CETEX

Centre for Economic Transition Expertise

*Research and Policy at* **LSE**

# Response to Invest 2035: the UK's modern industrial strategy

Submission to the Department for Business and Trade by CETEx and the Grantham Research Institute on Climate Change and the Environment

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LSE The London School of Economics and Political Science

Grantham Research Institute on Climate Change and the Environment

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## About this report

This report consists of a submission made in response to the consultation run by the Department for Business and Trade between 14 October and 25 November 2024 on Invest 23, the UK's 'modern industrial strategy', the Government's proposed 10-year plan for the economy. The submission was made on 22 November 2024. This report is a lightly edited version of the submission. See details of the consultation here: www.gov.uk/government/consultations/invest-2035-the-uks-modern-industrial-strategy.

The submission has drawn on research and insights from across CETEx and the Grantham Research Institute. Additionally, answers to Questions 1, 2, 4 and 5 are based on the Institute's work conducted in collaboration with the Centre for Economic Performance (CEP) and the Programme on Innovation and Diffusion (POID), both of which are also based at the London School of Economics and Political Science, and the Productive and Inclusive Net Zero (PRINZ) programme.

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# Summary

LSE's Centre for Economic Transition Expertise and Grantham Research Institute call for climate change to be a central consideration in the UK's upcoming industrial strategy.

This report presents a response submitted to the consultation on the UK's 'modern industrial strategy', which was run by the Department for Business and Trade from 14 October to 25 November 2024. The response answers Questions 1-2 within the Sector Methodology section; 4-6 within the Sectors section; 7, 8, 12, 20 and 23 within the Business Environment section; 30 in the Partnerships and Institutions section; 33-34 in the Theory of Change section; and 36 in the Additional Information section. Below is a summary of the full response, which is presented from page 6 onwards.

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A UK Industrial Strategy must start from the recognition that the country's economic success is reliant on an orderly and fast transition towards net zero and climate resilience, both at home and abroad. Without fast action now to mitigate emissions, build capabilities in relevant supply chains, adapt to a warming climate, and be a global leader on actions to address climate change, the UK will fail to protect its economy from substantial future costs. Inaction will also miss the economic, environmental and wellbeing opportunities presented by the transition to a resilient, clean economy.

**Our response begins by setting out an assessment framework for identifying subsectors for prioritisation in the Industrial Strategy.**

- We propose an assessment framework, which we call the 'green industrial policy matrix', to inform the prioritisation of subsectors within clean energy industries. The framework considers: 1) opportunities for growth, 2) strategic importance of a domestic supply chain and 3) distributional impacts from choosing specific subsectors.

- In assessing opportunities for growth, we analyse trade and patent data to shed light on the UK's comparative advantages along supply chains of different clean energy technologies and combine this with information on likely global demand growth.

- Within clean energy industries, our analysis points to carbon capture usage and storage (CCUS) and offshore wind as subsectors that have strong potential to contribute to the objectives assessed and could therefore take priority in the Industrial Strategy. However, we highlight that all the other subsectors assessed also contain specific UK strengths which warrant the attention of policymakers.

- These subsectors face several barriers to investment, including uncertainty regarding the availability, size and shape of future policy support; the extent of uncertainty varies across subsectors. Policy support for CCUS in particular needs to be subject to strong environmental guardrails and be fully aligned with net zero.

- Seven selected subsectors within clean energy industries were assessed using the framework in the first instance. The framework could be applied to a wider range of subsectors within clean energy industries, as well as to other growth-driving sectors.

**We emphasise policy uncertainty as an important barrier to investment.**

- We focus on the role of uncertainty, including policy uncertainty, in undermining business confidence and slowing down necessary investment for the net zero

transition. The Industrial Strategy should recognise this and set out measures designed to give the private sector greater confidence in the UK's efforts to transition.

- These measures should include updating the Net Zero Strategy, aligned with the advice of the Climate Change Committee (CCC), accompanied by government-backed sectoral pathways that outline carbon budgets for different sectors and the technology and investment needs for meeting them.

**We set out some key actions for Government on people and skills, regulation, crowding in finance, the role of the Industrial Strategy Council, and prioritising adaptation action as a cross-cutting theme.**

- **People and skills:** The Government should produce a workforce plan that identifies areas and sectors that could benefit from the transition to a clean economy, and additional skills required to adapt the UK to a changing climate. The plan should also identify which places may face a decline from the transition and identify actions that can support these communities. The Government should also prioritise allocating additional resources for training and preparing the public sector workforce for these challenges.

- **Regulation:** Accelerating and strengthening the ecosystem of regulation and supervision related to green and transition finance should be a priority action in the Industrial Strategy, alongside: introducing regulatory incentives for sustainable and transition finance; mandatory disclosure requirements on sustainability-related risks and opportunities and transition plans; implementing the manifesto commitment on 1.5-degree-aligned transition plans; embedding transition plans across policy instruments; introducing regulatory standards on the use of 'sustainability' and 'ESG' labels to manage greenwashing risk; and developing the regulatory infrastructure that supports high integrity voluntary carbon and biodiversity credit markets.

- **Crowding in finance:** The Government should focus on the role the UK policy banks can play in investing in the transition. It should work with the National Wealth Fund, British Business Bank, UK Research and Innovation and UK Export Finance to develop 10-year strategies for how these organisations will proactively support sectors at different stages of their development. This should be used to present a cohesive, proactive cross-government offer to private investors. This process should be coordinated by a central team within Government with experience of public and private investment.

- **Role of the Industrial Strategy Council:** To ensure the Council is effective in helping the strategy deliver for the UK's transition to a net zero and resilient economy, we recommend that its core role should be to facilitate the coordination between the Government and the business community, and interpret the practical implications for businesses. We also suggest that the Council works with other organisations, including the new National Infrastructure and Service Transformation Authority (NISTA) and the CCC, to understand the impact of the strategy on their remits.

- **Making climate change adaptation a priority cross-cutting theme:** The focus of this Industrial Strategy is on place-based growth opportunities and addressing local constraints. Climate risk and adaptation are drivers of economic outcomes, with many sectors exposed to risk from climate change. Conversely, there are several opportunities from adapting to a changing climate from which the UK economy could benefit. It is therefore critical that adapting to climate change is a cross-cutting theme in the strategy's development.

# Sector methodology

## 1. How should the UK government identify the most important subsectors for delivering our objectives?

### Putting net zero and climate resilience at the core of the Industrial Strategy

**A UK Industrial Strategy has to start from the recognition that the UK's economic success is reliant on an orderly and fast transition towards net zero and climate resilience, both at home and abroad.** The latest scenarios from the Network for Greening the Financial System (NGFS) published in 2024 have once again underlined the sizeable economic costs of inaction or delayed action on climate (NGFS, 2024). In a Delayed Transition scenario, the NGFS estimates global GDP will be 12% lower by 2050 than under a hypothetical baseline scenario that does not present any transition or physical risks. This increases to 15% in a Current Policy scenario. Note that several climate-related risks are excluded from these estimates, including the impacts of climate-induced migration, armed conflict and climate tipping points, and they are therefore likely to be an underestimation of the total impacts.

**Overall, the conclusions are clear: we cannot avoid the economic impacts of climate change. Early and coordinated policy action will yield the highest long-run returns.** The UK's economy is not insulated from these global trends. In 2022, LSE published a policy report exploring some of the key impact channels in the UK, including impacts on the productivity of agriculture and fisheries, labour productivity, flooding and trade, and estimating their respective impact on UK GDP (Rising et al., 2022). The two key conclusions from that work were: firstly, under current policies, the total climate damages to the UK are projected to increase from **1.1% in 2022** to **7.4% by 2100**; secondly, the net zero transition is expected to have a **net benefit** of around 4% of GDP, reducing the estimated impact of climate change from 7.4% of GDP to 2.4% of GDP by 2100. Similarly, the UK's Office for Budget Responsibility (2024) found that delaying policy action on net zero until the 2030s could more than double the total costs of the transition in debt terms to 43% of GDP by 2050. In contrast, if Government were to take bold and ambitious climate action, using existing investment plans to support the transition and reforming the tax system, transitioning to net zero could deliver a net fiscal benefit and lower the debt-to-GDP ratio by 12 percentage points by 2050, the OBR's estimates suggest. It is well documented that delivering the transition towards net zero and climate resilience can also have broad benefits for other economic, environmental and health outcomes.

