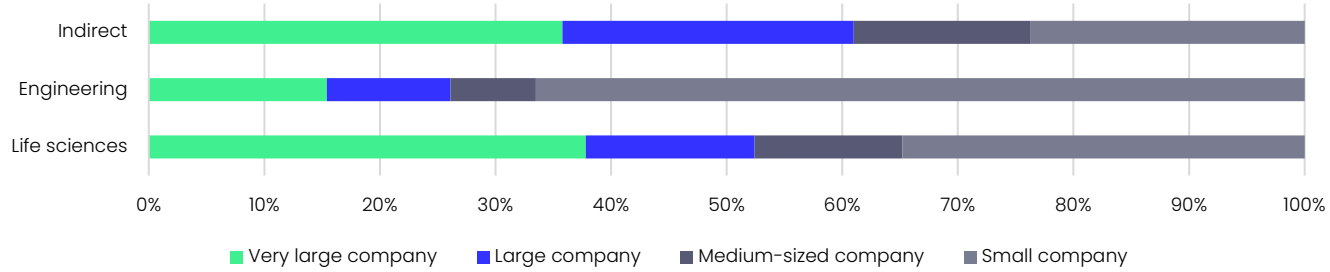
Figure 3.13. Breakdown of the type of organisations innovating in CCATs in the UK by adaptation category (2000-2022)



Notes: The x axis indicates the proportion of innovators in each category in the UK that are foundation/research institutes, corporates, public authorities/state/government actors, private equity firms, banks or 'other'.
Source: Authors' estimates based on PATSTAT Global (2023)

Figure 3.14 illustrates the breakdown of firms innovating in CCATs by firm size. Interestingly, a large share of small companies are innovating in CCATs, particularly in the engineering aggregate category. This may be because these interventions are highly localised and require local knowledge to deploy effectively. Further work is needed to understand why this relationship exists.

Figure 3.14. Breakdown of firms innovating in CCATs in the UK by adaptation category (2000-2022)



Notes: The x axis indicates the proportion of firms in each category in the UK that are very large, large, medium-sized or small companies. Company sizes are linked to the Orbis database and are defined using employee counts: small companies have fewer than 50 employees; medium-sized companies have 50-249 employees; large companies have 250-999 employees; and very large companies have 1000+ employees.
Source: Authors' estimates based on PATSTAT Global (2023); Orbis database (2024).

Table 3.2 shows the UK's top 10 innovating organisations in each of the CCAT groupings. While there are some universities listed, the top innovators reflect a mixture of small and large companies. In the box 3.1 below, we provide some examples of firms that are innovating in this space, their innovations and how they can support adaptation action, both domestically and internationally.

Table 3.2. UK's top 10 innovator organisations for adaptation by number of innovations (2000-2022)

Engineering		Life sciences		Indirect	
Company	**Number of innovations**	**Company**	**Number of innovations**	**Company**	**Number of innovations**
ReAqua Systems Limited	25	Johnson Matthey PLC	91	Schlumberger UK Holdings Limited	20
Electronicon Limited	9	Oxford University Innovation Limited	31	Micromass Limited	15
Metertech Limited	8	AstraZeneca UK Limited	25	Hayfin Services Limited	9
Xergy LTD	8	Haygrove Limited	20	Micromass UK Limited	5
BP Exploration Operating Company	6	King's College London Business Limited	18	BAE Systems PLC	4
Flowgem Limited	6	Helperby Therapeutics Limited	17	DEB IP Limited	3
Gobbler Oil Recovery Boats LTD	6	Glaxosmithkline Intellectual Property Development Limited	16	Freevolt Technologies Limited	3
Quinta 1 Limited	6	Jaguar Land Rover Limited	16	Medisyne LTD	3
Relevant Projects LTD	6	Louise Goldin Limited	14	SC Johnson Professional Group Limited	3
CNV Systems LTD	5	Saudi Arabian Oil Company LTD	14	Wind Farm Analytics Limited	3

Notes: We construct the table of top innovator organisations using Orbis IP, which allows us to match patent families to the organisation they are associated with. We match inventions to their most direct level of consolidation, meaning that patents are generally matched to the local subsidiary rather than the global ultimate owner of the corporate group. We match the organisations exactly as they appear in Orbis IP; due to the legal complexity of how patent portfolios are owned within large multinationals, some innovations may be mapped to holding companies or split between separate parts of a single corporate entity. Across this report, we use the location of the inventor to describe where innovation is happening. For the current table and tables A4–A9, for a given country we consider foreign firms doing research with inventors based in the country; hence the column 'Home country' which describes the location of the organisation rather than the inventors. Companies for which the 'Primary industry' information was not available in the source database have been manually classified by the authors, where possible, through a web-based search on their activities.
Source: Authors' estimates based on PATSTAT Global (2023)

Box 3.1. Innovation in adaptation goods

Below we provide some examples of innovations in firms based in the UK that count towards the Y02A category.

Technologies for adaptation in coastal zones and river basins

Patents in this category vary from technologies that help to predict and prevent issues such as flooding and coastal erosion, to those that protect property and assets from the impacts of flooding that will increase in frequency and severity with a changing climate. The firms who are innovating or have previously innovated in this space include:

1. StormHarvester Limited (small company)
   - **Company summary**: "StormHarvester helps wastewater utilities predict and prevent issues like flooding and pollution before they happen, protecting communities and reducing costs."
   - **Description of invention**: Improving run-off of surface water back into the surrounding ground.
2. Shore Defence LTD (small company)
   - **Company summary**: Description of activities on Companies House: construction of water projects; construction of other civil engineering projects not elsewhere classified.
   - **Description of invention**: System for the prevention of coastal erosion that involves wrapping wire mesh to contain rock pieces.
3. Fluds Limited (small company)
   - **Company summary:** Description of activities on Companies House: other professional, scientific and technical activities not elsewhere classified.
   - **Description of invention:** This patent provides an automatic, passive flood-protection mechanism integrated into surface-water drainage channels.

Technologies for improving water conservation, efficient water supply and water use

Patents in this category are largely related to reducing water leakages in existing systems and in the desalination of water. This will help build the resilience of water-distribution networks, which increasingly face stress due to climate-change-driven factors such as droughts, supply variability, infrastructure strain and extreme weather. There are several universities leading innovations in this field, probably driven, in part, by public funding.

1. University of Exeter (foundation/research institute)
   - **Description of invention:** The technology assesses where pressure-reducing valves will deliver greatest net benefit in reducing leakage across water networks. This conserves water, which is critical as droughts become more frequent. It also quantifies the reduction in burst frequency when a pressure release valve is installed at a location, allowing utilities to target areas with the highest vulnerability.
2. University of Manchester (foundation/research institute)
   - **Description of invention:** The invention uses a graphene-oxide laminate as a forward-osmosis membrane, enabling effective desalination of seawater. Forward osmosis often requires less energy than conventional reverse-osmosis desalination.
3. Watflo Systems Limited (small company)
   - **Company summary:** Watflo manufacture water saving products to reduce unnecessary water consumption.
   - **Description of invention:** By collecting and storing rainwater and greywater in a tank or butt, the system provides an alternative water source for everyday uses such as toilet flushing, garden irrigation and general outdoor water needs.
4. Unilever PL (very large company)
   - **Company summary:** Consumer packaged goods company.

- **Description of invention:** Improves water efficiency in personal washing, an area of high daily consumption, by continuously recycling shower or wash water.

Technologies for adapting or protecting infrastructure during their operation

Patents in this category vary from technologies protecting critical infrastructure, such as electricity power supply systems and transport infrastructure, to technologies supporting the adaptation of residential buildings through ventilation or air conditioning. It also includes planning and developing green urban infrastructure. These adjustments will be necessary as extreme heat and other weather events become more severe and prevalent.

1. Silentair Group Ltd (small company)
    - **Company summary:** Silentair is a group of privately held businesses specialising in designing, developing and manufacturing quiet and energy-efficient air conditioning products and solutions. It is principally a research and development business, which also markets its products to prove their effectiveness.
    - **Description of invention:** This invention enhances the performance, efficiency and usability of cooling systems. These systems are critical as climate change increases the frequency and severity of heatwaves, and we need temperature-controlled spaces for equipment, work and vulnerable individuals.
2. KUF limited (small Company)
    - **Company summary:** No available description.
    - **Description of invention:** The invention enables faster, cheaper and more maintainable installation of green roofs, an important urban adaptation strategy for responding to climate change. Green roofs lower roof-surface temperatures by providing vegetation and soil layers that absorb heat and provide evaporative cooling. They also help to absorb and slow down rainwater, reducing peak runoff.

Technologies for adapting agriculture, forestry, livestock or food production

The UK's patents in these technologies have a focus on alternative forms of farming that can improve crop yields in the face of changing weather conditions. They also cover technologies that help to improve food preservation in response to warmer and more unstable temperatures.

1. Ocado (large company)
    - **Company summary:** Ocado is a technology company that develops solutions for operating retail businesses online. It also holds a 50% share in the UK retail business Ocado.com.
    - **Description of invention:** A system for growing plants in a controlled environment agriculture system that can replicate specific historic growing conditions. The system uses computer-controlled growth chambers where environmental parameters (temperature, humidity, light) can be precisely managed based on historical data to consistently produce plants with desired characteristics such as quality, yield or taste.
2. Plant Bioscience Ltd (small company)
    - **Company summary:** Develops innovative technologies in life sciences, including agriculture, food and nutrition, microbiology, biotechnology and related industries.
    - **Description of invention:** This invention relates to the modulation of root hair development in plants by altering the expression of RHD6-related genes, to increase the number, length and/or longevity of root hairs in the plant. This may be useful in improving the ability of plants to extract nutrients from the soil to improve a plant's ability to access water from larger soil volumes to improve drought resilience and water-use efficiency.

Technologies in human health protection

The UK's patents in these technologies are mainly linked to developing vaccinations against diseases which are likely to increase in prevalence due to a changing climate, e.g. mosquito, fly, tick or water-borne diseases.

1. UK Ministry of Defence (large public entity)
    - **Description of invention:** This is a vaccine for plague that uses a polypeptide derived from the periplasmic space of Yersinia pestis, the bacteria that causes plague. Climate-change-linked rising temperatures and ecosystem disruption can alter the geographic distribution and population dynamics of plague-carrying rodents and fleas, potentially expanding plague transmission to new regions or increasing the frequency of outbreaks.

Technologies having an indirect contribution to adaptation to climate change

Patents filed by UK-based firms in this category are divided between techniques that improve weather forecasting and the identification of climate hazards, including those that lead to health vulnerability for high-risk people, sea floor mapping and mapping for seismic hazards and monitoring/assessment of water resources.

1. IBM, patent filed in the UK (large company)
    - **Company summary:** IBM is a technology company responsible for innovations in infrastructure, software and consulting services.
    - **Description of invention:** Individual health vulnerability is assessed by obtaining health risk prevalence-level data for one or more health risks over a given geographical area.

Discussion

Our analysis shows that the UK is a specialised innovator in CCATs, and this could translate into growth opportunities for innovators in the UK as global demand for adaptation solutions grows. Overall, the UK is more specialised in adaptation than mitigation technologies, although as our other work has highlighted, there are types of mitigation technologies where the UK is specialised (see, for example, Serin et al., 2024). The UK could build on the strengths across CCATs identified in this analysis, many of which align with, or are embedded within, priority sectors identified in the UK's Modern Industrial Strategy 2025. Moreover, there is evidence to suggest that CCATs have the potential to support regionally balanced growth in the UK, with several coastal areas specialising in these technologies. This concentration of patents suggests potential for place-based industrial strategies that leverage existing regional strengths and potential future adaptation requirements to deliver both growth and resilience outcomes for these areas. Spurring regional growth is already a priority of the current Government (alongside supporting coastal towns and communities) with the National Wealth Fund and Office for Investment tasked with working with local leaders across the UK to invest in projects linked to regional growth priorities (HM Treasury, 2025a). Increasing investment in adaptation technologies developed in these areas may further enhance this ambition.

