Cashing in our Chips

How to strengthen the UK's semiconductor sector

BY GERARD B LYONS AND ZACHARY SPIRO

FOREWORD BY
ALICIA KEARNS MP

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About the authors

Gerard B. Lyons is a Business Researcher at the Centre for Policy Studies, having previously worked in financial and crisis communications. He holds a masters in International Public Policy from University College London and an undergraduate degree from the University of Cambridge. He was a co-author of the Centre for Policy Studies report 'Why Choose Britain?', which looked at the UK's international competitiveness.

Zachary Spiro is a Manager at strategy consulting firm Flint Global. He specialises in R&D policy, emerging technology and economic security, as well as the UK's relationship with China. Prior to Flint, he worked as a Parliamentary Researcher for Sir Bernard Jenkin MP, in his capacity as Chair of the Public Administration and Constitutional Affairs Committee, and was part of the policy team on Boris Johnson's 2019 Conservative leadership campaign. He writes in a personal capacity.

Acknowledgements

The authors would like to thank those who reviewed and helped on this report, not least Tom Clougherty, Samuel Hughes and to Robert Colvile for his careful editing. Any mistakes are the authors' own.

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Foreword

By Alicia Kearns MP, Chair of the Foreign Affairs Select Committee

We have an obvious choice when it comes to semiconductors.

We can either choose to think strategically about developing a cutting edge, growth-boosting, secure and next-generation chip industry, or we can carry on with business as usual and find ourselves dependent on volatile and geopolitically-vulnerable supply chains.

We all felt the global shortage in semiconductors caused by the pandemic, which led to widespread disruption in many industries and caused nations across the world to rethink their access to the chips that are a vital ingredient in everything from advanced weaponry to kitchen appliances. At the time of writing, the UK still lacks any sort of strategic semiconductor programme, giving rise to numerous national security concerns and vulnerabilities within our current supply chain.

'Industrial policy' has remained a taboo phrase in British politics for the past 40 years. However, by failing to support the UK semiconductor sector we are putting British business at risk as other nations seek to build greater resilience into their own supply chains. Even more concerning is that competitor states such as China, which spends more on chips than any other product, are using overseas takeovers to gain access to our technology and undermine our industrial capacity. While we have historically viewed national security and business as largely separated, our rivals have viewed them as two sides of the same coin.

Industrial policy doesn't have to refer to an undesirable predicament in which markets become uncompetitive, dominated by stagnating firms that survive off government handouts. This paper puts forward creative market-driven solutions, leveraging our world-leading domestic industrial strengths and encouraging crucial cross-departmental Whitehall collaboration. Our strategy should be about reducing dependence and delivering policies that strengthen the British economy in the long run.

Our allies are moving in this space – and in a big way. The US has announced significant funding for its chip-making champions and crippling export controls on China, while the EU has also announced an unprecedented level of support to double its global market share in semiconductors by 2030. Alongside these like-minded partners, we must move to reduce our exposure to future disruption in global supplies of semiconductors and build on our key comparative advantages.

In my view, the choice is obvious. We cannot afford to fall behind when it comes to tackling technological dependence on un-democratic states and bolstering our economic competitiveness. As a result, this detailed research makes an incredibly important contribution.

Executive Summary

- A secure supply of high-end semiconductor chips underpins the modern world. Without them, the digital revolution and the dawn of the computer age would have been impossible. These chips, constructed at the scale of nanometres, underpin technology as varied as personal computers, dishwashers, cars, missiles and TVs. They are also vital to future policy and economic shifts: without a reliable supply of high-quality semiconductors, the Net Zero transition or proliferation of AI will likely not be deliverable, just as the wars of the future cannot be won.

- Pandemic-induced industrial shifts and natural disasters elevated the costs of semiconductors from 2020 into 2022, contributing significantly to the rising cost of consumer goods. At the same time increasing geopolitical tension centred on the US-China relationship has drawn attention to areas of critical technology dependence, in particular Taiwan's extraordinary dominance of high-end chip manufacturing. Policymakers around the world have responded: the US, EU and China – among others – have all committed tens of billions to strengthening their domestic industries. The US has also imposed potentially crippling sanctions on the Chinese semiconductor sector.