**This makes climate change a structural factor that is critical to the Government's Growth mission, and that therefore needs to be central to the design of the Industrial Strategy.** Including net zero as one of the main objectives of the strategy is a good start. We have two main recommendations for where the Government should go further in integrating climate considerations as it designs the Industrial Strategy:

(1) **Include considerations of adaptation and climate resilience.** Decarbonisation is only one of two twin challenges climate change poses to the UK. In parallel to reaching net zero, we urgently need to increase resilience to the physical impacts of the changing climate. For a more detailed discussion of the need to adapt to climate change and specific recommendations, see our response to **Question 36**.

(2) **Integrate transition considerations across all major building blocks of the strategy, recognising that the transition cannot be achieved through 'clean energy industries' in isolation but requires a whole-of-economy transition.** Such an integration would have implications for:

   a. All the sectors and subsectors the strategy prioritises for support (see further discussion below, plus responses to **Questions 2, 4, 5, 6**).

b. The sector plans that are developed as part of the strategy, which should focus on barriers to the transition as well as removing barriers to growth.

c. Any policy measures taken with regard to the cross-cutting policy areas identified in the Green Paper, which should aim to drive transition as well as growth (e.g. see answers to **Questions 7, 8, 20, 23**).

d. The overall theory of change along with governance and accountability structures put in place to support the development and delivery of the Industrial Strategy over time (see **Questions 30 and 34)**.

e. How success is defined, which should take into account not only the levels of growth achieved but also the degree to which the strategy contributes to reducing emissions and strengthening the climate resilience of the UK economy.

## An assessment framework for the prioritisation of subsectors

**As the discussion above makes clear, support for a growth-driving sector would only be justified if it can demonstrate potential to drive (or at the very least be aligned with) the UK's transition to net zero.** Once a growth-driving sector is identified on that basis, policymakers need to go a step further and choose the subsectors and technologies within it to prioritise for support. Along with other collaborating centres at LSE, we have developed an assessment framework to assist policymakers in this effort (see Serin et al., 2024). We title our framework the **'green industrial policy matrix'**, as in the first instance we have used it to assess various clean energy technologies for prioritisation for policy support. However, the framework could be used to inform industrial policy priorities in other growth-driving sectors as well.

**The 'green industrial policy matrix' offers a way of assessing different subsectors and technologies for their potential contribution to important economic and social objectives.** The objectives we have chosen for assessment in our framework map closely to the objectives set out by the Government in its Green Paper. Our chosen objectives are: 1) opportunities for growth, 2) strategic importance of a domestic supply chain, and 3) distributional impacts of choosing specific subsectors and technologies. We include multiple assessment criteria under each objective, as shown in Table 1, to inform an overview of the extent to which a subsector or technology can contribute to that objective. Our selection of these criteria has drawn on existing academic and policy literature on industry, and our own substantial policy engagement in recent years.

**Table 1. Overview of criteria assessed under the green industrial policy matrix**

| Opportunities for growth | Strategic importance | Distributional aspects |
|---|---|---|
| • Global tradeable market potential<br>• Comparative advantage in trade<br>• Comparative advantage in technology and innovation | • Domestic demand under net zero<br>• State of global supply chain | • Job creation potential<br>• Places – regional spread of opportunities |

**It is important to emphasise that we apply our criteria to informing an industrial strategy that seeks to build domestic supply chains, as opposed to prioritising support for deploying relevant technologies domestically.** While the two decisions are interlinked – as domestic demand can drive domestic supply chains – the latter decision is primarily a consideration for the Government's overall strategy for ensuring energy security and meeting its legal obligation to bring UK emissions to net zero by 2050.

The assessment criteria along the three objectives in the matrix can be summarised as follows:

- First, to assess **opportunities for growth**, we consider where there is evidence of UK comparative advantage in different clean energy technologies and combine this with information on likely global demand growth.

- Second, we consider the **strategic importance** of these technologies for meeting the UK's net zero commitments (based on existing policy commitments where available), and the extent to which UK supply chain capabilities are needed given geopolitical uncertainties.

- And finally, we consider the likely **distributional aspects** of growth in these technologies, in terms of both job creation potential and the regional spread of opportunities.

**The matrix is not intended to provide deterministic policy advice, but rather to inform the development of an industrial strategy by making potential trade-offs between support for different areas more visible.** The way it is interpreted and incorporated into decisions by policymakers would ultimately depend on the weights they assign to different objectives, and their appetite for risk. Some high-level insights we draw from applying the matrix assessment approach on various clean energy technologies are summarised in Questions 4 and 5.

## 2. How should the UK government account for emerging sectors and technologies for which conventional data sources are less appropriate?

**The starting point for our response to this question is to recognise that a UK net zero economy will be characterised by rapidly emerging new sectors and technologies.** The Government could explore new sources of data to inform its decision-making in the context of net-zero-relevant sectors and technologies. For example, in previous work (see Curran et al., 2022), we have capitalised on an innovative approach to classifying UK businesses developed by The Data City to shed light on the UK's capabilities across various clean sectors and technologies. The Data City classifies businesses into what it calls 'Real-Time Industrial Classifications' (RTICs) based on textual descriptions of businesses' activities found on their websites using 'expert-in-the-loop' training. This exercise includes an explicit RTIC for the net zero economy which is made up of even more specific classifications about businesses' activities such as 'building technologies', 'energy storage' and 'carbon capture'. This kind of **approach to building classifications using real-time data** can be particularly informative in emerging sectors where traditional industrial classifications do not provide sufficient detail (such as the Standard Industrial Classification [SIC] system, which was last updated in 2007).

However, there is also much insight still to be gained from conventional data sources when it comes to developing a judgement on emerging sectors and technologies. **At LSE, we analyse trade and patent data, two well-established sources of data that can be of value to policymakers in understanding the capabilities of the UK economy and choosing priority sectors.** What is important here is capitalising on existing literature and expert input in order to design an analytical approach that will enable policymakers to closely capture the productive and innovative capabilities relevant for a given technology of interest, while being honest about the limitations of the data when interpreting the results. The backbone of such analyses is a robust approach to identifying the classifications under which the data comes organised (namely, the Harmonised System in relation to trade data and the Cooperative Patent Classification system in relation to patent data), and mapping these onto the supply chains of the technologies of interest. We have shown how this can be done and the kinds of insights possible to extract as a result in our detailed analyses of two relatively early-stage sectors within the net zero economy – carbon capture, usage and storage (CCUS) (Serin et al., 2021) and tidal stream energy (Serin et al., 2023) – and in higher-level analyses of a wider range of clean technologies (Curran et al., 2022 and Serin et al., 2024).

**Our analysis of trade data is motivated by the idea that when a country exports a product, this tells us that the country is either efficient at producing it**, relative to other countries and to other products; **or that it offers a unique (or differentiated) product or service that is desired by other countries** (Curran et al., 2022). Looking at exports, therefore, tells us something about the UK's ability to produce products that are valued on the world stage (ibid.). However, when it comes to rapidly evolving sectors and emerging technologies as in the context of net zero, it is important to understand not only the existing strengths of an economy, but also areas where it is well-placed to develop these. An analysis of trade data applying the quantitative methodology developed by Mealy and Teytelboym (2022) to the green economy allows us to shed light on this question. Evidence from the economic geography literature shows that countries and regions more easily develop new competitive advantages in products that are similar to those they already produce competitively (Hidalgo et al., 2007a; Neffke et al., 2011). Additionally, the production and export of technologically complex products are associated with greater economic prosperity and growth (Hidalgo et al., 2007a, 2007b; Hausmann et al., 2007). Building on these findings and the aforementioned methodology, our analysis sheds light on countries' current green export capabilities and helps to identify new green export opportunities and predict likely future green export growth.