Given the societal benefits of adaptation technologies, including improved resilience to climate-related impacts, public investment in adaptation technology development is critical (e.g. through research and development grants, and given its cross-cutting nature, the prioritisation of climate change adaptation in wider policymaking). Small companies make up a significant proportion of innovators in adaptation technologies, which presents opportunities for the UK's competitive position. It suggests the UK has an innovation ecosystem with lower barriers to entry and potentially greater innovation diversity. The significant patent share attributed to research centres in the UK indicates strong knowledge transfer from academia. However, small firms often face constraints in scaling up production, accessing finance and navigating international markets. Support from policy should therefore focus not only on increasing research and development funding, but also on commercialisation pathways, including support for scale-up finance and export facilitation for these technologies. Creating networks or clusters that connect small innovators with larger industrial partners and end-users, particularly in the construction, infrastructure and utilities sectors, could help bridge the gap between innovation and deployment.

An analysis of the UK's current or potential comparative advantage in traded goods relevant for adaptation is left for future research. It is likely that several CCATs considered here will be suitable for export, and future research could assess where the UK can competitively meet the adaptation needs of other countries, especially those facing similar climate-related hazards to the UK, such as coastal erosion, flooding and overheating in buildings.

4. The UK's strengths in adaptation-related services

The UK's professional services, finance and insurance sectors are well-positioned to lead on climate adaptation. Adaptation advisory services are growing at roughly twice the pace of mitigation services, although from a lower base. Key demand drivers include regulatory pressure around climate-risk disclosure, major infrastructure investment cycles and growing recognition of physical climate risk by financial institutions. However, adaptation-oriented financial products remain nascent. Unlocking growth in this sector requires stronger policy-demand signals, clearer investment taxonomies and public finance mechanisms to de-risk private investment in adaptation.

Services are a key strength of the UK's economy, and there are several areas within financial services and professional and business services (both industrial strategy sectors) that are relevant for adaptation (see Section 2). In this section, we use case studies to explore three key service sectors:

- **Professional and business climate adaptation advisory services** are key for the UK's economic and environmental transition. A structural, long-term demand for climate-adaptation advisory services across government, regulated sectors and infrastructure investment drives this.
- **Financial services focused on climate adaptation**. Advisory services are increasingly required to translate climate risk and adaptation needs into investment-ready projects, credible financial structures and bankable risk-return propositions.
- **Insurance services and products for climate adaptation**. Insurance could play a transformative role in climate adaptation, extending beyond traditional risk transfer to include risk prevention, resilience incentives, investment mobilisation and public–private risk sharing.

To develop these case studies, we have relied on desk-based research complemented by stakeholder engagement carried out as part of several recent research projects:

- Financing Adaptation and Resilience in London and the UK: Moving from Aspiration to Reality: This research project takes a practical approach, leveraging case studies and structured interviews by focusing on the real estate and water sectors in London and the UK; it has produced three separate papers (Della Croce et al., 2024).
- Growth in a Changing Climate: event series from the Grantham Institute: The Grantham Institute at Imperial College London organised a series of events in 2025 to discuss how businesses can better assess climate risks, capitalise on emerging opportunities and protect their workforce as we adapt to our changing climate (Bird, 2025).
- The UNIDO Climate Adaptation and Industrial Resilience Forum 2026: Held in Vienna in February 2026, the Forum was one of the first international platforms to convene after COP30 to turn new adaptation commitments into real-economy industrial strategies and projects.
- IEA, CDRI and Grantham Institute workshop on energy infrastructure resilience. The Grantham Institute at Imperial College London, in partnership with the Coalition for Disaster Resilient Infrastructure (CDRI) and the International Energy Agency (IEA), co-hosted a technical workshop in October 2025 to shape a global research agenda on energy infrastructure resilience to follow up on the Future of Energy Security Summit hosted by the IEA and the UK government in April 2025 (IEA, 2025).

Case study 1: Professional and business advisory services for climate adaptation

Market outlook

Adaptation services are a growing part of the UK's consulting market. The UK's environment and sustainability (E&S) market grew strongly, up 8.9% to £4.1 billion in 2024. Adaptation-related services started from a low base, but grew by 20.9% in 2024, double the pace of mitigation services (Jakaityte, 2025). Adaptation advisory services support businesses in managing climate-related impacts, preserving asset performance and long-term value.

Adaptation advisory services leverage engineering, finance, procurement and governance expertise. In the UK, six firms (RSK, Tetra Tech, Jacobs, WSP, AECOM and Arup) account for 48% of the UK's E&S market, generating close to £2 billion in annual revenue. Having grown their market share by 15 percentage points since 2019, these companies have the scale and capital to drive further consolidation and pursue organic growth in the UK and abroad.

The E&S consulting market is expected to continue to grow, driven by government and regulators' action to achieve climate-adaptation objectives. This growth should open new service lines for consultants to help clients assess their vulnerabilities against the impacts of climate change, develop adaptive strategies and secure funding for resilience projects. In the UK, to meet the increasing demand for advisory services, the E&S workforce will need to grow by at least 57% from the current 27,800 professionals (Jakaityte, 2025).

However, the transition is impacting the job market, creating a 'green skills gap'. From 2021 to 2025, the demand for employees in green sectors overall in the UK has grown more than twice as fast as the supply of green skills in the workforce (7.8% vs 3.4%) (LinkedIn, 2025). Climate change adaptation is expected to be the third-largest source of net job growth by 2030, creating five million additional jobs globally (World Economic Forum [WEF], 2025).

Key demand drivers and opportunities for adaptation advisory services in the UK

1. Building a resilient net zero energy system

Government and regulators, such as the UK's Department for Energy Security & Net Zero and Ofgem, are increasingly including resilience in policy, standards and price controls (DEFRA, 2025). Following the CCC's recommendations, the Department for Energy Security & Net Zero is considering introducing resilience standards for the sector, while Ofgem is supporting the government, the National Energy System Operator (NESO) and industry in reviewing standards and energy codes to build resilience (as set out in Ofgem's Strategic Direction Statement 2025). Ofgem is also working with network companies to develop climate-resilience metrics and indicators to monitor climate resilience and drive action, and introducing stress-testing requirements to inform a climate-resilience goal.

This is creating demand for the advisory services that translate climate science into operational requirements, resilience metrics and investment decisions for the energy sector.

2. Increasing resilience in the water sector

The UK needs new physical water infrastructure to adapt to a changing climate. The twin challenges of population growth and drought resilience necessitate a significant new programme of investment in water infrastructure, such as reservoirs and interconnectors, as well as improvements in water efficiency. In the next five-year regulatory cycle, from April 2025 to March 2030, the water regulator Ofwat (or its successor) is expecting to invest a record-breaking £104 billion (77% more than the previous cycle) in new infrastructure to manage increasing risk of water shortages (Ofwat, 2024). Reducing water demand will be a key measure for managing water shortages. Ofwat are introducing measures to incentivise reduced leakage, per capita consumption and business demand. Regulatory shifts towards an integrated regional planning system, as recommended by the Independent Water Commission, will also affect the UK's advisory sector.

These measures will increase the demand for advisory services in the water sector from water companies, project developers and investors. Demand for environmental impact assessments, nature-based solution design, systems modelling, drought planning and governance reform is likely to increase.

3. Transport and digital infrastructure investment and climate proofing

Climate-proofing and assessing the environmental impact of transport and digital infrastructure remain among the UK's largest and fastest-growing service areas (HM Treasury, 2025b).

The UK's National Infrastructure Commission (NIC) estimates that total annual investment in the UK's infrastructure will need to increase from £55 billion currently to £70–80 billion in the 2030s to meet net zero and resilience objectives, including better public transport and improved national road and rail connections, totalling around £28 billion per year (NIC, 2023). As most infrastructure assets that will be operating in the 2050s already exist, advisory opportunities increasingly focus on asset renewal, maintenance and retrofitting.

The transport sector is introducing new guidance and tools for adaptation planning. The UK's Department for Transport published a transport adaptation strategy for consultation in April 2024, and climate risk assessment guidance in March 2025 to help transport infrastructure operators identify their climate risks and prioritise adaptation actions. As such, there is increasing demand for advisory services to support risk identification, prioritisation and regulatory assurance.

In parallel, emerging policy on digital and telecommunications resilience is expanding the scope of adaptation advice to include information and communications technologies and data infrastructure, particularly in relation to heat stress, flooding and power dependency. The resilience of data infrastructure and the integration of climate adaptation into network planning and operations are major areas of the forthcoming Cyber Security and Resilience Bill and Ofcom's Network and Service Resilience Guidance. Data centres are rapidly becoming critical national infrastructure that should be considered in risk assessments due to their high demand for water, particularly in regions facing drought or water scarcity (Research & Markets [R&M], 2025). Data centres that proactively embrace greener operations (including resilience against a changing climate, as well as low-carbon energy) will not only ensure compliance, but also improve efficiency, reduce long-term costs and enhance market competitiveness (Thurley et al., 2025).

4. Role of data, analytics and AI

The demand for services that utilise new technologies to improve adaptation practices presents a new opportunity for professional and business advisory services.

There is increasing interest in AI's role in processing vast datasets, identifying patterns and generating actionable insights for climate mitigation and adaptation strategies. Those responsible for managing climate risk are keen to understand the practical applications of AI in areas such as emissions monitoring, climate risk modelling, resource optimisation and the development of intelligent climate solutions. However, there are concerns about data quality, algorithmic bias and the ethical implications of deploying AI in critical environmental decision-making contexts.

Businesses in the UK specialising in digital engineering, for example, can seize opportunities to develop advanced climate data tools and smart technologies for urban planning and infrastructure, including predictive modelling, remote sensing and real-time monitoring. In an industrial setting, addressing heat-related risks will require advanced modelling and simulation tools to support layout design, heat-risk monitoring, and the cooling of equipment and assets under future temperature extremes (Institute of Mechanical Engineers, 2023). The UK's agribusinesses and food retailers will require scenario-based supply chain risk assessments and stress-testing tools to respond to global disruptions in agricultural commodities or critical infrastructure (CCC, 2021).

Case study 2: Finance advisory services for climate adaptation

Market outlook

The UK is specialised in financial services (De Lyon et al., 2022) and is consistently ranked first in the world in green and sustainable finance (Caldecott, 2022). Finance for climate adaptation technologies and services is becoming an important component of the UK's financial services and infrastructure investment. The market is shifting from compliance-oriented environmental, social and governance (ESG) services towards strategic advisory services that link sustainability, risk management and capital allocation. As the gap in adaptation finance is significant, more capital is expected to be channelled towards adaptation, driving adaptation markets to mature and evolve over the next decade. This will require specialist financial, analytical and structuring expertise — a core function of adaptation-focused finance advisory services.

Key demand drivers and opportunities for the UK's adaptation finance advisory services

1. Regulation

Demand for adaptation finance advisory services is driven by regulatory pressure, investor recognition of underpriced physical climate risk and reform of public procurement. Despite rising resistance, green finance and ESG investing remain key components in the sector, driven by institutional investors with long-term horizons and fiduciary duties, such as pension funds. The sustainable finance agenda also links to the government's action to mobilise private finance, including through the creation of the National Wealth Fund in 2024 and the public energy investment company Great British Energy in 2025.