- Given the global shift towards onshoring (or 'friendshoring') is firmly set, the question for the UK is how and whether it will benefit from this transition. The UK has a nascent semiconductor sector, although it is not currently a major player in traditional silicon chips. It is extremely unlikely that the UK Government could select and nurture a home-grown champion to displace the likes of Taiwan's TSMC, or match that firm's $36 billion in annual capital expenditure. Even the US's huge investment in the sector, not least the billions in subsidies given to TSMC's new fabrication plant in Arizona, is expected to leave it trailing a generation behind the cutting-edge fabs in Taiwan.

- But the UK does have areas of strength in the semiconductor sector, some of which are world leading. If we were to double down on our existing advantages, including early-stage R&D, basic IP, chip design, and create a conducive environment for next-generation semiconductor technologies, we could capture billions of additional GVA for the economy, in a sector for which trade was worth $1.7tn globally in 2019. By working with our allies, we would also boost our collective resilience in a sector that is fundamental to economic stability.

- Boosting the semiconductor sector would also help with the Government's levelling up ambitions. The UK's semiconductor clusters are almost all outside the South East. The sector is also extremely economically productive, with average revenues-per-employee on a par with the most valuable global tech companies.

- The UK Government has been clear that it wants a bolstered semiconductor industry. That is why it imposed national security controls on all significant investments in the sector. However, this has not been backed up with a coherent approach to developing the UK industry. The 2021 Innovation Strategy identified semiconductors

as one of several potential technology families of opportunity for the UK, but limited action has been taken to follow up on those ambitions.

- We argue in this paper that rather than joining the subsidy arms race, or trying to select national champions only to see them crushed by their Taiwanese, American or Dutch rivals, we need to be smart – not least because of the UK's severe fiscal constraints. So, ahead of the Government's publication of its long-awaited semiconductor strategy, this paper sets out a series of proposals that would support the industry, while boosting UK science, industry and innovation overall.

- Crucially our approach is, at its core, market-led. The history of industrial policy is littered with firms who have grown fat on public subsidy, before finally succumbing to market forces. The Government should instead focus on creating an environment which is conducive to growing R&D-intensive sectors – with a particular emphasis on semiconductors.

- Importantly, none of these recommendations requires new primary legislation beyond existing law or what is currently before Parliament. The only exceptions to this are tax measures, which could be implemented via the usual Budget process. This means that the Government could, if it so chose, act immediately to adopt nearly all of these proposals. We encourage them to do so.

- Specifically, we recommend that the Government should:

    - **Introduce tax and investment incentives for high-intensity R&D industries**
        - *The Government should offer a bespoke R&D tax credit for companies in sectors that fall within the 'families of UK strength and opportunity' as set out in the Innovation Strategy. In addition, amendments to the RDA scheme and Patent Box and streamlining the application process for the credits themselves should be considered.*
        - *We should permanently introduce full expensing for non-R&D related plant and machinery, in addition to structures and buildings, for companies in sectors that fall within the 'families of UK strength and opportunity'.*
        - *We should establish an Emerging Technologies Strategic Investment Fund (ETSIF) within the British Business Bank, which actively courts international capital to be invested in the UK's emerging technology industries.*

    - **Improve the immigration system for highly skilled workers**
        - *The UK should expand its High Potential Individual Visa scheme to all advanced degree-holders in STEM fields who are graduates of top 20% ranked universities in allied countries and blocs, such as the European Union, USA, other Five Eyes countries, and Taiwan. The health surcharge should also be waived for these applicants.*
        - *The UK should waive or refund visa application fees and health surcharges for emerging technology companies for employees on a Skilled Worker Visa.*
        - *The UK should actively seek to foster specific mobility arrangements with allied countries for the semiconductor sector, including short-term work placements, knowledge exchanges and fellowships.*

    - **Add flexibility to the planning system to encourage the construction of scientific infrastructure**
        - *HMG should use the powers in the Levelling Up and Regeneration Bill to issue national development management policies affecting laboratory and industrial*

construction which have supremacy over local plans.