**Patents, on the other hand, are commonly used by researchers to make comparative analyses of innovation patterns, being internationally available over time and organised under detailed technological classifications.** As patents are a key measure of innovation output, comparative analyses using this data could be a good guide to where future economic value will be generated. However, the value ultimately generated would be contingent on decisions taken today and on how much of the production and trade activity related to an innovation is retained within the UK supply chain. While it is true that not all innovation is patented – particularly in the services sector, which constitutes a large proportion of the UK economy – we know that the transition to net zero will involve the further refinement and invention of several 'hard' technologies and equipment for which patenting data tends to have good coverage.

**A forward-looking view of the UK's innovative capabilities can also be taken using patent data, through an analysis of patenting activities related to a given technology that co-occur with patenting in other innovation fields**, including on a spatial basis (which could point to potential for transferability of innovative strengths). For example, applying this approach to CCUS, we have found that areas of the UK that have traditionally patented more intensively in oil and gas extraction technologies also patent intensively in CCUS (Serin et al., 2021). Through the Industrial Strategy Index (IStraX) methodology, we are also able to estimate economic returns on potential government R&D subsidies for different technology areas, taking into account the variation in the private returns on innovation in different sectors, along with direct and indirect knowledge spillovers to other firms (as measured through citations in patents) (for further detail see Martin and Verhoeven, 2022).

# Sectors

## 4. What are the most important subsectors and technologies that the UK government should focus on and why?

**Our response to this question focuses specifically on clean energy industries among the Government's eight selected growth-driving sectors.** In a recent paper we set out evidence across a range of criteria we consider to be important for informing the prioritisation of industrial policy across **seven selected clean energy technology categories** and within them (Serin et al., 2024). These technologies were selected based on evidence from our previous work of existing UK strengths along associated supply chains (for example, see Curran et al., 2022), and the potential growth opportunities that could be unlocked if those strengths were to be nurtured.

This assessment was underpinned by our 'green industrial policy matrix' introduced in Question 1. This was produced through a collaboration between the Grantham Research Institute, the Centre for Economic Performance (CEP), the Programme on Innovation and Diffusion (POID), all based at LSE, and the Productive and Inclusive Net Zero (PRINZ) programme. We assessed seven selected technologies: 1) Buildings (including low-carbon heating and cooling and building fabric), 2) carbon capture, usage and storage (CCUS), 3) green hydrogen (including electrolysers and fuel cells), 4) grid flexibility and smart systems, 5) nuclear, 6) offshore wind, and 7) tidal stream energy.

**While the weights assigned to different objectives and the appetite for risk will matter for detailed implementation, at a high level our 'green industrial policy matrix' points to CCUS and offshore wind as subsectors that have strong potential to contribute to the objectives assessed and could therefore take priority for industrial policies in the UK.** Tidal stream energy is also an interesting example: an emerging area with relatively small overall growth potential but in which the UK has important strengths, suggesting an opportunity for the country to lead globally.

As explained in Question 1, we emphasise that the matrix intends to inform the prioritisation of support for different technologies from the perspective of building domestic supply chains. It does not involve assessing the technologies for their emissions reductions potential and therefore cannot inform a judgement on the appropriate level of domestic deployment for the different technologies. The latter is primarily a consideration for the Government's overall strategy for meeting its legal obligation to bring emissions to net zero by 2050.

**For illustration, we summarise the main insights from our assessments on the three technologies we highlight below. However, there are specific UK strengths within the other subsectors assessed, too, that warrant the attention of policymakers.** For example, the UK does not demonstrate comparative advantage in innovation for green hydrogen or grid flexibility when these are analysed as aggregate technology groupings. But it has comparative advantage in some specific innovations within them which could be significant for the clean energy transition: these include demand-side response within grid flexibility and hydrogen production through electrolysis within green hydrogen (our aggregate grouping also includes innovations relating to hydrogen distribution, storage and fuel cells). Our assessment methodology and full results are available in Serin et al. (2024). A summary of the results presented within the green industrial policy matrix is available in the Appendix. Also note that the list of seven technologies we assess is not exhaustive; further priorities could be identified through an analysis of UK capabilities across a more comprehensive list of clean energy technologies.

**CCUS is a technology for which global demand is expected to grow rapidly and where the UK has existing comparative advantage in the majority of relevant products and innovations we analysed.** It is also a technology expected to play a significant role along the UK's own transition towards net zero. For example, even the scenario to meet net zero in the

Climate Change Committee's (CCC) Sixth Carbon Budget with the least reliance on CCUS sees the UK capturing and storing around 13 $MtCO_2$ annually by 2030 (CCC, 2020). This implies a foreseeable level of domestic demand which could be leveraged to drive domestic supply chains. However, domestic deployment of CCUS needs to be subject to strong environmental guardrails, as we discuss further in Question 6.

**The global market for offshore wind is also expected to grow substantially and the UK is one of the top countries when it comes to innovating related technologies.** In the specific context of floating offshore wind (FLOW) – a new frontier emerging within offshore wind – the UK already has comparative advantage in the exports of the relevant core product, floating structures, as well as in relevant innovation. Furthermore, pathways for meeting the Government's Clean Power 2030 target rely heavily on a rapid expansion of offshore wind domestically (NESO, 2024). However, the global demand for wind power equipment is expected to outstrip supply in the coming years, with supply chain bottlenecks expected in Europe as soon as 2026 (IEA, 2024; Gasperin and Emden, 2024). This creates an economic resilience argument, in addition to potential growth opportunities, for the development of a domestic supply chain for offshore wind in the UK.

**Tidal stream energy is attached to a global market that is likely to remain relatively small (as it is constrained by the natural resource) but one in which the UK holds potential to lead globally** given its comparative advantages in turbine exports and almost all relevant specific innovations we have analysed. The UK currently ranks third place globally on innovative specialisation in tidal stream technologies. The development of a domestic supply chain could also enable the UK to capitalise on the domestic demand for relevant products, driven by the project pipeline secured under the Contracts for Difference mechanism, to create growth benefits and jobs.

**The growth of these three subsectors also has potential to support jobs in the UK's industrial heartlands and coastal communities, and create transition opportunities for the North Sea workforce,** based on the geographical spread of activities we demonstrate in our analysis and wider evidence on transferable skills and capabilities. Careful sequencing along the transition is needed to ensure that the jobs and regional benefits of growth in these subsectors respond effectively to declining employment in high-carbon industrial activities.

## 5. What are the UK's strengths and capabilities in these subsectors?

**With our analysis of trade and patent data we are able to look within a technology grouping to identify the specific products and innovations driving the UK's performance in that overall grouping.** Building on our answer to Question 4, below we summarise our detailed results based on this analysis for CCUS, offshore wind and tidal stream energy. Such detailed analyses of the UK's strengths and capabilities looking within subsectors are also available for the rest of our seven technologies assessed in Serin et al. (2024).

We analyse trade data because when a country exports a product, this tells us that the country is either efficient at producing it, relative to other countries and to other products; or that it offers a unique (or differentiated) product or service that is desired by other countries (Curran et al., 2022). The key concept underpinning this analysis is 'revealed comparative advantage' (RCA): a measure of a country's specialisation in a product derived by comparing that product's share of a country's exports to that product's share in global exports. In subsequent discussions, we refer to products in which the UK readily has RCA as 'strengths', and those in which it does not currently have RCA but could build it in the future as 'potential opportunities'. We combine this measure with country-to-product proximity (a measure of relatedness that is predictive of the probability of a country developing RCA in a given product in the future) and the Product Complexity Index (a proxy for technological sophistication) to inform an overall view on opportunities associated with a product.

Patents are a key measure of innovation output and thus can be a good indicator of where future economic value will be generated. Not all innovation is patented – and this is especially true for the services sector, which constitutes a large proportion of the UK

economy. However, data on patents are commonly used by researchers to make comparative analyses of innovation patterns, being internationally available over time and organised under detailed technological classifications. The key concept underpinning this analysis is 'revealed technological advantage' (RTA), which compares a technology category's share in the country's total patenting to that technology category's share in global total patenting. RTA indicates innovative specialisation.