Physical climate risk is increasingly recognised as a financial risk with systemic implications. Research by central banks and supervisors indicates that physical risks extend well beyond climate-related transition risks and may already be under-priced in asset valuations and loan portfolios. The Bank of England's Climate Biennial Exploratory Scenario exercise has shown progress in UK banks' climate risk management, but also highlighted significant gaps in physical risk assessment and data integration. UK-specific case studies highlight indirect impacts of flooding on banks' agricultural loan books and SME credit quality (Della Croce et al., 2024) Therefore, financial institutions will continue to seek advice on measuring and managing climate-related risks.

As a result, there are major drivers of demand from increasing regulatory and supervisory expectations on financial institutions. Since April 2022, climate disclosures aligned with the Task Force on Climate-related Financial Disclosures (TCFD) have been mandatory for certain large companies and financial institutions in the UK. While early disclosures focused primarily on climate-related transition risk, regulators are increasingly emphasising the importance of physical climate risk and adaptation planning. The UK Sustainability Reporting Standards, aligned with the International Sustainability Standards Board (ISSB) IFRS S1 and S2 frameworks, will further strengthen expectations around climate risk identification, assessment and financial integration. To manage these obligations, financial institutions will need external support.

Public procurement is further reinforcing this trend. Under the Procurement Act 2023, contracting authorities must consider social value, environmental sustainability and local economic benefits alongside cost. This shift towards place-based and resilience-oriented outcomes increases demand for advisory services that can integrate adaptation considerations into infrastructure planning, procurement strategies and bid development.

2. Climate and nature physical risk financial assessment and economic valuation

Investors increasingly recognise that asset-level risk assessment is insufficient. Compounding hazards, system interactions and portfolio-level exposure require integrated climate and nature risk analysis linked to financial projections.

In response to demand from investors, financial advisory services increasingly focus on asset- and portfolio-level climate-hazard modelling; quantification of avoided losses; standards for defining, measuring and monetising adaptation benefits; and the integration of physical risk into valuations,

credit analysis and financial planning. Advances in climate modelling, Earth observation and AI-driven analytics offer opportunities to integrate adaptation into underwriting and capital allocation.

Among the major drivers is the activity at the international level of the Task Force on Nature-related Financial Disclosures (TNFD). In the UK, key legislation is the Biodiversity Net Gain (BNG), which came into force in 2024 and will become mandatory for nationally significant infrastructure projects (NSIPs) in 2026, including power stations and highways, in line with the Environment Act 2021 targets. Further opportunities exist for consultants supporting the Environment Agency's 2030 strategy, which aims to enhance water, land and soil quality, strengthen climate resilience and support economic growth.

Balancing rapid project delivery with the protection of nature and local communities will create significant opportunities for consultants. Advisory services, combining integrated environmental compliance, biodiversity planning, ESG advisory and stakeholder engagement, will be well-positioned to capture this growing demand.

3. Development of sustainable financial instruments for adaptation

Green fixed-income financial instruments can raise the finance needed for adaptation and resilience. Investors can gain exposure to adaptation investments via the global US$2.9 trillion green bond market. Recent research has found US$160 billion of issuance in 2024, and a quarter of the green bonds in London Stock Exchange Group's (LSEG) GovCorp database are related to adaptation and resilience investments (LSEG, 2025).

The UK was one of the first countries to introduce a green gilt, something that could be useful for adaptation financing in other countries, where the expertise of the UK's institutions can be exported. Since 2021, the UK's Green Financing Programme has raised more than £51 billion from the sale of green gilts and retail Green Savings Bonds and could have a major role in further developing the corporate green bonds market in the UK (HM Treasury, 2025c). However, while sustainability-linked bonds and loans for resilient buildings and water efficiency are rapidly growing, the inclusion of climate resilience remains limited. Barriers include the lack of regulatory guidance and established metrics, and often unpredictable revenue streams (UNEP, 2023).

This creates a strong role for advisory services to develop adaptation-specific metrics, issuer frameworks and reporting approaches, and to support the emergence of dedicated adaptation bonds and resilience-linked instruments in the UK's market, aligning issuance with international principles and taxonomies, such as those of the International Capital Market Association and the Climate Bond Initiative.

4. Blended finance and the role of the UK's public financial institutions

By combining public and private capital with blended finance leveraging guarantees, first loss financials structures can reduce risk, improve project viability and attract commercial investors to adaptation activities (Khosla and Watkiss, 2022).

Several proposals and initiatives have been put forward to mobilise pension savings pools in the UK to increase private investment in the UK's economy. LSE estimated that, based on the £4.6 trillion of current insurance and pension fund assets in the UK, blended finance funds proposals together could potentially unlock £5 billion in private investment for public policy priorities at the time of the funds' launch, and at least £50 billion in the next five to 10 years (Gordon, 2023). The newly established Office for Impact Investment is aiming to address some of these challenges.

Leveraging the UK's finance advisory experience and collaborating with the British International Investment will increase demand for specialist advisory services to design, implement and scale up blended-finance solutions.

Case study 3: Insurance services and products for climate adaptation

Market outlook

Increasing global social, political, economic and climate change-related uncertainty is putting pressure on insurers' profitability, making coverage less affordable, while also opening new opportunities for insurance to play a role in managing these growing risks. This evolving role reflects insurers' dual position as risk managers and long-term institutional investors, with incentives to reduce future loss exposure while maintaining portfolio performance. As climate risks intensify, concerns around affordability and gaps in protection are likely to grow, creating incentives for insurers to support upstream adaptation measures that reduce underlying risk. At the same time, without insurance, businesses will be unable to achieve their net-zero transition goals or become resilient in the face of a changing climate.

Historically, the insurance sector's engagement with climate risk has focused on post-disaster compensation and risk pooling. However, recent research and policy analysis indicate a gradual shift towards more proactive roles, including risk prevention, resilience incentives and investment in climate-resilient infrastructure (Della Croce and Whittaker et al., 2024). Governments are transferring public liabilities to private markets. Beyond traditional insurance, insurance-linked securities (ILS), catastrophe bonds and resilience bonds enable insurers to transfer climate risk to capital markets, increasing insurers' capacity to insure high-severity events. International experience demonstrates the relevance of these specialist securities for supporting climate-related adaptation. While the UK's deployment of these financial products is limited, the global market offers major opportunities (United Nations Disaster Risk Reduction [UNDRR], 2023).

The UK's insurance services are well placed to respond to the rise in global uncertainty, and in turn, create economic growth. The UK hosts one of the world's most significant insurance and reinsurance markets, acting as a global centre for specialty insurance and reinsurance. The London Market, including Lloyd's of London, can cover new climate risks for marine, aviation, energy, innovative technology and large infrastructure, leveraging in-depth expertise from brokers, lawyers, actuaries and other professionals. As explained by Emma Reynolds MP, former Economic Secretary to the Treasury, the UK is a natural home for complex and innovative mechanisms to transfer risk, with a long history and readily available experts and advisers. As more novel and extreme risks arise, so does the need for a robust and flexible insurance sector (HM Treasury 2025c).

There is a critical role for government to play here in encouraging the private insurance market to sufficiently price risk and develop innovative solutions to cover the losses from climate change-related events. This will help the government to avoid the fiscal cost of repeatedly stepping in as insurer of last resort.

Furthermore, the development of longer-term partnerships between businesses and insurers is now essential to ensure sufficient capacity and insurance coverage will be available. Public-private partnerships are increasingly seen as essential for scaling insurance-based adaptation mechanisms and transferring risks to private markets. Insurers can collaborate with the government to provide risk pooling, disaster financing and resilience investment instruments that reduce fiscal exposure during major events and improve risk signalling. International examples, including sovereign catastrophe risk pools and regional insurance facilities, demonstrate the potential for the UK's insurance advisory market to support forward-looking, risk-informed investment strategies in developing countries.

Trends and opportunities for insurance services and products for climate adaptation

1. Regulatory and policy drivers

Beyond increasing exposure and losses, key drivers of growth for the insurance sector are regulatory action and risk transfer to capital markets.

Regulators in the UK are increasingly framing climate change as a financial stability issue. The Prudential Regulation Authority requires insurers to embed climate risk within risk management, Own Risk and Solvency Assessments (ORSA) and governance structures. Regulatory guidance now

mandates improved climate-risk governance, stress testing and disclosure, increasing demand for data, analytics and advisory services within the insurance sector. These developments position the UK to become a leader in insurance-based adaptation mechanisms, if policy and market frameworks evolve to support innovation.

Climate-related disclosure requirements, aligned with TCFD and future UK Sustainability Reporting Standards, are pushing insurers to quantify physical risks more rigorously. However, disclosures often remain high-level and qualitative, with limited linkage to underwriting, pricing and capital allocation decisions. The Bank of England's Climate Biennial Exploratory Scenario (CBES) found that insurers in the UK have made progress in integrating climate risk into governance frameworks. Still, it highlighted persistent data limitations and wide variation in firms' physical risk-modelling capabilities. These challenges constrain insurers' ability to price risk accurately and to design products that reward climate-related adaptation.

HM Treasury and the Bank of England are consulting on insurance-linked securities, including catastrophe bonds and the potential they pose for the UK's market (Bank of England, 2025; HM Treasury, 2025c). This will allow the UK to capture a larger share of insurance-linked securities activity versus other international finance hubs, while also making the regulatory regime accessible to the country's insurance and reinsurance industry, complementing traditional indemnity natural disaster cover.

2. Parametric and index-based insurance

Parametric insurance products trigger payouts based on predefined climate indicators (e.g., rainfall thresholds or river gauge levels), rather than assessed losses. The adaptation advantage of such instruments is greater speed and flexibility in how bond proceeds are used, and the potential to leverage capital markets (FCA 2025).

Although the market remains small, covering overseas and generally large industrial risks, it has been steadily growing in recent decades. Catastrophe bond market activity in 2025 resulted in a record-breaking year for the sector: 2025 was the first year to exceed $20 billion in catastrophe bond issuance, driving a record high level of third-party capital (Artemis 2026 and S&P 2026).

While London remains the global leader in risk transfer, as demonstrated by its growth in absolute size and market share, it still has a nascent insurance-linked securities market. London Bridge 2 PCC, the Lloyd's of London insurance and reinsurance market's insurance-linked securities structure, while increasing rapidly to around US$ 1.9 billion in capital deployed, is just 2% of global alternative capital, according to LGM estimates (Evans, 2026).

3. Resilience-linked insurance products

Resilience-linked insurance explicitly rewards policyholders for undertaking adaptation measures, such as installing flood defences, using resilient building materials or implementing nature-based solutions. Incentives may include premium reductions, rebates or enhanced coverage terms.

Since 2022, Flood Re has introduced 'Build Back Better' payments of up to £10,000 above like-for-like reinstatement to support resilient repairs, a step towards adaptation-oriented insurance design. In France, for example, the life insurer AXA will pay 50% of the extra cost of 'green' improvements, covering both climate adaptation and transition, after a major extreme event.

While resilience investments can reduce claim severity and insurance premiums, according to the Association of British Insurers, there is still evidence of poor-quality buildings, not built to expected standards (Ministry of Housing Communities and Local Government [MHCLG], 2025). The uptake remains limited due to verification costs, fragmented standards and uncertainty about effectiveness.

There is an opportunity to build on Flood Re's expertise and co-develop successor schemes that maintain access to insurance, while actively promoting resilience investment. Engineering and insurance advisory services are needed to help scale up these products by standardising resilience certifications and integrating them into underwriting practices.