- *HMG should amend the NPPF such that, for areas within three miles of university campuses, there shall be a presumption in favour of laboratory development.*
- *HMG should amend Section 44 of the NPPF to reduce local authority discretion over local information requirements for laboratory or industrial planning applications, and introduce clauses elsewhere in the NPPF to encourage national standardisation.*
- *Relevant governments should issue development orders granting permitted development rights in areas identified as semiconductor clusters.*
- *HMG should update the Permission in Principle Order to allow for development of laboratories or research space on brownfield sites.*

- **Strengthen the focus on semiconductor policy within Whitehall**
  - *The Science Secretary should order UKRI and Innovate UK to create a specific multi-year fund for the semiconductor sector, using money already allocated in the 2021 Spending review and matched with private investment.*
  - *The Science Secretary should oblige UKRI and its funding councils to 'have regard' to the technology families of the Innovation Strategy and to the priorities of the Integrated Review when making funding decisions.*
  - *Given the UK's investment clearance apparatus is no longer in a growth-oriented department, the Chancellor of the Duchy of Lancaster should create a formal forum for the departments for science and business to provide input into national security investment decisions. The National Science and Technology Council (NSTC) should actively coordinate semiconductor and other emerging technology policy across Government. The NSTC should publish a formal, public and clear statement of national security policy as it relates to emerging technology investment and development. To operate effectively, the NSTC should also meet at least twice monthly. A business engagement unit should be established in DSIT to advise businesses on the potential national security risks of academic partnerships.*

Introduction

The technological achievements of the past half-century have been built on a stable and increasingly sophisticated supply of semiconductors: materials with intermediate electrical conductivity which are vital building blocks of the integrated circuit. Without them, the digital revolution and the dawn of the computer age would have been impossible: a steady and high-quality supply is necessary to manufacture goods as varied as dishwashers, mobile phones, computers, missiles, cars and TVs.

For the next set of major economic shifts, semiconductors will again be crucial. Delivering the Net Zero transition, making the most of the coming AI revolution, quantum computing technology and developing and deploying cutting-edge weaponry will all be hampered to the point of impossibility if the supply of computer chips is fragile or unreliable.

‘Global trade in semiconductors in 2019 alone was $1.7tn, and R&D and capital spend over the next decade is estimated to be $300bn annually’

In the words of Pat Gelsinger, CEO of Intel: ‘*Over the last five decades the location of oil reserves has defined geopolitics… Where technology supply chains are will be more important for the next five decades.*’[1]

Precisely because it is so important, the semiconductor industry is extraordinarily valuable. Global trade in semiconductors in 2019 alone was $1.7tn, and R&D and capital spend over the next decade is estimated to be $300bn annually.[2]

However, the intricate logistical network via which semiconductors are assembled is also alarmingly vulnerable. The world is in the process of recovering from a global chip shortage that started in 2020 and ran into mid-2022, caused by sudden shifts in manufacturing patterns during the pandemic (as carmakers and other firms cancelled orders in the face of a global economic shutdown, only to find themselves scrambling for chips as normality resumed, while demand for products such as laptops to work from home surged).[3] There were also freak weather events, such as the Texas snowstorms in early 2021 which caused chip factories to be shut down.[4] Evidence suggests that the chip shortage also contributed to the global increase in inflation: by September 2021, prices in manufacturing industries dependent on semiconductors had risen 4% faster than those that did not rely on the chips.[5]