## CCUS

The UK is the fourth most specialised exporter of products relevant for CCUS globally, according to our analysis of the subsector at the aggregate level. Within CCUS, the UK has **strengths in several products that are highly complex and represent large volumes of global trade**. These include machinery (and constituent parts) for filtering or purifying gases; types of iron or steel pipes of a kind used for oil and gas pipelines; pumps and compressors for air, vacuum or gas; and certain instruments and apparatus relevant for measurement and monitoring (for instance, for checking pressure and the flow or level of liquids). The UK is also specialised in surveying equipment (for example for oceanographic and geophysical purposes), which is highly proximate to its capabilities.

Turning to CCUS innovations, the UK is the tenth most specialised innovator of CCUS technologies (analysed as an aggregate category) globally. Within CCUS, the UK has **specialisation in almost all the specific innovations we identify as relevant for this subsector**. This includes a particular strength in the capture aspects of CCUS. Indeed, the UK is specialised in innovations relating to the capture and disposal not only of carbon dioxide but also other greenhouse gases, including methane. Furthermore, the UK demonstrates RTA in innovations related to applications of CCUS to reduce emissions from metal processing and combined cycle gas power plants.

While out of the scope of the analysis presented here, we emphasise that the development of CCUS needs to be guided by **strong guardrails for the technology to make a genuine contribution to the transition to net zero** in the UK and globally. We discuss the role of the Government here in Question 6.

## Offshore wind

The UK is a **specialised exporter of floating structures**; this finding is relevant for the UK's potential competitiveness in early stage floating offshore wind (FLOW) products. FLOW represents a new frontier for the offshore wind sector which could see this source of power extend to new sites in deeper waters and with lower seabed impact in the UK and overseas. The UK also has product opportunities spanning iron or steel structures (which could include turbine towers), certain electrical equipment, parts of electric motors and generators, and several types of bearings and gearings.

The UK is the fourth most specialised innovator of offshore wind technologies on the world stage and demonstrates **specialisation in the majority of specific innovations** within the category. Almost half of these specific innovations are growing areas of global patenting. Of these growing areas, diagnostics of wind motors is an especially large one in terms of global patenting volume, while submerged foundations is also of notable size. The UK's specialisations in floating structures and mountings on structures floating on a liquid surface are relevant in the specific context of FLOW.

## Tidal stream energy

The UK is a leader in developing tidal stream technologies (Serin et al., 2023) and has already deployed several projects to date that have very high domestic content, reaching over 80% in some cases (ORE Catapult, 2022). Almost **all the products in which the UK has specialisation within the tidal stream category are complex products** (meaning they are associated with higher growth opportunities). They include both small (less than 1 MW) and larger (1–10 MW) hydraulic turbines; and types of engines and motors (and their parts). The UK's strength in

floating structures is relevant here as well. Turning to potential opportunities, the UK could build specialisation in the future in many types of bearings and gearing that are relatively high in both technological complexity and proximity to the UK.

The UK ranks third place on innovative specialisation in tidal stream technologies in the world. This is also the area of highest UK specialisation among our seven technologies assessed (the full list is set out in Question 4). Looking within tidal stream, the UK is **specialised in almost all the relevant specific innovations**. This includes the overall classification of tide (or wave) power plants and also many specific innovations relating to structures that would support these plants in the sea. Examples include: submerged foundations and anchoring arrangements (which can be relevant for tidal stream devices fixed on the seabed) and floating structures (which could have applications for floating tidal stream devices).

## 6. What are the key enablers and barriers to growth in these subsectors and how could the UK government address them?

In Question 7 we discuss how policy uncertainty can be a significant barrier to investment in the overall context of the UK's delivery of net zero and climate resilience, and that this is currently not sufficiently reflected in the Government's Green Paper. The three subsectors we identify in previous questions as potential priorities for industrial policies in the UK are affected by policy uncertainty to varying degrees; we discuss this in further detail below.

### CCUS

The Government has confirmed up to £21.7bn of funding over 25 years to enable the UK's first CCUS projects in two industrial clusters (DESNZ, 2024). However, insufficient detail has been provided on how this funding will be allocated, over time or between the different applications of CCUS. CCUS can contribute to decarbonisation in various ways but all CCUS applications are not created equally (Serin, 2023; Serin and Bradeen, 2024). The net emissions impact associated with applications will vary based on the emissions source, energy requirements of the operation and the configuration of the supply chain, and may be especially limited when the application involves the use of natural gas, such as in the case of 'blue hydrogen' production (Carbon Tracker Initiative, 2024). Given these risks, the **development of CCUS should be subject to strong environmental guardrails and policy support should only be allocated to projects and supply chains that demonstrate potential to make a genuine contribution to national and global mitigation efforts**. The Government should specify the amount of CCUS it intends to rely on, and in which sectors, for emissions reductions as part of its new Net Zero Strategy (while retaining flexibility to adapt to technological developments on the way) (Serin and Bradeen, 2024).

### Offshore wind

The key question when it comes to offshore wind is how the Contracts for Difference (CfD) can remain a fit-for-purpose mechanism to drive the rapid deployment of the technology required under the Government's Clean Power 2030 target. The clean power pathways recently published by the National Energy System Operator (NESO) see 43–50 GW of offshore wind in the UK by 2030, up from 15 GW in 2023 (NESO, 2024). Various reforms have been proposed to enhance the CfD's ability to secure the necessary levels of capacity (RenewableUK, 2024). Furthermore, the Government has introduced the CfD Clean Industry Bonus, which will allow fixed and floating offshore wind applicants to receive extra revenue support under the scheme if they choose to invest in more sustainable supply chains. This is intended to incentivise investment in manufacturing facilities in deprived areas and in more sustainable means of production. While this reflects the right kind of joined-up thinking between deployment and supply chain development, the effectiveness of relying on project developers to drive investment in supply chains is unclear. **The Government should also be providing more direct support to relevant supply chains to scale up in order to unlock the full potential of the sector for generating regional growth benefits and jobs – for example, through the National Wealth Fund and GB Energy.** We also know that the current practice of recovering policy costs of the CfD through energy bills is regressive (Owen and Barrett, 2020).

Therefore, increasing policy costs associated with the CfD to incentivise supply chains without reforming this approach would exacerbate the disproportionate burden on poorer households.

## Tidal stream energy

Tidal stream is a nascent technology market which will appear risky to private investors. The Government has made a ringfenced budget available for the technology within its annual Contracts for Difference auctions since 2022. However, the availability and the size of the ringfence is only confirmed in the year prior to the auction being held, which is not enough notice to guide investment decisions with long-term returns. **The Government should consider providing longer-term funding certainty for tidal stream (and other similarly early-stage but promising technologies), through the CfD and any other mechanisms it employs for support.** That way, associated supply chains have the necessary confidence to scale up, maximising economic benefits and UK jobs (Serin et al., 2023). Were the Government to adopt an explicitly stated domestic deployment target in capacity terms, this could also help to signal to the private sector its intention to work together to drive the necessary investment towards that target, while allowing flexibility on the precise amount and shape of future support (ibid.).

# Business environment

## 7. What are the most significant barriers to investment? Do they vary across the growth-driving sectors? What evidence can you share to illustrate this?

**A key investment barrier that is not reflected in the Government's Green Paper is the role of uncertainty, including policy uncertainty on how the UK will deliver the transition to net zero and climate resilience.** A broad range of factors can increase overall levels of uncertainties that businesses face, including, for example, geopolitical tensions, sudden environmental disasters, unforeseen economic fluctuations or perceived instability in the future direction of government policies. It is well documented that where overall levels of business uncertainty are high, this leads to more cautious investment behaviour. A recent analysis by the International Monetary Fund (IMF) investigating the drivers for low investment rates in the UK found that uncertainties related to Brexit and Covid have both led to large and persistent negative impacts on business investment (IMF, 2023). Analysis in 2021 by the Bank of England based on the Decision Maker Panel (DMP), a monthly survey of UK businesses, came to a similar conclusion (Bank of England, 2021): it found that businesses that cited Brexit to be in their top three sources of uncertainty had had lower investment growth since 2016 than peers who were less affected by Brexit uncertainty (the former were generally firms with higher exports to or imports from the EU, or a reliance on EU migrant workers). The National Infrastructure Commission also cites a lack of long-term strategic direction and greater volatility in public capital investment relative to other large economies as a barrier to investment in large infrastructure projects in the UK (NIC, 2024). It concludes that a stable long-term investment environment helps generate certainty and encourage 'programmatic pipelines'.