Discussion

The UK's professional and business services, insurance and wider adaptation financial services sectors are well-positioned to respond to the growing demand for climate adaptation advisory work. The market remains in an early stage of development, but the environment and sustainability consulting market is growing strongly, and adaptation services are growing at twice the pace of mitigation services, albeit from a low baseline. However, sustained market growth will depend heavily on regulatory and policy action to create demand, rather than market forces alone. For example, providing a definition of adaptation goals at the national and sector level, developing climate metrics and indicators, compulsory stress testing for extreme hazards for corporates, are the main priorities to develop further this nascent market. The government, through the National Wealth Fund or other public financial institutions, could address the adaptation finance gap by providing adaptation finance instruments, such as government-backed first-loss facility or guarantee scheme to de-risk adaptation investment.

The case studies presented highlight both the scale of the opportunity and the barriers to unlocking it. The UK's comparative advantage in financial services, particularly in complex risk structuring, green bonds and insurance, means it is the prime market for developing the adaptation finance instruments required to manage the challenge of climate change-related adaptation. However, despite physical climate risk being increasingly acknowledged as a financial stability issue, disclosures remain qualitative, pricing of products does not yet adequately reward adaptation, and the volume of adaptation-related products remains small. The pipeline of regulatory change, for example, through TCFD, UK Sustainability Reporting Standards and the Procurement Act (where, for example, the government could mandate climate adaptation assessments as part of major infrastructure contracts), should create stronger demand signals. But translating regulatory pressure into investable, bankable adaptation projects, at scale, remains the central challenge.

This insurance section may best illustrate the broader tension running through all three case studies: the sector has the tools, the expertise and the institutional infrastructure to play a transformative role in adaptation, but uptake of genuinely adaptation-oriented products such as resilience-linked insurance and parametric instruments remains limited. Flood Re's Build Back Better payments and the growth of catastrophe bonds are promising signals, but they are not yet mainstream. The UK therefore has strong market foundations in advisory expertise, financial services and a large insurance market, but demand-side policy frameworks are yet to mature sufficiently to unlock this potential at scale. Closing that gap will require not only regulatory pressure, but deliberate public investment, similar to the Dutch Climate Fund. It will also need procurement strategies that treat adaptation as an economic opportunity as much as a social, economic and environmental imperative.

Adapting to climate change-related impacts or deploying new technologies will require a skilled workforce. The UK has the capability to bridge the green-skills gap, producing a workforce that can blend knowledge in climate science and financial engineering. To do so, companies and the UK government should strengthen their understanding of the skills needed to adapt and build resilience across the UK's supply chains. Agencies focused on labour, education and workforce, such as the UK's Office for Clean Energy Jobs should formulate strategies for skills training for adaptation and resilience, coordinating with other parts of the government leading climate-adaptation efforts. Academic curricula should be updated to reflect the multidisciplinary skills needed in climate science and engineering. Other countries are already leading in this area. Singapore is aiming to capture a projected S$4 to S$5 trillion from the Association of Southeast Asian Nations (ASEAN) sustainable finance market, with the Monetary Authority of Singapore committing S$35 million to upskill their financial services workforce.

The UK should leverage its world-leading business and financial advisory ecosystem to safeguard critical domestic supply chains and infrastructure from cascading global crises, while simultaneously exporting relevant services to other countries to build a more resilient global economy.

5. Snapshot of British firms operating in climate adaptation and resilience sectors

Analysing how firms describe their operations provides insight into the number and characteristics of businesses providing climate change adaptation technologies or services, areas that are not captured in traditional industry classifications. We find a nascent but growing adaptation economy. There are more than 1,500 firms in the UK working directly on climate adaptation, and many others in indirect but relevant sectors (e.g. air conditioning). The firms operating in adaptation-relevant sectors, using the definition of growth provided by The Data City, are growing by 8.3% each year, faster than the net zero economy overall (6.4% annually). However, the adaptation economy is much smaller: around a third of the size of the net zero economy.

Approach and methodology

In this section, our analysis aims to build a picture of the current landscape of firms in the UK operating in sectors relevant to climate change adaptation. It is challenging to estimate the number of firms operating in this area for three reasons.

- First, standard industrial classification (SIC) codes do not feature detailed classifiers relevant for adaptation technologies and services.
- Second, some relevant firms and activities are found in pre-existing sectors that may see greater demand due to climate change, for example, air conditioning, flood risk management and insurance services.
- Third, firms operating in adaptation technologies or services are likely to have a broader remit, for example, related to net zero or wider environmental management. In this case, only a small proportion of their employees, production and profit can be attributed to adaptation activity.

However, we can document the number of firms that reference climate change adaptation or relevant terms in their remit, and where they are located.

This section is divided into three parts. First, we use existing real-time industrial classification codes (RTICs) developed by The Data City and its users to identify firms that may undertake climate change adaptation-relevant activities based on firm website text descriptors. Second, we look at the category of 'direct' climate change adaptation, where firms are delivering goods and services specifically for the purpose of climate change adaptation. Finally, we consider a selection of 'indirect' adaptation technologies and services, where demand is likely to increase under a changing climate.

Introduction to the dataset

The Data City (TDC) is a company that has developed a methodology for real-time classification of UK firms based on their registration on Companies House and the firm's website. They build a real-time industrial classification (RTIC) system by training machine learning models on the web-scraped text of company websites, including descriptions, product pages and metadata, to classify firms into emergent industrial categories based on what they actually do, rather than the standard SIC codes firms self-report at registration. These model-generated classifications are then validated and refined

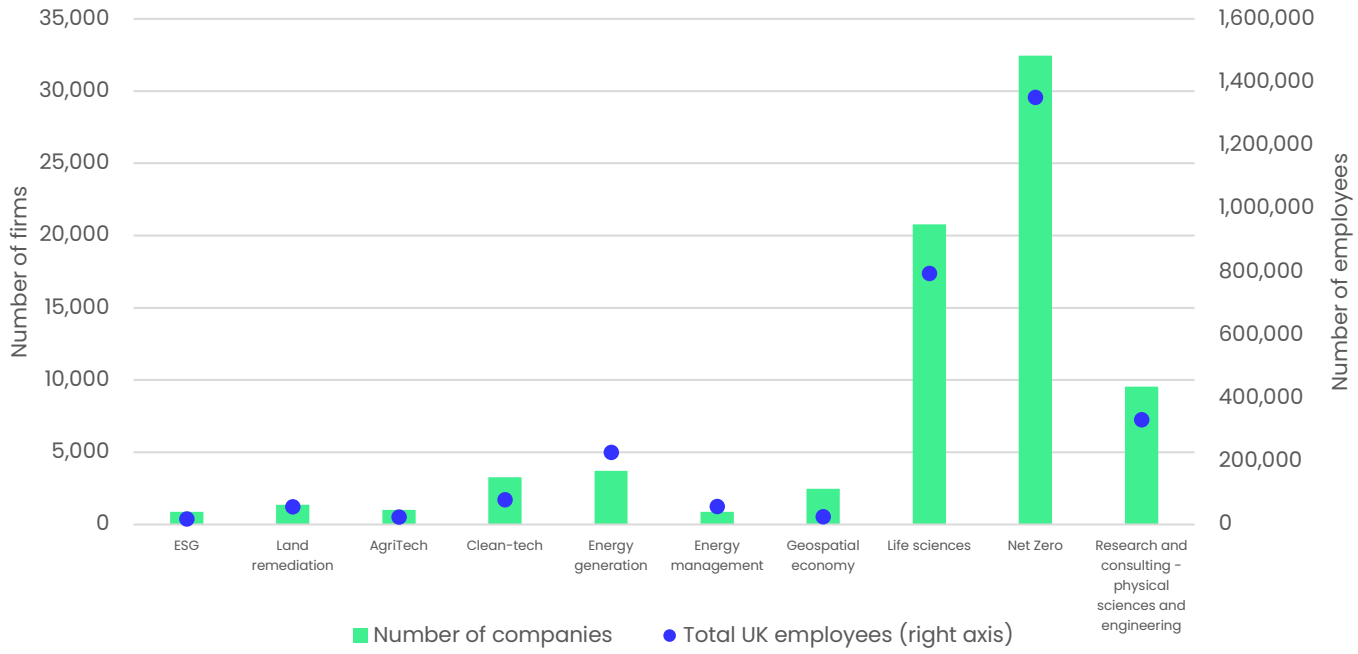
by sector experts. This provides more detail on new areas of activity relative to the SIC system, widely used in official statistics (and last updated in 2007).

The Data City have shared their taxonomy of the net zero economy produced by WPI economics consultancy in 2021. At the time, this identified 16,000 firms operating in low-carbon economy sectors (now estimated to be over 32,000, The Data City, 2026). This taxonomy included a classification of 'climate adaptation' firms. We broadened the scope of this taxonomy to include firms that were not included in the original mapping by expanding the search terms used by WPI to other forms of adaptation.[7]

Method 1: Firms providing adaptation goods and services within existing relevant RTICs

In this section, we explore the firms that are captured within relevant existing RTICs in The Data City database. We consider how many of them may provide adaptation goods and services alongside other activities linked to climate change mitigation or environmental management. We have selected the RTICs that we expect to have the highest number of firms also working on climate change adaptation. These RTICs include: environmental, social and governance (ESG), land remediation, agricultural technology (AgriTech), clean-tech, energy generation, energy management, geospatial economy, life sciences, net zero, and research and consulting (physical sciences and engineering). These RTICs are not mutually exclusive and there are likely to be firms that are captured across several of these sectors.

Figure 5.1. Number of firms and number of employees in 2025-2026 for existing RTICs relevant to managing climate change adaptation and mitigation from The Data City



Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

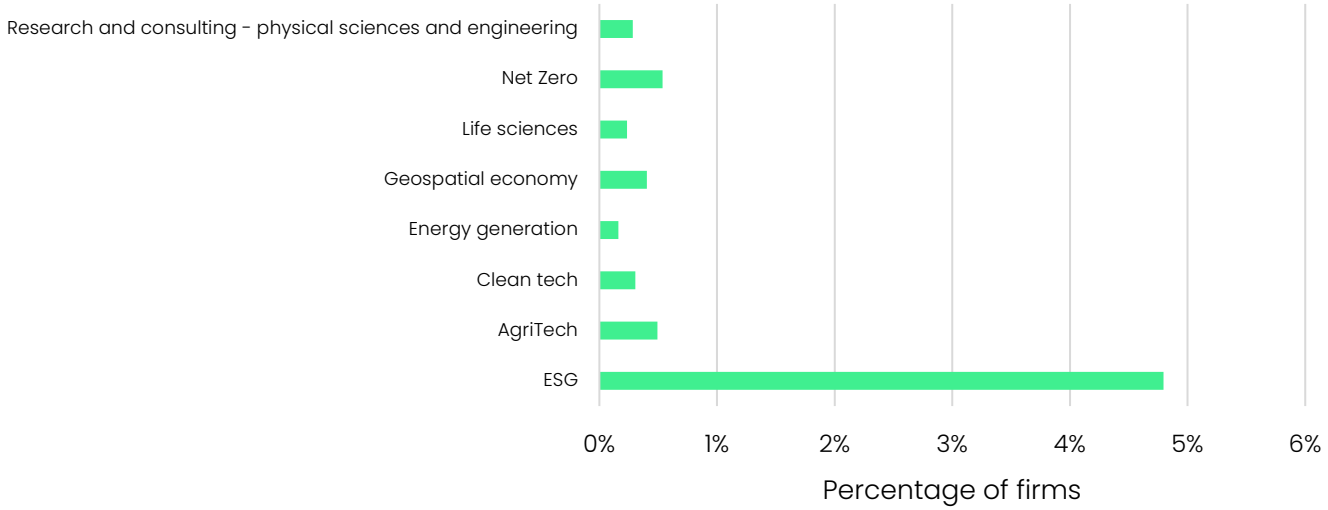
Figure 5.1 shows the number firms and the number of employees for existing RTICs relevant to managing climate change as of February 2026. The largest sector is net zero, followed by life sciences and research and consulting. The largest employers are also net zero and life sciences. This highlights the UK's existing strengths in these sectors.