1 The Times, *Downturn won’t end chip shortage, Intel boss warns: 18 January 2023.* Link

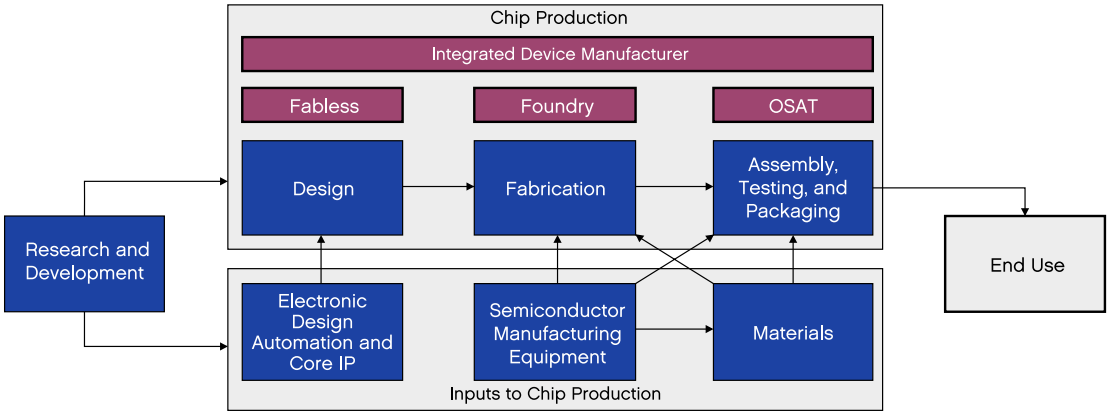
2 Semiconductor Industry Association & BCG, *Strengthening the global semiconductor supply chain in an uncertain era.* Link

3 Reuters, *Home work triggers demand jump for chips, laptops and network goods: 23 March 2020.* Link

4 The Verge, *Samsung forced to halt chip production in Austin due to power outages: 17 February 2021.* Link

5 Federal Reserve Bank of St Louis, *Did the Computer Chip Shortage Affect Inflation?.* Link

Figure 1: The semiconductor supply chain



Source: Centre for Security and Emerging Technology – The Semiconductor Supply Chain: Assessing National Competitiveness

This fragility is exacerbated by the nature of the semiconductor supply chain. While the supply chain has connections all over the world, the superficial impression of a heavily diversified industry is not accurate. Globalisation has not resulted in multiple suppliers at each point in the value chain competing with each other for clients, with resilience to disruption. Instead, it has created an industry with extremely tight bottlenecks all over the world. As a result, it is not unusual for the dominant companies at different stages of the manufacturing process to often have more than 75% of the global market share. For example:

- 95.5% of global electronic design automation software is produced in the United States[6]
- 100% of Extreme Ultra-Violet lithography scanner manufacturing capacity is in the Netherlands[7]
- 87.9% of wafer handling machinery manufacturing capacity is in Japan[8]
- Most crucially, 92% of high-end sub-10nm node fabrication is in Taiwan[9]

With rising geopolitical tension around Taiwan, as well as the experience of the past two years, it is unsurprising that governments around the world have devoted increasing attention to securing their own semiconductor supply chains.

At the forefront of these efforts is the United States. Last year, the US government passed legislation allocating tens of billions of dollars in direct semiconductor manufacturing subsidies, grants and tax incentives. The stated purpose of this funding is to improve resilience. But more forthrightly, the aim is also to onshore the sector to the United States.

6 Figure 24, Center for Security and Emerging Technology, *The Semiconductor Supply Chain: Assessing National Competitiveness.* Link

7 Figure 17, Ibid.

8 Figure 18, Ibid.

9 Exhibit 17, Semiconductor Industry Association & BCG, *Strengthening the global semiconductor supply chain in an uncertain era.* Link

In parallel, the US has also imposed waves of tough global sanctions on the Chinese semiconductor sector, introducing onerous export licence requirements, targeting competitors by name[10], and causing some firms to stop working with Chinese clients.[11] In the words of one analyst, the Biden administration is attempting to *'so deeply undermine China's semiconductor fabrication capabilities that it won't matter how motivated or well-resourced China's efforts are to create its own semiconductor industry – they simply won't be able to catch up.'*[12]

Case Study: The US CHIPS and Science Act

In 2022, the US passed the CHIPS and Science Act into law. In addition to substantial investments in basic R&D, it also constitutes an injection of more than $70bn into the US semiconductor sector.[13] This includes:

- A $39bn 'Chips for America' fund, of which $31bn is direct investment. The remainder is legacy chip subsidies and loan financing.
- At least $11bn for advanced semiconductor R&D, distributed via specialised funds and research institutes named in the legislation.
- An Advanced Manufacturing Tax Credit, estimated to cost $24bn over the life of the programme and worth 25% of qualifying investment.