**There is a growing body of evidence to show that uncertainty around climate policy is an important factor that can significantly undermine business confidence and slow investment behaviour.** For example, an analysis conducted by the OECD found that climate policy uncertainty is associated with economically and statistically significant decreases in investment, particularly in capital-intensive and pollution-exposed sectors (Berestycki et al., 2022). The OECD findings indicate that climate policy uncertainty slows investment overall, but particularly among those firms that most urgently need to upgrade their production (which, as outlined in **Question 1**, is a fundamental pre-condition for growth). Basaglia et al. (2021) find a similar effect on R&D efforts and employment levels. Uncertainty is a critical barrier, particularly in those sectors that rely on strong demand signals to justify risky investments in new, innovative and still unproven technologies to achieve transition objectives. Government policies are also frequently cited as a critical dependency by companies setting out their transition plans (Rose et al., 2024).

**On the flipside, we know that the transition towards net zero and a well-adapted UK will be highly capital-intensive, and that private sector climate action can be an important positive driver of business investment.** Drawing on responses to the DMP, the Bank of England finds that UK firms expect to increase climate-related investments in the near term, which would have a positive overall effect on capital expenditure (Bank of England, 2024). Over a quarter of the firms surveyed expect a large impact of over 10% of total investments. The Bank further estimates that UK businesses are likely to invest around £13 billion in climate-related investments per year over the next three years, which is sizeable but below the annual investment needs of £20–£22 billion estimated by the CCC. This finding further underlines the well-evidenced observation that the UK's private sector is not yet transitioning at the speed and scale required.

**There has been significant rollback by the UK Government on climate change action and mixed messaging around its climate efforts over the past few years** (CCC, 2024). In 2023, 11.7% firms in the DMP survey cited climate change (both physical risks and climate-related policies) as one of the top three sources of uncertainty (Bank of England, 2024). The recent Transition Finance Market Review also identified a "lack of long-term regulatory and policy

certainty with regard to real economy transition" as a key barrier to scaling up transition finance (TFMR, 2024, p.9). As well as hindering the UK's ability to reach climate targets, uncertainty also undermines investment overall and prevents UK companies from building competitive advantage in those areas where it would be uniquely positioned to benefit from a global transition (see Questions 1, 2, 4, 5, 6). These trends are already visible in the UK and elsewhere. For example, the automotive industry reacted negatively when the UK Government U-turned on its Zero Emission Vehicle targets in 2023 (Institute of the Motor Industry, 2023), warning they would reduce domestic production of electric vehicles, leading to lower competitiveness over the medium term. Similar trends are emerging in Germany, where the automotive industry is losing its international competitiveness in light of a sluggish shift towards electrification (PwC, 2024).

**The implication for the Industrial Strategy is that the growth mission cannot be seen as detached from climate objectives, and that uncertainty around climate policy should be recognised as an important investment barrier.** For the Industrial Strategy to be successful in driving investment and growth, it must support and be accompanied by measures that give the private sector greater confidence in the UK's efforts to transition. The Government is legally required to update its Net Zero strategy next year, after previous iterations were ruled inadequate by the High Court (ClientEarth, 2024). This Strategy will be a critical vehicle for providing this certainty and should be based on the analysis provided by the CCC's Seventh Carbon Budget, expected in early 2025. This should be underpinned by government-backed sectoral pathways that outline the carbon budgets for different sectors, the technology and investment needs required, and policies designed to support their achievement.

## People and skills

### 8. Where you identified barriers in response to Question 7 which relate to people and skills (including issues such as delivery of employment support, careers, and skills provision), what UK government policy solutions could best address these?

**Existing analysis shows that there is currently a mismatch between the country's current skills profile and the skills required for a successful transition to a net zero, well-adapted UK.** For net zero, the CCC (2023) has highlighted that there is likely a shortfall in the types of workers and skills required to deliver a low-carbon transition in sectors including building construction and retrofit, forestry and peatland restoration, energy supply and electric vehicle infrastructure.

**There is also a potential shortage of the skills required to deliver a well-adapted UK.** Private companies (particularly in food, construction and the regulated sectors) will need additional skills on climate risk assessment and supply chain management. SMEs will require guidance and tools to support climate resilience (Surminski, 2021). Furthermore, the demand for green finance jobs is already increasing, a trend that is predicted to continue. Currently, financial service firms are not doing enough to upskill their existing workforce and new entrants will not be sufficient to close the skills gap (PwC, 2023). To ensure the financial services sector can realise the opportunities from the transition to a clean economy, the Government must build working groups with the Transition Finance Council, financial institutions, professional services firms, academics, regulators and the education sector to increase the number of experts to develop concrete proposals to fill this skills gap (TFMR, 2024).

**There are several actions the Government could take as part of an Industrial Strategy to address these shortages. As per the commitment stated in the Industrial Strategy Green Paper, a detailed plan is needed that identifies which sectors will require additional workers and a change in skills. This will help deliver the certainty required for businesses to invest in training their workforce.** The Government should specifically include a section or separate publication on the jobs and skills required for the net zero transition. This should build on the work of the CCC (2023) in estimating the jobs that will be required for delivering net zero and should go beyond the sectors identified in the Industrial Strategy Green Paper to

include an assessment of job requirements for delivering adaptation action in the UK and internationally, building on the analysis conducted by Ricardo Energy & Environment (2017).

**The plan should also set out ambitious steps that the Government will take in identifying sectors that will decline in the transition to net zero and how investments will be made to ensure the workforce in those sectors are supported to transition to alternative employment.** The strategy should take a place-based approach to ensure places that have a high concentration of declining industry are supported in the transition to avoid repeating failures of previous economic transitions and mitigate the risk of high unemployment rates (Green Jobs Taskforce Report, 2021). This should take account of lessons learned from the EU's Just Transition Fund. The UK's policy banks, notably the National Wealth Fund and the British Business Bank, could also learn lessons from the ways in which the European Investment Bank has supported the EU's just transition efforts. The Transition Finance Market Review (2024) identified the use of diagnostic tool development by Multilateral Development Banks in showing where jobs will be lost in the transition. The strategy should take into account the opportunities identified in individual subsectors, as we set out in our response to Question 4.

**The Government should also consider providing additional resources for training and developing the public sector workforce.** In particular, this should involve increasing support for local authorities, regulators and planning authorities to respond to the impacts of climate change on local economies and how responses can and should be planned (see our recommendations for embedding climate considerations into decision-making in the UK's planning system in our submission to the Ministry of Housing, Communities and Local Government [Grantham Research Institute, 2024]). Additional resources are particularly key for maintaining local resilience against the impacts of climate change through the implementation of adaptation measures. Further, as noted by the 2021 Green Jobs Taskforce, the Government and education providers should ensure that teachers have the expertise to teach about climate change in STEM and other key subject areas.

## Data

### 12. How can the UK government best use data to support the delivery of the Industrial Strategy?

The Government should explore both well-established and innovative sources of data to inform its Industrial Strategy. See our answer to **Question 2** for a relevant discussion.

## Regulation

### 20. Do you have suggestions on where regulation can be reformed or introduced to encourage growth and innovation, including addressing any barriers you identified in Question 7?