Of the firms in these sectors (74,126), only a relatively small proportion (323 firms) reference that they are working on climate change adaptation on their website. The area where the share referencing

[7] These search terms were: "flood", "resilience", "protection", "climate", "environmental risk", "flood management", "natural and built environment", "engineering", "adapt", "sustainable drainage system", "sustainable urban drainage system".

adaptation is highest is ESG; although this RTIC is very small (see Figure 5.1) and the share is still low, at less than 5% of firms in this category (see Figure 5.2). This may be because adaptation is not explicitly mentioned on their website, but it might also reflect that adaptation is not consistently a part of firms' operations in this area. We also explored other terms that might be relevant for climate change adaptation in the firm's descriptions of their work (e.g. resilience, flood risk, flood defence, flood resilience). While this allows us to identify more firms, the references might be related to contexts outside of climate change adaptation (e.g. resilience might refer to energy resilience). The number of firms referencing 'resilience' was 10,135; 'flood risk'/'flood defence'/'flood resilience' was 2,445; 'water'/'waste water'/'water treatment' was 1,246; and 'insurance' was 184.

Figure 5.2. Percentage of firms in each key sector that refer to "climate change adaptation" on their website



Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

Method 2: Firms directly working on climate change adaptation

Our second approach involves developing a bespoke classification including firms that mention climate change adaptation as a key part of their operations on their website, which we consider to represent firms directly working on climate change adaptation.

Table 5.1 below shows a summary of firms that work directly on climate change adaptation, often in adaptation services. In total, we identified 1,525 companies using this method, two thirds of which have more than one employee. The headline figures on employment and gross value added (GVA) are very large, but this will almost entirely be a reflection of how this sector is constructed. Large professional services and consultancy firms, engineering and infrastructure companies, and insurance firms are all represented, where adaptation will be one part of a broader suite of activities. Therefore, these figures should be treated as a significant overestimate and not a true measure of the UK's adaptation economy.

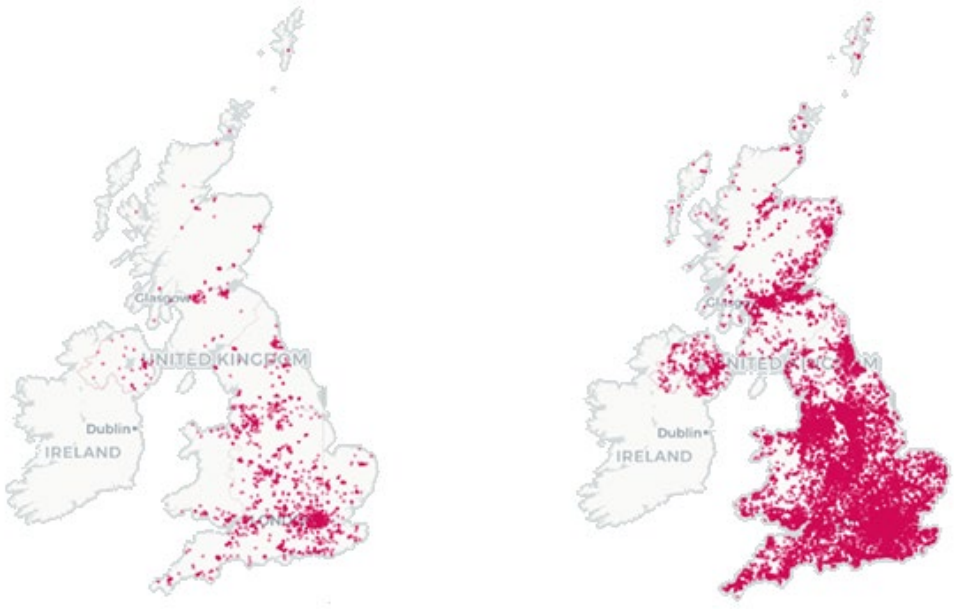
The firms operating in this sector have an average estimated growth per year of 8.3%, larger than the 6.4% for the net zero RTIC.

Table 5.1. Summary of firms operating in the 'Direct climate adaptation' category	
Firm count • 1,525 companies • 1,017 with more than one employee	**Employment** • 384,305 UK employees
Output • £250 billion total turnover (from 1,143 companies) • £8.9 billion gross value added (GVA) • £81,278 GVA per employee	**Public and private funding** • £289 million non-grant investment funding (in total from 2003-2026, including debt, equity – i.e. seed funding, venture capital etc.) • £85.6 million grant funding from Innovate UK, UK Research and Innovation, or non-profits (in total from 2003-2026)
Top 10 sector key words (from their websites): Environmental, climate change, sustainability, energy, industry, water, design, resilience, digital, compliance	**Top real-time industrial classification counts:** Net zero (789); life sciences (208); ESG (114); research and consulting (109); geospatial economy (53); land remediation (48)

Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

Figure 5.3 shows the locations of UK firms working directly on climate change adaptation.

Figure 5.3. Map of locations of firms operating in the 'direct climate change adaptation' category (left) and the 'net zero' real-time industrial classification (right) for comparison



Source: Analysis of The Data City, 2026. Based on the net zero RTIC and authors' own categories.

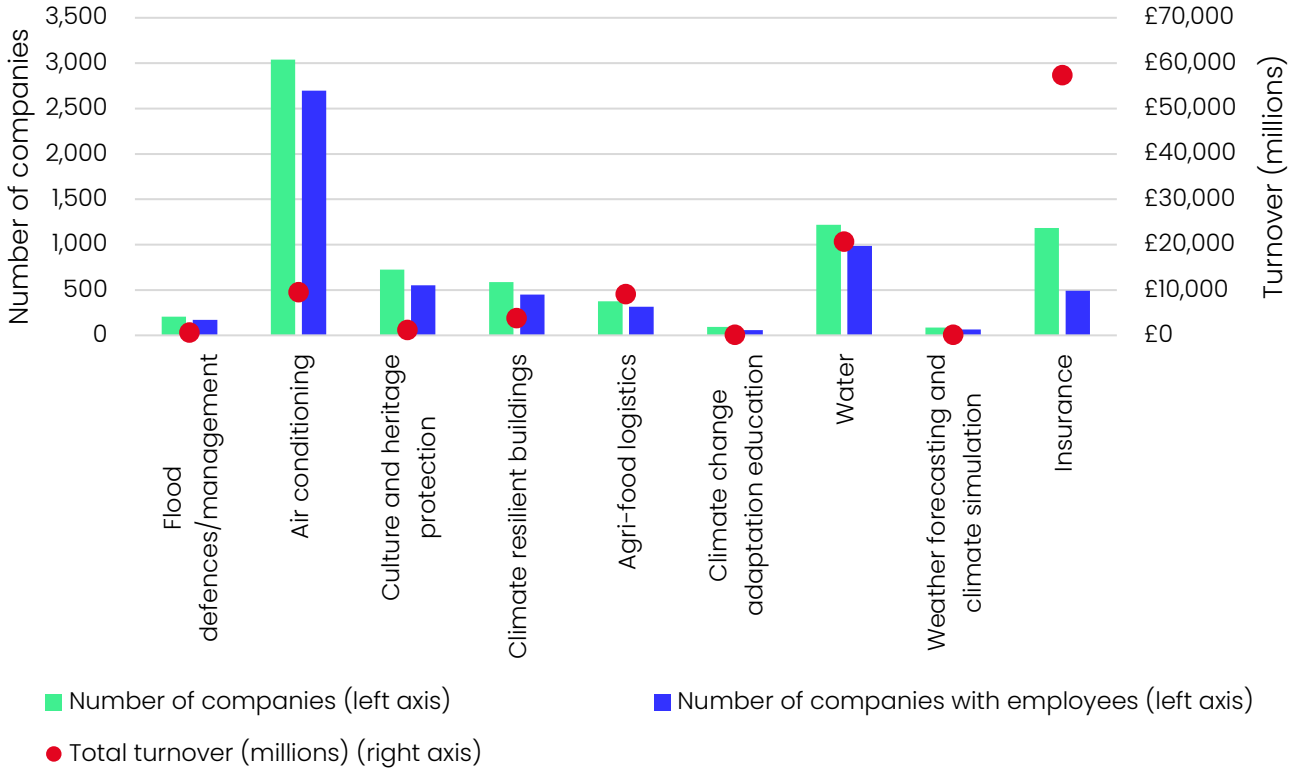
There is a large concentration of firms based in London and other large cities, which is likely to reflect the location of business advisory and finance firms. There are far fewer firms operating in this category relative to the net zero RTIC (2,301 for climate change adaptation compared to 32,448 for net zero).

Method 3: Firms indirectly working on climate change adaptation

We selected some key sectors relevant to the UK context that are likely to experience growth under a changing climate to describe characteristics of firms indirectly providing adaptation technologies and services. These sectors include:

- Flood defences/management
- Air conditioning
- Culture and heritage protection
- Climate-resilient buildings
- Agri-food logistics (e.g. cold chain storage)
- Climate change adaptation education
- Water
- Weather forecasting and climate simulation
- Insurance

Figure 5.4. The number of firms operating in climate adaptation sectors and their total turnover varies, with the largest number of firms concentrated in on-the-ground delivery, but the highest turnover in the service sectors



Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

Figure 5.4 shows the number of companies (both with and without employees to indicate the number of sole traders/shell companies that may be being picked up in the data) operating in adaptation-related sectors. It also shows the turnover of these sectors. The largest sector by number of companies is air conditioning; the largest by turnover is insurance. There is also variation in the growth per year of these sectors (see Figure 5.5), with the highest growth in the buildings, insurance and agri-food logistics sectors. Most of these sectors are seeing higher growth rates than the net zero RTIC. As the climate changes, we may expect to see increasing demand for the goods and services that these sectors provide.

Figure 5.5. Variation in firms' total gross value added growth per year[8], with the highest growing sectors sitting in service sectors. The net zero growth rate is included for comparison

Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

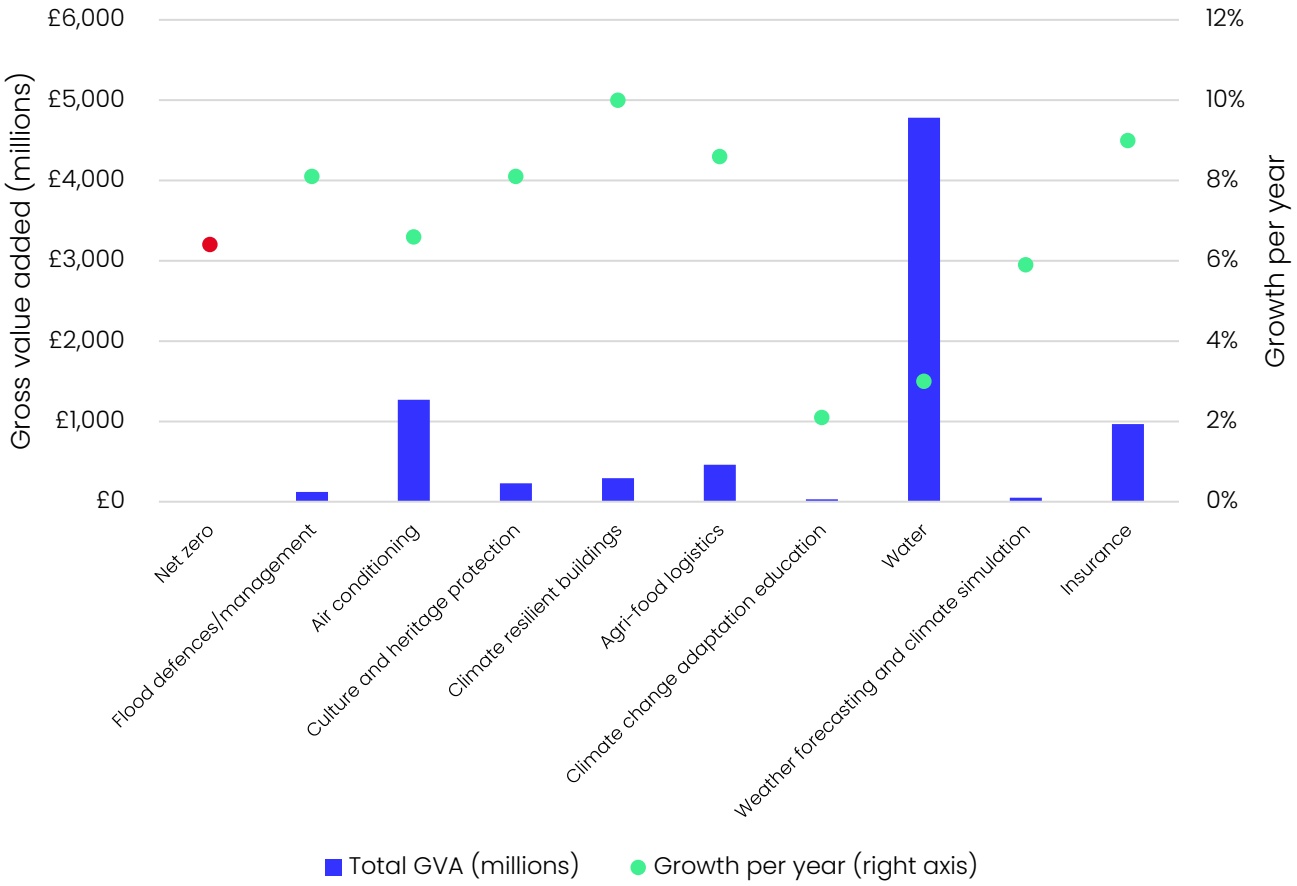
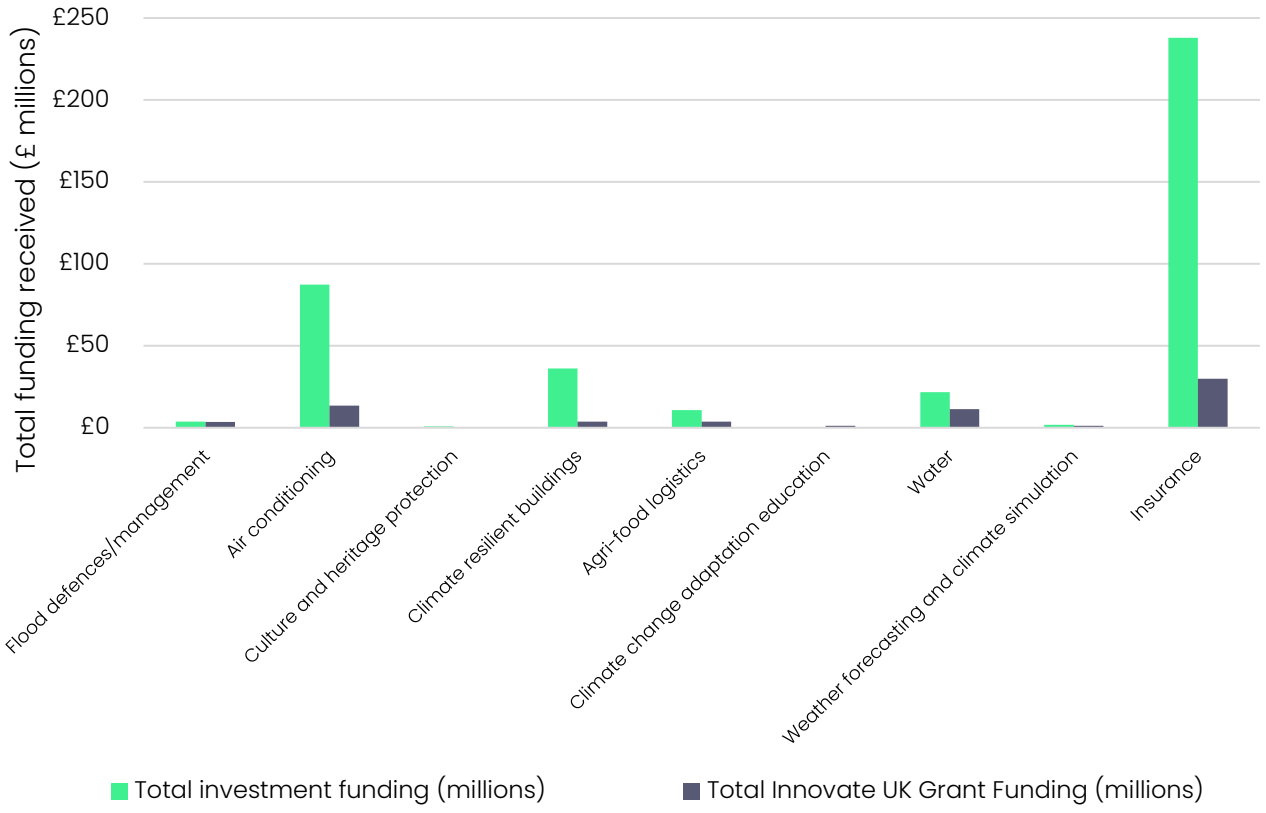


Figure 5.6 shows the private investment funding (total from 2003-2026, including debt, equity – i.e. seed funding, venture capital etc.) and grant funding (total grant funding from Innovate UK, UK Research and Innovation, or non-profits from 2003-2026) flowing into each sector. All the sectors receive more individual grants than private investments, but receive more in volume through private investment. This is in comparison to the net zero RTIC, where just 29% of investments come from grant funding. The largest recipient sector is the insurance sector.

[8] Details on The Data City's approach to estimating GVA can be found here: https://help.thedatacity.com/knowledge/gva-data. The growth rate is the growth of companies that are trading today, rather than the growth rate of the sector (it therefore does not include companies that have ceased trading during this period).

Figure 5.6. Volume of private funding flowing into adaptation-related sectors



Source: Analysis of The Data City, 2026. Based on authors' own sectors and other relevant RTIC codes.

We show the geographical location of these firms in Appendix 2. The service-based sectors (e.g. insurance) are concentrated in London and large cities, whereas the more delivery-focused sectors (e.g. flood management and air conditioning) are more dispersed across the UK.

Discussion

Our comparison between the number of firms operating in climate adaptation-related technologies and services (both those working directly on climate adaptation, and those in sectors that will see an increase in demand as a result of a changing climate, but which may not necessarily be operating purely to address climate risk) and the number of firms operating in the wider net zero RTIC is striking. The net zero economy has benefitted from decades of policy support, subsidy frameworks and investor attention. At an absolute maximum (it includes all firms that do any adaptation), the adaptation economy is around a third of the size of the net zero economy, despite the impacts of climate change already being felt domestically and internationally.

Improving adaptation capabilities in the economy is often a public good where the benefits are realised in the long term, meaning it is a challenging market for attracting private investment. These features of the climate change-related adaptation sector are reflected in the currently low levels of investment (both public and private) going into this area relative to the adaptation needs of both the UK and the rest of the world. Our analysis also shows that firms are relatively grant-dependent in many of the UK's adaptation subsectors. Private investment outweighs public grant funding in volume terms (£1 billion of investment is flowing into these sectors, 19% from public sources). This is particularly evident in sectors such as climate-resilient buildings, water management, weather forecasting and climate simulation. Without clearer revenue models and stronger policy-backed demand signals, private capital is unlikely to flow into these areas at the scale needed. The contrast with the net zero RTIC, into which £31 billion of investment is flowing, 12% from public sources, illustrates how far the

adaptation investment ecosystem still has to develop. It also underscores the catalytic role that public funding must play in the near term.

Notwithstanding the current scale gap, the growth trajectory of the adaptation economy is notable. The direct climate adaptation category is growing at 8.3% per year, and many of the indirect categories (including flood defences/management, air conditioning, insurance and climate-resilient buildings) are outpacing the net zero RTIC at 6.4%. The majority of the indirect adaptation sectors analysed are also growing faster than the net zero RTIC. This suggests that even in the absence of strong policy demand signals, market actors are beginning to respond to the realities of a changing climate, although, of course, the sector is starting from a lower base. However, this growth dynamic also presents a risk: if supply-side capacity does not increase in a coordinated and adequately funded way, the gap between what the adaptation economy can deliver and what a changing climate will demand is likely to widen. Early and targeted policy intervention is therefore important not only to stimulate investment, but also to shape the composition of that growth toward the areas of greatest need.

There are examples of other countries that have built a clear strategic architecture for developing expertise in adaptation technologies and services. The Netherlands, for example, has designated water as a key sector under its industrial policy, resulting in targeted government investments with the objective of increasing water security and optimising Dutch earning capacity. The sector now represents nearly 2% of Dutch exports (Netherlands Water Partnership, 2020). A similar strategy has been adopted in Denmark where the government plans to invest over €5 billion in water technology over the next 15-20 years. Denmark now ranks first in Europe in water patents per capita and water technology exports per capita (United Nations, n.d.).

6. Conclusion and recommendations

The UK is well-placed to become a world leader in climate change adaptation goods and services, but realising that potential will require deliberate and sustained policy intervention.

Currently, there is a small and growing market for climate change-related adaptation goods and services in the UK and globally. But as the climate changes both domestically and internationally, a gap is likely to emerge between what the adaptation economy can currently deliver and what the impacts of the changing climate will demand.

This report finds that the UK has strong supply-side foundations to meet the growing demand for climate change-related adaptation goods and services. The UK holds significant revealed technological advantage in adaptation technologies, and its financial and professional services sectors are highly competitive in the areas that will be required as adaptation finance increases.

However, even under the most generous assumptions (including the activity of firms where climate change adaptation will be a small part of their operations in our analysis of The Data City dataset), the adaptation economy is, at most, a third of the size of the net zero economy. Investment flows remain low and heavily grant-dependent across most subsectors. Furthermore, while regulatory frameworks are developing, they do not yet generate adaptation investments with strong revenue models and demand signals that would unlock private capital at scale. The innovation ecosystem, while active, is concentrated in small firms that face well-established barriers to commercialisation and export.

Our analysis shows that the UK's adaptation economy is in a similar position to the net zero economy a decade ago: waiting for sustained policy support, subsidy frameworks, regulatory mandates and public investment that together can create the right market conditions for growth. The sector needs deliberate intervention to realise the advantages that the UK holds in adaptation goods and services to keep pace with demand, and to respond and build resilience to a rapidly changing climate. This is especially so as countries in the EU and elsewhere take targeted action to prioritise adaptation innovation.

Policy recommendations

1. **Highlight climate change adaptation as a key aspect of resilience in the UK's Modern Industrial Strategy.** The UK's industrial strategy sets out a plan to drive growth across eight sectors where the UK has comparative advantages and growth potential, alongside boosting resilience and supporting environmental goals and the net zero transition. Climate change adaptation technologies, products and services map to existing industrial strategy sectors, including advanced manufacturing, life sciences, professional and business services, and financial services. Identifying areas where demand is increasing due to the need to adapt to a changing climate offers a new lens for considering growth opportunities in sub-sectors. These opportunities have implications for policies within the scope of the UK's industrial strategy, including support for innovation, skills and building innovation clusters across the country.