**We are supportive of the fact that the UK Government plans to examine the regulatory environment faced by firms**. In line with the general recommendations outlined in **Question 1**, we recommend that as part of this examination, the UK Government pays attention to ensuring that the regulatory environment supports and enables the economy-wide transition to net zero and climate resilience. Building blocks of such a supportive regulatory environment could include:

- **An acceleration and strengthening of the ecosystem of regulation and supervision related to green and transition finance.** There is a need to significantly accelerate the implementation of policies that are already underway, such as the roll-out of International Sustainability Standards Board and Transition Plan Taskforce-aligned disclosure requirements (see below). But there are also important gaps in the existing and announced policy landscape. For example, questions around how transition plans will be assessed and supervised, both individually and collectively, remain

unanswered (see below). In this context, there is a critical need for greater coordination and alignment between the efforts of the financial conduct and market regulators (e.g. the Financial Conduct Authority, Competition and Markets Authority, the Financial Reporting Council and the Bank of England) and sectoral regulators (e.g. Ofwat and Ofgem).

- **Introducing regulatory incentives for sustainable and transition finance.** Government must use many different levers – regulatory, fiscal, administrative – in a coordinated way to encourage investment in the transition. Such coordination may require changes to the prudential framework to counter the status quo bias within existing rules and integrate the long-term transition risk perspective. Furthermore, the Government should consider sandboxing approaches that support risk-pooling for transition investments by SMEs.

- **Mandatory disclosure requirements on sustainability-related risks and opportunities and transition plans.** We welcome that during her first Mansion House speech the Chancellor restated the general election manifesto commitment that the UK Government will consult on introducing disclosures in line with UK Sustainability Reporting Standards, based on the International Sustainability Standards Board's inaugural S1 and S2 Standards. We strongly encourage the Government also to mandate disclosures in line with the guidance developed by the Transition Plan Taskforce (TPT), as recommended by the Transition Finance Market Review (TFMR, 2024). Disclosure of transition plans is a critical prerequisite for a financial ecosystem that supports the transition towards net zero and climate resilience, as this provides lenders, insurers, asset managers and other financial institutions with the information required to manage risks, identify opportunities and make better capital allocation decisions. The resources developed by the TPT were developed in partnership with companies, financial institutions and regulators and contain recommendations that have been internationally recognised as best practice. The Government should move ahead with implementing mandatory disclosures in line with these recommendations in parallel to consulting on the wider approach to implementing the manifesto commitment.

- **Implementing the manifesto commitment on 1.5 degree-aligned transition plans.** Disclosure will not, by itself, be sufficient to ensure that private sector action is aligned with, and supports, the Government's objectives of reaching net zero and climate resilience. We are therefore supportive of the manifesto commitment to introduce further requirements to ensure that transition plans are aligned with a 1.5-degree trajectory. Such a requirement will raise new questions of policy design (e.g. How will such alignment be determined at the entity-level? Who will be responsible for the assessment of alignment? What are the consequences for firms whose transition plans are deemed misaligned?). These are themes that CETEx plans to explore in evidence-based research and analysis over the coming months, and we would welcome continued engagement with the UK Government in the context of that work.

- **Streamlining requirements by embedding transition plans across policy instruments.** The UK Government could go further in both simplifying the regulatory ecosystem and streamlining incentives for companies by embedding private sector transition plans into a whole range of policy applications (TPT, 2024). For example, transition plans could be used to determine access to subsidies or tax incentives, assess eligibility for large public procurement contracts, inform the provision of loans, guarantees and other financial products by public financial institutions or inform decision-making on planning permissions for large developments. This could replace existing climate-conditionalities across a range of these instruments, which are often intended to support a similar objective but differ across different policy areas, increasing complexity for companies. For example, requirements to publish Carbon Reduction Plans under procurement rules differ from net zero-related KPIs applied by the UK's public financial institutions. The roll-out of transition plan requirements provides an opportunity to tie these various policy tools to the same underlying

instrument. This would increase simplicity for companies, while also amplifying the incentives to develop and implement credible transition plans.

- **Introducing regulation supporting high-quality standards related to the use of 'sustainability' and 'ESG' labels to reduce greenwashing risk.** The Government should accelerate implementation of rules related to strengthening governance standards related to ESG for services providers, including their accountability to users, and introduce mandatory disclosure standards regarding ESG rating methodologies. While introducing a UK-based taxonomy regulation could be helpful in clarifying the categories of a 'sustainable' project, the Government could also provide guidance on such categories directly by developing ambitious sectoral policies.

- **Developing the regulatory infrastructure that supports high integrity voluntary carbon and biodiversity credit markets.** Recognising the value of the already existing Woodland Carbon Code, Peatland Carbon Code and Biodiversity Net Gain legislation, the UK could take further regulatory action to enable the development and upscaling of high integrity voluntary carbon and biodiversity credit markets. Steps could include: adopting criteria to which accepted methodologies or claims must adhere; mandating reporting and transparency requirements; maintaining public registries of projects; introducing approved methodologies; and introducing requirements around third-party verification and reporting (see for example the recommendations of the Demand Working Group of the International Advisory Panel on Biodiversity Credits [IAPB, 2024]). These actions could follow existing examples such as the recently established Australian Nature Repair Market (DCCEEW, 2024), or the voluntary biodiversity credit market that was announced by the French Government in November 2024 (Environmental Finance, 2024). As underlined in the recommendations of the IAPB Demand Working Group, such actions should be coupled with further policies to stimulate demand for voluntary schemes, such as the introduction of mandatory requirements for private sector actors to invest in nature.

## Mobilising capital

### 23. The UK government currently seeks to support growth through a range of financial instruments including grants, loans, guarantees and equity. Are there additional instruments of which you have experience in other jurisdictions, which could encourage strategic investment?

**The Industrial Strategy should promote the role of public and private institutions in delivering its goals and ambitions.** The creation of the National Wealth Fund and abundance of experience in the UK's existing public financial institutions are positive foundations for effective policymaking in this Industrial Strategy. Below we set out some specific actions the Government should consider for integrating public financial institutions into industrial policymaking.

**The Government, in developing its growth-driving sector plans, should ask UKRI, British Business Bank (BBB), UK Export Finance and the National Wealth Fund (NWF) to work together to develop 10-year strategies for how they will proactively support sectors at different stages of their development** (Jameson, 2024). The exact combination of coordination across these organisations will depend on the maturity and profile of the subsector in question. These plans should aim to identify where there are opportunities for the NWF or BBB to support the development of these sectors, for example by providing patient financing for innovative companies and projects or mobilising private capital through the strategic deployment of blended finance structures or risk mitigation instruments (e.g. loan guarantees, first-loss provisions). These plans should take account of the distributional and regional implications of net zero and climate impacts to support a just transition across the UK.

**The Government should use this collaboration to ensure a cohesive offer is presented to any project sponsors.** This would enable it to consider the correct mixture of loans and

grants to develop sectors and address any market weaknesses and is particularly important given the change to the UK's fiscal framework to better reflect the returns on public sector financial investments. Collaboration between policy institutions and central government would follow similar models in other European countries, including the development bank KfW in Germany, whose Group-wide Impact Management sets out how it invests to achieve reduced greenhouse gas emissions and increased resilience to climate change. KfW has also produced Sector Guidelines that are designed to steer its activities according to the targets of the Paris Agreement.

**The policy banks should be permitted to seek investment opportunities proactively and it should not be explicitly required that the organisation must be 'additional'; instead, it should be allowed to invest where the market is hesitant (if not fully unwilling) to invest.** Waiting for obvious signs of market failure may mean acting too late, justifying a focus on addressing market weakness, rather than just failure. The Government should weigh the risk of crowding-out private investment where projects may fall under the risk/return profile of parts of the private market against the cost of delayed action as a result of an underdeveloped market. This should be captured within the sectoral plans and should be considered on a case-by-case basis.

**The process of collaborating between policy banks and sectoral investment plans should be coordinated by a central team within Government who have experience of public and private investment,** as recommended by Gordon (2023). This team should coordinate with public and private stakeholders (including across central government and local authorities) and have the power to request and share information with these organisations to maximise the potential for successful market interventions and preventing delays to progress. This central team should also hold responsibility for evaluating previous examples of blending finance projects for what has been effective, and where improvements can be made. It should be clear what the team's priorities are, and their remit should include recognising the value of investing in the low-emission economy and adaptation measures.

# Partnerships and institutions

### 30. How can the Industrial Strategy Council best support the UK government to deliver and monitor the Industrial Strategy?