2. **Support commercialisation and scale-up for innovators in adaptation technologies and services.** The UK's innovation ecosystem in climate change adaptation technologies and services is growing, but with many small firms operating in these markets, policy is likely to need to play a role in developing commercialisation pathways and enabling scale-up of these technologies and services. Creating networks or clusters that connect small innovators with larger industrial partners and end-users (particularly in the construction, infrastructure and utilities sectors) could help bridge the gap between innovations and their deployment. Given the concentration of adaptation innovation in coastal and flood-exposed regions, support for such firms presents an opportunity to drive regional growth at the same time as directly helping to build local resilience.

3. **Develop a dedicated adaptation investment strategy.** Investment flows to adaptation sectors remain significantly lower than those directed towards the net zero economy, despite growing domestic need and international demand for adaptation technologies and services. A strategic framework, comparable to those that have successfully mobilised investment in low-carbon technologies, would provide the demand-side signals for a pipeline of demand for adaptation technologies and services, especially as adaptation action is largely driven by the public sector. This should be complemented by enabling regulation, and consideration of the skills required for the UK to both adapt to climate change and become a competitive provide of adaptation technologies and services globally.

4. **Build further evidence on the UK's strengths in sectors relevant for adaptation.** In this report, we map the current landscape of firms operating in climate change adaptation goods and services sectors. Further work is needed to understand the UK's export advantage in these goods and services, and the spillover effects of innovation in the adaptation economy.

References

Adenle A A, Azadi H, Arbiol J (2015) Global assessment of technological innovation for climate change adaptation and mitigation in developing world. *Journal of Environmental Management*, 161: 261-275. *http://doi.org/10.1016/j.jenvman.2015.05.040*

Artemis (2026) *Artemis Deal Directory*. Web page. www.artemis.bm/deal-directory

Auci S, Barbieri N, Coromaldi M, Vignani D (2021) Innovation for climate change adaptation and technical efficiency: an empirical analysis in the European agricultural sector. *Econ Polit* 38, 597–623. https://doi.org/10.1007/s40888-020-00182-9

Bank of England (2025) DP2/25 – *Alternative Life Capital: Supporting innovation in the life insurance sector.* London: Bank of England. www.bankofengland.co.uk/prudential-regulation/publication/2025/november/alternative-life-capital-discussion-paper

Brandon C, Kratzer B, Aggarwal A, Heubaum H (2025) *Strengthening the Investment Case for Climate Adaptation: A Triple Dividend Approach.* Washington, DC: World Resources Institute. www.wri.org/research/climate-adaptation-investment-case

Buchner B, Naran B, Padmanabhi R, Stout S, Strinati C, Wignarajah D, Miao G and Connolly J (2023) *Global Landscape of Climate Finance 2023*. San Francisco: Climate Policy Initiative. www.climatepolicyinitiative.org/wp-content/uploads/2023/11/Global-Landscape-of-Climate-Finance-2023.pdf

Caldecott B (2019) *Green Finance Strategy 2.0: Here's what an ambitious UK plan should look like*. University of Oxford. www.smithschool.ox.ac.uk/page/green-finance-strategy-20-heres-what-ambitious-uk-plan-should-look

Climate Change Committee [CCC] (2019) *Progress in preparing for climate change 2019 Report to Parliament* www.theccc.org.uk/wp-content/uploads/2019/07/CCC-2019-Progress-in-preparing-for-climate-change.pdf

Climate Change Committee [CCC] (2021) *Independent Assessment of UK Climate Risk – Technical Report, Risk I3 (International supply chains).* www.theccc.org.uk/publication/independent-assessment-of-uk-climate-risk/

Climate Change Committee [CCC] (2023) *Investment for a well-adapted UK*. [online] www.theccc.org.uk/wp-content/uploads/2023/01/Investment-for-a-well-adapted-UK-CCC.pdf

Cimato F and Mullan M (2010) *Adapting to Climate Change: Analysing the Role of Government.* Department for Environment Food and Rural Affairs. https://assets.publishing.service.gov.uk/media/5a79c1b4ed915d07d35b7dff/pb13341-analysing-role-government-100122.pdf

Conger J, Havstrup E, Jasper L, Jonkers L, Patrahau I, Ramdani S, van Schaik L and Tasse J (2024) *World Climate and Security Report 2024 - The Council on Strategic Risks*. Washington, DC: Council on Strategic Risks. https://councilonstrategicrisks.org/2024/07/10/world-climate-and-security-report-2024

Cooperative Patent Classification [CPC] (2025) *CPC Scheme - Y02a Technologies for Adaptation to Climate Change.* United States Patent and Trademark Office. www.uspto.gov/web/patents/classification/cpc/html/cpc-Y02A.html

Curran B, Martin R, Muller S, Nguyen-Tien V, Oliveira-Cunha J, Serin E, Shah A, Valero A & Verhoeven D (2022) *Growing clean: Identifying and investing in sustainable growth opportunities across the UK*. London: The Resolution Foundation, May 2022

Department for Business and Trade [DBT] (2025) *Industrial Strategy, Strategy document setting out a new economic approach to backing the UK's strengths, with ambitious plans for 8 high-growth sectors*. London: DBT

De Lyon J, Martin R, Cunha O, Shah A, Shah K, Thwaites G and Valero A (2022) *Enduring strengths: analysing the UK's current and potential economic strengths, and what they mean for its economic strategy, at the start of the decisive decade.* London: London School of Economics and Political

Science. https://researchonline.lse.ac.uk/id/eprint/117344/1/Oliveira_Cunha_enduring_strengths_published.pdf

Dechezleprêtre A, Fankhauser S, Glachant M, Stoever J, and Touboul S (2023) Invention and Global Diffusion of Technologies for Climate Change Adaptation: A Patent Analysis. *Review of Environmental Economics and Policy* 17(2). doi: https://doi.org/10.1086/725365

Department for Environment, Food and Rural Affairs [Defra] (2025) *Government response to the Climate Change Committee 2025 adaptation progress report*. Policy paper, 29 October 2025. London: DEFRA.

Della Croce R, Hlavackova C, Whittaker S, Nguyen P (2024) *Financing climate adaptation and resilience in London and the UK*. London: Imperial College Business School. www.imperial.ac.uk/business-school/faculty-research/research-centres/centre-climate-finance-investment/research/financing-adaptation-and-resilience-london-and-the-uk-moving-aspiration-reality

Elsen M and Tietze F (2024) Contributions from low- and middle-income countries to the development of climate change adaptation technologies: A patent analysis. *Technological Forecasting and Social Change, 209, p.123660. https://doi.org/10.1016/j.techfore.2024.123660*

Espacenet (2026) *Patent search database.* Web page: European Patent Office. https://worldwide.espacenet.com/patent/search?q=cpc%20any%20%22Y02A%22%20AND%20pd%20within%20%222022-01-01%3A2022-12-31%22

Evans, S (2026) *London Market must build on London Bridge 2 success, despite stalled UK ILS: LMG Chair*. Web page. Artemis.bm. www.artemis.bm/news/london-market-must-build-on-london-bridge-2-success-despite-stalled-uk-ils-lmg-chair

Fernandes S da C, Pigosso D C A, McAloone T C, Rozenfeld H (2020) Towards product-service system oriented to circular economy: a systematic review of value proposition design approaches. *Journal of Cleaner Production*, 257(1), p.120507. doi: https://doi.org/10.1016/j.jclepro.2020.120507

Financial Conduct Authority [FCA] (2025) *The Financial Conduct Authority's Adaptation Report*. London: FCA www.fca.org.uk/publication/corporate/fca-adaptation-report-2025.pdf

Global Centre on Adaptation (2018). *About us.* Web page. https://gca.org/about-us/

Gordon S (2023) *Investing in our future Practical solutions for the UK government to mobilise private investment for economic, environmental and social policy priorities*. London: Grantham Research Institute, London School of Economics and Political Science. www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/10/Investing-in-our-future-Practical-solutions-for-the-UK-government-to-mobilise-private-investment.pdf

Green Denmark in South East Asia (2023) *Snapshot: Update on Climate Adaptation Initiatives in Singapore*. Blog post. GreenDKinSEA. Available at: www.greendkinsea.com/post/snapshot-update-on-climate-adaption-initiatives-in-singapore

Hall B H, Jaffe A, and Trajtenberg M (2005) Market Value and Patent Citations. *The RAND Journal of Economics*, 36(1), 16–38. www.jstor.org/stable/1593752

Hall L, Macfarland M and Munday P (2025) *Climate costs are rising, but few companies have an adaptation plan | S&P Global*. Web page. S&P Global. www.spglobal.com/en/research-insights/special-reports/look-forward/climate-costs-are-rising-but-few-companies-have-an-adaptation-plan

HM Treasury (2024) *Financial Services Growth and Competitiveness Strategy, Call for evidence outcome*. London: HM Treasury. www.gov.uk/government/calls-for-evidence/financial-services-growth-and-competitiveness-strategy

HM Treasury (2025a) *Chancellor unveils plan to turbocharge investment across the UK*. London: HM Treasury. www.gov.uk/government/news/chancellor-unveils-plan-to-turbocharge-investment-across-the-uk

HM Treasury (2025b) *UK Infrastructure: A 10 Year Strategy*. London: HM Treasury. www.gov.uk/government/publications/uk-infrastructure-a-10-year-strategy

HM Treasury (2025c) *Changes to the Risk Transformation Regulations Consultation*. London: HM Treasury. www.gov.uk/government/publications/changes-to-the-risk-transformation-regulations/changes-to-the-risk-transformation-regulations-consultation-accessible

Hotte N, Jee J (2022) Knowledge for a warmer world: a patent analysis of climate change adaptation technologies. *Technological Forecasting and Social Change,* 183, p.121879. https://doi.org/10.1016/j.techfore.2022.121879

Institute of Mechanical Engineers [IMECHE] (2023) *Adapting industry to withstand rising temperatures and future heatwaves*. London: IMECHE. www.imeche.org/policy-and-press/reports/detail/adapting-industry-to-withstand-rising-temperatures-and-future-heatwaves

Intergovernmental Panel on Climate Change [IPCC] (2023) *Sections.* In: Lee H and Romero J (eds) *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* IPCC, Geneva, Switzerland, pp. 35-115, https://doi.org/10.59327/IPCC/AR6-9789291691647

Jakaityte I (2025) *UK E&S consulting finds balance after boom.* Environment Analyst Global. https://environment-analyst.com/global/111264/uk-es-consulting-finds-balance-after-boom

Kogan L, Papanikolaou D, Seru A, Stoffman N (2017) Technological Innovation, Resource Allocation, and Growth. *The Quarterly Journal of Economics* 132(2): 665–712. https://doi.org/10.1093/qje/qjw040

LinkedIn (2025) *Green Skills Report 2025.* London: LinkedIn. https://economicgraph.linkedin.com/content/dam/me/economicgraph/en-us/PDF/2180-global-green-skills-report-v04.pdf

London Stock Exchange Group [LSEG] (2025) *Investing in the green economy 2025: Navigating volatility and disruption.* London: LSEG www.lseg.com/en/insights/investing-in-the-green-economy-2025-navigating-volatility-and-disruptions

Ministry of Housing Communities and Local Government [MHCLG] (2025) *Government response to the proposed reforms to the National Planning Policy Framework and other changes to the planning system consultation*. Gov.UK. www.gov.uk/government/consultations/proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system/outcome/government-response-to-the-proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system-consultation

Moody's Analytics / Bureau van Dijk (2024) *Orbis Database*. Web page. Moody's Analytics www.moodys.com/web/en/us/capabilities/company-reference-data/orbis.html

National Infrastructure Commission [NIC] (2023) *Second National Infrastructure Assessment.* London: NIC. www.north-herts.gov.uk/sites/default/files/2025-05/CD6.3.5%20National%20Infrastructure%20Assessment%20(October%202023).pdf

Netherlands Water Partnership (2020) *Sector makes the International Water Ambition tangible* | NWP. Web page: www.netherlandswaterpartnership.com/news/sector-makes-international-water-ambition-tangible

Organisation for Economic Co-operation and Development [OECD] (2025) *Financing Climate Adaptation: Mobilising Investment at Scale*. Paris: OECD. www.oecd.org/content/dam/oecd/en/publications/support-materials/2024/11/FCA-Highlights-final.pdf

Oehling D, Fischer G, Sivaprasad D, Nanji T, Shandal V, Sheridan B, Chua H.L, Zimmermann F, Teo J, Teo M and Lim H (2025) *The Private Equity Opportunity in Climate Adaptation and Resilience*. Boston: Boston Consulting Group. https://web-assets.bcg.com/63/1c/a0ddaf5e48148fc8e53f5a608338/the-private-equity-opportunity-in-climate-adaptation-and-resilience-may-2025.pdf

Ofgem (2025) *Preliminary Strategic Direction Statement for industry codes 1 Preliminary Strategic Direction Statement for industry codes Preliminary Strategic Direction Statement for industry codes*. London: Ofgem. www.ofgem.gov.uk/sites/default/files/2025-07/Preliminary-Strategic-Direction-Statement.pdf

Ofwat (2024) *PR24 Final Determinations and Water Efficiency Fund*. London: Ofwat. www.ofwat.gov.uk/publication/water-efficiency-fund-final-decision-document

Olazabal M, Galarraga I, Ford J, Sainz De Murieta E, Lesnikowski A (2019) Are local climate adaptation policies credible? A conceptual and operational assessment framework. *International Journal of Urban Sustainable Development,* 11(3):277-296. https://doi.org/10.1080/19463138.2019.1583234

Paul Watkiss Associates (2021) Mon*etary Valuation of Risks and Opportunities in CCRA3.* www.ukclimaterisk.org/wp-content/uploads/2021/06/Monetary-Valuation-of-Risks-and-Opportunities-in-CCRA3.pdf

Payiatakis D (2025) *Investing in climate adaptation*. Web page. Barclays Private Bank. https://privatebank.barclays.com/insights/market-perspectives-march-2025-03-2025/investing-in-climate-adaptation

Probst B, Touboul S, Glachant M, Dechezleprêtre A (2021) Global trends in the invention and diffusion of climate change mitigation technologies. *Nature Energy* 6: 1077–1086. www.nature.com/articles/s41560-021-00931-5

Research and Markets [R&M] (2025) *United Kingdom Data Centre Landscape 2025.* Research And Markets 2025. www.researchandmarkets.com/reports/5441205/united-kingdom-data-centre-landscape-2025?srsltid=AfmBOoqIkOvd1jZulBuGCRsobxDzgGJpuVnYkYM3sstaCXircEhw_cz2

Serin E, Valero A, Martin R, Shah A, Andres P and Mealy P (2021). *Seizing sustainable growth opportunities from carbon capture, usage and storage in the UK.* London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/09/Seizing-Sustainable-Growth-Opportunities-from-CCUS-in-the-UK_FULL-REPORT-1.pdf

Serin E, Andres P, Martin R, Shah A and Valero A (2023). *Seizing sustainable growth opportunities from tidal stream energy in the UK.* London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/06/Sustainable-Growth-Opportunities-from-Tidal-Stream-Energy-in-the-UK-.pdf

Serin E, Andres P, Martin R, Read M, Shah A and Valero A (2024) *The green industrial policy matrix Informing an industrial strategy for clean energy technologies.* London: Centre for Economic Performance, London School of Economics and Political Science. https://cep.lse.ac.uk/pubs/download/special/cepsp48.pdf

Serin E, Burke J, Feng S, Read M, Suresh Kumar R (2025) *The innovation race on geological carbon removal: who is best placed to lead?* London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. www.lse.ac.uk/granthaminstitute/publication/the-innovation-race-on-geological-carbon-removal-who-is-best-placed-to-lead

Standard & Poor [S&P] (2026) *Global Reinsurance Sector View 2026*, Standard & Poor's

Swiss Re Institute (2025) sigma 1/2025: Natural catastrophes: insured losses on trend to USD 145 billion in 2025. Web page. www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html

The Data City (2026) *The Data City Platform*. Dataset. https://thedatacity.com

Thurley A, Wilson J and Newton K (2025) *Entering the UK Data Centre Market: Opportunities and Strategic Considerations.* Web page. Gardiner & Theobald Market Intelligence. www.gardiner.com/marketintel/entering-the-uk-data-centre-market-opportunities-and-strategic-considerations

Trittipo A, Ahlawat H, Mysore M, Kalavar S, and Kane S (2025) *Climate resilience technology: An inflection point for new investment.* Web page. McKinsey & Company. www.mckinsey.com/capabilities/sustainability/our-insights/climate-resilience-technology-an-inflection-point-for-new-investment

United Nations Disaster Risk Reduction [UNDRR] (2023) *Global Assessment Report on Disaster Risk Reduction*. Geneva: UNDRR. https://digitallibrary.un.org/record/4022485

United Nations Environment Programme [UNEP] (2023) *Adaptation Gap Report 2023*. Nairobi: UNEP. www.unep.org/resources/adaptation-gap-report-2023

United Nations Environment Programme [UNEP] (2025) *Adaptation Gap Report 2025: Running on Empty - The World is Gearing up for Climate Resilience — without the Money to get there.* United Nations Environment Programme eBooks. https://doi.org/10.59117/20.500.11822/48798

United Nations Environment Programme [UNEP] (2025) *Emissions Gap Report 2025: Off target – Continued collective inaction puts global temperature goal at risk* [Olhoff, A., chief editor; Lamb, W.; Kuramochi, T.; Rogelj, J.; den Elzen, M.; Christensen, J.; Fransen, T.; Pathak, M.; Tong, D. (eds)]. Nairobi: UNEP. https://doi.org/10.59117/20.500.11822/48854

United Nations Framework Convention on Climate Change [UNFCCC] (2005) *Earth Negotiations Bulletin - UNFCCC seminar on the development and transfer of environmentally sound technologies for adaptation to climate change - Saturday, 18 June 2005*. UNFCCC. https://enb.iisd.org/vol12/enb12271e.html

United Nations Framework Convention on Climate Change [UNFCCC] (2025) *Adaptation and Resilience*. UNFCCC. https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

University of Notre Dame (2024) *Country Index, Notre Dame Global Adaptation Initiative*. United States: Notre Dame Global Adaptation Initiative. https://gain.nd.edu/our-work/country-index/

United Nations (n.d.). *A National Growth Plan for the Danish Water Sector*. United Nations Department of Economic and Social Affairs. https://sdgs.un.org/partnerships/national-growth-plan-danish-water-sector

Unsworth S, Valero A, Martin R and Verhoeven D (2020) *Seizing sustainable growth opportunities from zero emission passenger vehicles in the UK*. London: Centre for Economic Performance, London School of Economics and Political Science. www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2020/02/GRI_Seizing-sustainable-growth-opportunities-from-zero-emissions-passenger-vehicles-in-the-UK_FULL-REPORT.pdf

Watkiss, P (2022) *The Costs of Adaptation, and the Economic Costs and Benefits of Adaptation in the UK*. Policy Paper. www.theccc.org.uk/wp-content/uploads/2023/01/The-Costs-of-Adaptation-and-the-Economic-Costs-and-Benefits-of-Adaptation-in-the-UK-Paul-Watkiss.pdf

World Economic Forum [WEF] (2025) *The Future of Jobs Report 2025*. Geneva: WEF. www.weforum.org/publications/the-future-of-jobs-report-2025

Appendix 1. List of CPC Y02A categories

Adaptation at coastal zones; at river basins
Hard structures, e.g. dams, dykes or breakwaters
Dune restoration or creation; Cliff stabilisation
Artificial reefs or seaweed; Restoration or protection of coral reefs
Flood prevention; Flood or storm water management, e.g. using flood barriers
Controlling or monitoring, e.g. of flood or hurricane; Forecasting, e.g. risk assessment or mapping
Water conservation; Efficient water supply; Efficient water use
Rainwater harvesting
Water desalination using reverse-osmosis, using renewable energy (e.g. windpower, solar thermal; photovoltaics, wave energy)
Using grey water (e.g. using household water from wash basins or showers)
Leakage reduction or detection in water storage or distribution
Water filtration
Controlling water pollution; Wastewater treatment (e.g. keeping clear the surface of open water from oil spills or off-grid powered water treatment through solar-powered water purification or solar-powered wastewater sewage treatment, e.g. spray evaporation)
Relating to industrial water supply, e.g. used for cooling
Protecting water resources (e.g. ricer restoration, saltwater intrusion barriers, acquifer discharge, water saving techniques at user level)
30/00 Adapting or protecting infrastructure or their operations
Extreme weather resilient electric power supply systems, e.g. strengthening power lines or underground cables
Structural elements or technologies for improving thermal insulation (e.g. Slab shaped vacuum insulation, using natural or recycled building materials, e.g. straw, wool, clay or used tires, glazing, e.g. vacuum glazing, Roof garden systems; Roof coverings with high solar reflectance)
Relating to heating, ventilation or air conditioning [HVAC] technologies (e.g. Solar heating or cooling, using waste energy, e.g. from internal combustion engine)
In transportation, e.g. on roads, waterways or railways
Planning or developing urban green infrastructure
Adaptation technologies in agriculture, forestry, livestock or agroalimentary production
In agriculture (e.g. Abiotic stress, including plants tolerant to drought, salinity, heat; Genetically Modified [GMO] plants, e.g. transgenic plants; fertilizers of biological origin, e.g. guano or fertilizers made from animal corpses; Improving land use; Improving water use or availability; Controlling erosion; Greenhouse technology, e.g. cooling systems, specially adapted for farming; specially adapted for storing agricultural or horticultural products, specifically using renewable energies)
Ecological corridors or buffer zones
Adaptation in livestock or poultry (including using renewable energy)
in fisheries management (e.g. Aquaculture, e.g. of fish, including Alternative feeds for fish, e.g. in aquacultures)

In food processing or handling, e.g. food conservation (including using renewable energies, e.g. Cooking stoves or furnaces using solar heat or biomass or off-grid food refrigeration (including those powered by renewable energy sources)
Adaptation in human health protection, e.g. against extreme weather
Air quality improvement or preservation, e.g. vehicle emission control or emission reduction by using catalytic converters, e.g. Atmospheric particulate matter [PM], e.g. carbon smoke microparticles, smog, aerosol particles, dust
Against vector-borne diseases, e.g. mosquito-borne, fly-borne, tick-borne or waterborne diseases whose impact is exacerbated by climate change
Technologies having an indirect contribution to adaptation to climate change
Information and communication technologies [ICT] supporting adaptation to climate change, e.g. for weather forecasting or climate simulation
Assessment of water resources
Monitoring or fighting invasive species

Appendix 2. Locations of firms in climate change adaptation sectors

Flood defences / management

Air conditioning

Culture and heritage protection

Climate resilient buildings

Agri-food logistics

Adaptation education

Water

Weather forecasting and climate simulation

Adaptation finance

Insurance

Adaptation consultancy and advisory services