**The formation of an Industrial Strategy Council is a promising move.** Including the Council in legislation will be a positive step towards ensuring its independence and longevity, and encouraging members to rotate will mitigate falling enthusiasm and engagement. However, as acknowledged by the Institute for Government (IfG, 2024), there is a need for further clarity about the powers of the Council and how its 'plans' will help businesses take long-term decisions.

**Following the IfG's conclusions, the Council should learn from the lessons of the previous Industrial Strategy Council.** The role of the Council should be to support the Government to deliver its Industrial Strategy. Once established, the strategy should be taken as it is: the Council should assist in its development but should avoid publicly critiquing it after publication. Commenting on the overall strategy risks undermining the ability of the Government to create a pro-business environment. The Council should therefore instead act as an advisor on the most effective way of delivering the strategy and monitor the Government's progress in delivering against its ambitions, taking the core ambitions in the Government's strategy as given.

**To ensure the Council is effective in helping the strategy deliver for the UK's transition to a net zero, resilient economy, we recommend that its core role should include coordinating between the Government and the business community, interpreting the practical implications for businesses.** For example, as the Government implements the Manifesto Commitments on transition plans, the Council could play a role in advising the Government on how to construct the conditions that will enable businesses to meet this requirement. The Council should also provide expert advice on specific questions the Government asks of it, such as reviews into barriers facing specific subsectors/markets.

**We also recommend the Council helps other institutions, including the Climate Change Committee and the National Infrastructure and Service Transformation Authority (NISTA), to understand the impact of the strategy on their remits.** The remit of the Council should reflect existing legislated commitments for the Government, including net zero and adaptation targets. This should prevent conflicting priorities across organisations and help avoid duplication of progress-monitoring.

**For the Council to be successful, we recommend it is staffed by a strong secretariat responsible for these core functions.** We also recommend that it does not solely report to the Chancellor and Secretary of State for Business and Trade but also to the Secretary of State for Energy and Net Zero, particularly on progress in energy and infrastructure.

**In the understandable absence of clear, legislated goals (like the net zero target), it is hard to envisage the legal strength behind the CCC's framework will be replicated in this context.** The Council should instead rely on the reaction of the business community as an indicator of the strength of the strategy. It is also therefore the responsibility of the Chancellor and supporting Secretaries of State to maintain the momentum of the Council and use policy leavers accordingly.

# Theory of change

### 33. How could the analytical framework (e.g. identifying intermediate outcomes) for the Industrial Strategy be strengthened?

**As outlined in Question 1, climate change is a structural factor that is of fundamental importance to the Government's Growth mission.** It is therefore good to see 'sustainability' embedded in the overarching objectives defined in the Theory of Change. We recommend that additionally, the climate considerations are explicitly included in the definition of the outcomes, recognising that successful sectors, places, markets, people and institutions all require a stable climate and a well-adapted UK. This should also then flow through to inform the intermediate inputs, outputs and outcomes.

### 34. What are the key risks and assumptions we should embed in the logical model underpinning the Theory of Change?

**The physical impacts of climate change and a 'bumpy' transition towards net zero and climate resilience globally will mean that there are many areas where past experience is not a reliable basis for assumptions about the future.** We strongly recommend that in defining key risks and assumptions in the logical model underpinning the Theory of Change, the Government pays attention to any underlying climate-related assumptions (e.g. regarding the time by which key technologies will be cost-effective and available at scale), along with the impact of key climate-related risks to other assumptions embedded in logical models. For example, on assumptions related to future levels of labour productivity, risks arising from the impacts of high temperatures should be considered. Similarly, assumptions related to trade patterns should be considered in light of the risk of climate-related losses in other economies which can lead to a negative impact on demand for UK goods and services and the rising likelihood of extreme weather events that trigger supply chain disruptions. The analysis conducted by Rising et al. (2022) can provide a useful starting point for considering the various impact channels through which climate-related risks are likely to impact various assumptions underpinning the Theory of Change.

# Additional information

## 36. Is there any additional information you would like to provide?

**Building resilience to climate change, and investment for a well-adapted UK, should be a core cross-cutting theme in the Industrial Strategy.** The UK's Third Climate Change Risk Assessment found that adaptation to climate change had not been mainstreamed into previous industrial strategies (Surminski, 2021). The focus of this Industrial Strategy is on place-based growth opportunities and addressing local constraints. It is therefore critical that adapting to climate change is a cross-cutting theme in its development.

**Climate risk and adaptation are drivers of economic outcomes, with particular sectors exposed to risk from climate change.** In its 2024 *Fiscal Risks and Sustainability Report*, the Office for Budget Responsibility estimates the potential fiscal costs of climate damage. It considers a rise in global temperatures between below-2 degrees and 3 degrees Celsius above pre-industrial levels to present a central (rather than reasonable worst-case) scenario of climate change. It also focuses on costs from heatwaves, river and surface flooding, coastal flooding and erosion. The OBR does not account for more catastrophic risks (e.g. the melting of the Greenland ice sheet) or the transmission of the economic impact of more dramatic changes in climatic conditions elsewhere in the world to the UK economy via trade, investment and migration. Regardless, its central estimates are that real GDP will be around 3% lower by 2074 in a below-2-degree world and 5% lower by 2074 in a below-3-degree scenario. These are in the range of credible studies in the literature, although are still likely to be an underestimate. A warming climate will also likely increase future fiscal pressures directly, through heightened demand for emergency and other public services, damage to publicly owned infrastructure and other assets, and the potential costs of compensating uninsured households and businesses.

**Other studies take a broader look to include the economic impacts of additional transmission channels.** Rising et al. (2022) find that the largest future economic costs to the UK are likely to be through catastrophic disruption to the global economic system, trade impacts, impacts to agriculture, droughts and flooding, health impacts of extreme heat and the impacts of sea level rise. The paper projects that, under current policies, the total cost of climate damages to the UK is projected to increase from 1.1% in 2022 to 3.3% by 2050 and 7.4% by 2100.

**The Industrial Strategy should reflect that failing to address climate risk and investing in adaptation action would threaten the goals of the strategy, including current and future economic growth.** It would also fail to recognise the opportunities that can arise from investing in adaptation action. The UK is in a strong position to benefit from adapting to the impacts of climate change, with the opportunities not limited to addressing the cost of inaction. UK skills, services and technologies can be used to support adaptation efforts at home and internationally.

**The Industrial Strategy should therefore recognise climate risks as a potential barrier to economic development and identify which of the priority sectors could fail to reach its established goals because of domestic and international climate shocks.** This will be particularly relevant for energy and infrastructure (particularly transport connectivity and energy infrastructure), and financial services (particularly the insurance sector and parts of the sector exposed to international financial markets).

**The strategy should also identify opportunities to work with these sectors to build resilience against climate change.** This includes opportunities for investing in adaptation measures and climate risk assessments. The strategy should therefore consider the additional skills that will be required to understand climate risk and implement adaptation measures in the key sectors identified in the Green Paper, including clean energy industries, digital and technologies (e.g. harnessing technology for early warning systems), financial

services and professional and business services. Opportunities in sectors including construction and infrastructure should also be identified and pursued.

**Finally, indicators should be included of the impact of climate risk as part of the monitoring and evaluation process of the Industrial Strategy, to identify how climate change impacts the economy, with a particular focus on the core sectors identified in the Industrial Strategy Green Paper.** Monitoring the impacts of climate change on labour productivity in these sectors, potential supply chain disruptions, costs of inputs and the impacts to export and import demand can help identify where worsening climate impacts could undermine the goals of the Industrial Strategy.

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# Appendix: Green industrial policy matrix

*(Underpinning analysis is available in Serin et al., 2024)*

| | Opportunities for growth | | | Strategic importance | | Distributional aspects | |
|---|---|---|---|---|---|---|---|
| | **Global tradeable market potential[1]** | **Comparative advantage (trade)** | **Comparative advantage (technology)** | **Domestic demand under net zero[2]** | **State of global supply chain[3]** | **Job creation potential[4]** | **Places – regional spread of opportunities** |
| **Buildings** | **Medium* (higher in the nearer term)**<br>EINA (2019)[5] estimate of global tradeable market for building fabric: £6bn by 2050.<br>For low-carbon heating and cooling: £34bn by 2050.<br>Combined: £40bn by 2050. | **No export specialisation on aggregate** but specific strengths in non-domestic heat exchange units and thermal insulation materials. No current specialisation in heat pumps but they present a highly complex and proximate opportunity. | **No innovative specialisation on aggregate** but specific strengths in heat pumps, energy efficient HVAC, solar heating or cooling and thermal insulation. | **Likely high in the near term and beyond**<br>Warm Homes Plan: aims to drive energy efficiency upgrades and low carbon heating installations in homes, with initial funding confirmed in Autumn Budget 2024. | **Diversified supply chain with UK among top exporters**<br>UK is the tenth largest exporter despite a modest 2% share. China leads but there is a diverse set of other countries (e.g. US, Germany) to trade with. | **High* (mainly from domestic market)**<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: ~30,000 (building fabric) and 43,000 (heating and cooling)<br>By exports: 4,000 (building fabric) and 7,000 (heating and cooling)<br>Total: 84,000 | Well-spread across the UK but London and the South East still hold greatest share of activity. |

1 Only indicatively assessed.
2 As above.
3 As above.
4 As above.
* Relative to other technologies in the table.
5 EINA (2019 refers to the Energy Innovation Needs Assessments of 2019 commissioned by the former Department for Business, Energy and Industrial Strategy.

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| **CCUS** | **Large***<br>EINA (2019) estimate of global tradeable market for CCUS: £188bn by 2050. | **Yes** – among the most specialised exporters globally, with notable strengths in machinery for filtering or purifying gases; types of iron or steel pipes; pumps and compressors; measurement and monitoring instruments; and surveying equipment.<br>Only category other than nuclear where UK has specialisation on aggregate. | **Yes** – the 10th most specialised innovator globally, with specialisation in almost all sub-categories. Notable strengths relate to capture technologies (for $CO_2$ and some other GHGs) and applications of CCUS specifically in metal processing and gas power generation. | **Likely high in the near term and beyond**<br>Up to £22bn of funding committed, over 25 years, to develop CCUS at scale in two clusters. | **Diversified supply chain with UK among top exporters**<br>UK is the eighth largest exporter with a 3.6% share. China leads but several countries in Europe as well as Japan, Korea and Mexico also among top exporters, suggesting good optionality. | **High* (mainly from export market)**<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: ~6,000 (exact figure for 2050 not provided)<br>By exports: 48,000<br>Total: 54,000 | **Warrants special attention from perspective of regional growth**<br>Activity concentrated in Yorkshire and the Humber (home to industrial activities along the East Coast). |
| **Green hydrogen** | **Small***<br>EINA (2019) estimate of global tradeable market for electrolysis and fuel cells: £20bn by 2050 (in a high-demand scenario). | **No export specialisation on aggregate** or in electrolysers within that, but strengths and opportunities in various types of electric motors and generators which could be relevant for / transferable to the | **No innovative specialisation on aggregate** but specific strengths in hydrogen production from non-carbon containing sources (inc. electrolysis), hydrogen distribution, hydrogen storage as well as certain types of fuels cells. | **Likely modest in the near term, potentially higher in the longer term**<br>Autumn Budget 2024 confirmed contracts with 11 green hydrogen producers. | **Diversified supply chain but UK not a top exporter**<br>UK is not a top exporter, with a 2% share. China leads with over 20% share but a set of other substantial exporters exist, spread widely geographically. | **Medium* (mainly from domestic market, hinges on large-scale domestic deployment)**<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: 15,000<br>By exports: 3,600<br>Total: 18,600 | **Warrants special attention from perspective of regional growth**<br>Opportunities well-spread across the UK and particular importance for industrial heartlands. |

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| | | manufacturing of fuel cells. | | | | | |
| **Grid flexibility and smart systems** | **Large***<br>EINA (2019) estimate of global tradeable market for smart systems: £144bn by 2050. | **No export specialisation on aggregate** and only couple of existing strengths (which are small areas of global trade). No current specialisation in most types of batteries but opportunities lie in few specific types and other electrical equipment that are complex and proximate to UK capabilities. | **No innovative specialisation on aggregate** or in sub-categories of energy storage (or batteries within that). However, specific strengths lie in digital capabilities e.g. use of ICT in system operation, demand-side response and data transmission between smart grids. | **Likely high in the near term and beyond**<br>NESO clean power 2030 pathways see a four- to five-fold increase in demand flexibility and an increase in grid connected battery storage from 5 GW to over 22 GW. | **Strong dominance of a single supplier (China) and UK not a top exporter**<br>UK is not a major exporter, with 1.5% share. China holds an almost 40% share – its greatest share across the seven categories. | **Medium***<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: 10,000<br>By exports: 14,000<br>Total: 24,000 | Well-spread across the UK but London and the South East still hold greatest share of activity. |
| **Nuclear** | **Medium***<br>EINA (2019) estimate of global tradeable market for nuclear fission: £36bn by 2050. | **Yes** – among the most specialised exporters globally, with notable strengths in reactors and fuel fabrication.<br>Highest export specialisation for the UK among the seven categories. | **Yes** – among the most specialised innovators globally, with specialisation in majority of sub-categories. Notable strengths relate to fuel fabrication, plant O&M, and nuclear fusion (e.g. Tokamaks). | **Likely moderate in the near term, potentially higher in the longer term**<br>Autumn Budget 2024 stated that new nuclear will play an "important role" in helping the UK achieve energy security and clean power. | **UK itself and several of its European trading partners among top exporters**<br>UK is the fourth largest exporter with 8% share. Several of its European trading partners among the largest exporters. | **High* (predominantly from domestic market, hinges on large-scale domestic deployment)**<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: 130,000<br>By exports: 8,300<br>Total: 138,300 | **Warrants special attention from perspective of regional growth**<br>Activity in various regions, likely concentrated around existing and proposed plants. |

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| **Offshore wind** | **Medium***<br>EINA (2019) estimate of global tradeable market for offshore wind: £40bn by 2050. | **No export specialisation on aggregate** but **specific strengths (e.g. in floating structures)** which are relevant for floating offshore wind, as well as various potential opportunities (for example, in steel or iron structures and types of electrical equipment). | **Yes** – the fourth most specialised innovator globally, with specialisation in majority of sub-categories. Notable strengths relate to floating offshore wind (e.g. floating structures and mountings on floating structures) as well as diagnostics of wind motors. | **Likely high in the near term and beyond**<br>NESO clean power 2030 pathways see between 43-50 GW of offshore wind by 2030. | **Diversified supply chain but UK not a top exporter**<br>UK is a small exporter with 1.4% share. China leads on export volume but otherwise diversified supply chain inc. Germany, Japan and US among top exporters. | **High***<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: 21,000<br>By exports: 21,000<br>Total: 42,000 | **Warrants special attention from perspective of regional growth**<br>Activity concentrated in Scotland (and manufacturing firms exceed service firms – a unique feature of this category). |
| **Tidal stream energy** | **Small* (constrained by natural resource)**<br>EINA (2019) estimate of global tradeable market for tidal stream: £13bn by 2050. | **No export specialisation on aggregate** but **specific strengths in many complex products including turbines** and types of engines and motors, as well as in floating structures. | **Yes** – the third most specialised innovator globally, with specialisation in almost all sub-categories. Notable strengths include floating structures and submerged foundations.<br>Highest UK innovative specialisation among the seven categories. | **Relatively small overall potential but rapid growth expected**<br>No explicitly stated deployment target but over 130 MW by 2029 set to be operational (from ~10 MW now). | **Diversified supply chain but UK not a top exporter**<br>UK is a small exporter with 1.5% share. Five countries incl. China (and Germany and US – UK's major trading partners) account for over half of global export volume. | **Low***<br>EINA (2019) estimate of jobs supported by 2050:<br>By domestic market: N/A<br>By exports: 5,000<br>Total: 5,000 | **Warrants special attention from perspective of regional growth**<br>Activity concentrated in coastal communities and some historically less productive regions. |