In order to qualify for the funds or tax credits, companies must be based in the US, and refrain from expanding semiconductor manufacturing in certain countries (including China) for at least ten years after receiving them.[14]

The US is not acting in isolation. China is also thought to be preparing over $100bn in funding announcements to subsidise its own semiconductor sector.[15] Meanwhile, the European Union is also in advanced stages of drafting its own Chips Act to coordinate industrial policy across member states, worth an estimated €43bn, of which €15bn will be new public and private investment and a further €11bn will support large-scale capacity building.[16] Added to this, South Korea is pursuing its 'K-Semiconductor Belt' strategy, which aims to build the world's largest semiconductor supply chain by 2030,[17] while Japan started a $338 million research initiative in 2021 and has since approved a further $6.8 billion in funding for its domestic semiconductor sector.[18]

While the scale of direct funding is unusual, the fact of it is not. The semiconductor industry has historically relied on government support and is extremely capital intensive, with long production and research cycles. American semiconductor pioneers Fairchild Semiconductor and Texas Instruments both relied heavily on

10 FT, *US targets China's potential chip starts with new restrictions: 21 December 2022.* Link

11 FT, *World's top chip equipment suppliers halt business with China: 13 October 2022.* Link

12 Carnegie Endowment for International Peace, *Biden's Unprecedented Semiconductor Bet.* Link

13 Mckinsey, *The CHIPS and Science Act: Here's what's in it.* Link

14 PwC, *The CHIPS Act: What it means for the semiconductor ecosystem.* Link

15 Al Jazeera, *China readying $143bn package for chip firms in face of US curbs: 14 December 2022.* Link

16 European Commission, *European Chips Act.* Link

17 BEIS Committee Inquiry, The Semiconductor Industry in the UK, *Written submission from The Society of Motor Manufacturers and Traders (SMMT).* Link

18 Ibid.

federal contracts with NASA and the Department of Defense in their early years.[19] Taiwan's modern dominance of high-end manufacturing was also built on years of careful government subsidy. The Taiwan Semiconductor Manufacturing Company (TSMC), currently the world's most valuable chip company,[20] had 48% of its start-up capital provided by the Taiwanese government, with a large portion of the rest *'raised from wealthy Taiwanese who were "asked" by the government to invest'.*[21]

'The question for the UK Government is simple: what role will it play in this dangerous new world? A passive bystander – or an active player?'

In short, the next phase of the global semiconductor supply chain is increasingly coming into view. The nations of the West are attempting to develop their own semiconductor capacity, not least as an insurance policy against a Chinese invasion of Taiwan – whatever the reality of that prospect is – while China is attempting to build its own rival capacity. In the words of Morris Chang, founder of TSMC, as far as chips are concerned: *'Globalisation is almost dead and free trade is almost dead.'*[22]

The question for the UK Government is simple: what role will it play in this dangerous new world? A passive bystander – or an active player?

The UK's domestic semiconductor sector and industrial strategy

The UK does not have a substantial traditional silicon chip manufacturing capacity. And, if we are being realistic, the odds of government policy developing one are extremely low. Imagine writing the business case for the British state trying to build its own competitor to TSMC, from a standing start, and somehow matching not only its decades of expertise but its $36 billion in annual manufacturing investment.[23] Or likewise trying to compete with the Netherlands in developing the cutting-edge lithography machines that are required to produce the most advanced chips.

However, the UK does have internationally recognised strengths in other, more competitive parts of the sector. These include:

- World-leading chip design companies, including Arm and Imagination. These contribute to the UK's role as a major player in chip design, accounting for 43% of core global IP.[24]

- Globally competitive next-generation compound semiconductor design and R&D companies. Although compound chips (so named because they are based on compounds of different elements, rather than just silicon) currently only constitute 20% of global semiconductor trade, their superior characteristics mean demand is expected to significantly grow in coming years.[25]

19 pp19-22, Chip War – Chris Miller, 2022.

20 Reuters, *Taiwan's TSMC to build Arizona chip plant as US-China tech rivalry escalates: 14 May 2020.* Link

21 p167, Chip War – Chris Miller, 2022.

22 Nikkei, *TSMC founder Morris Chang says globalization 'almost dead': 7 December 2022.* Link

23 Focus Taiwan, *TSMC cuts capex to $36bn on short-term market uncertainty: 13 October 2022.* Link

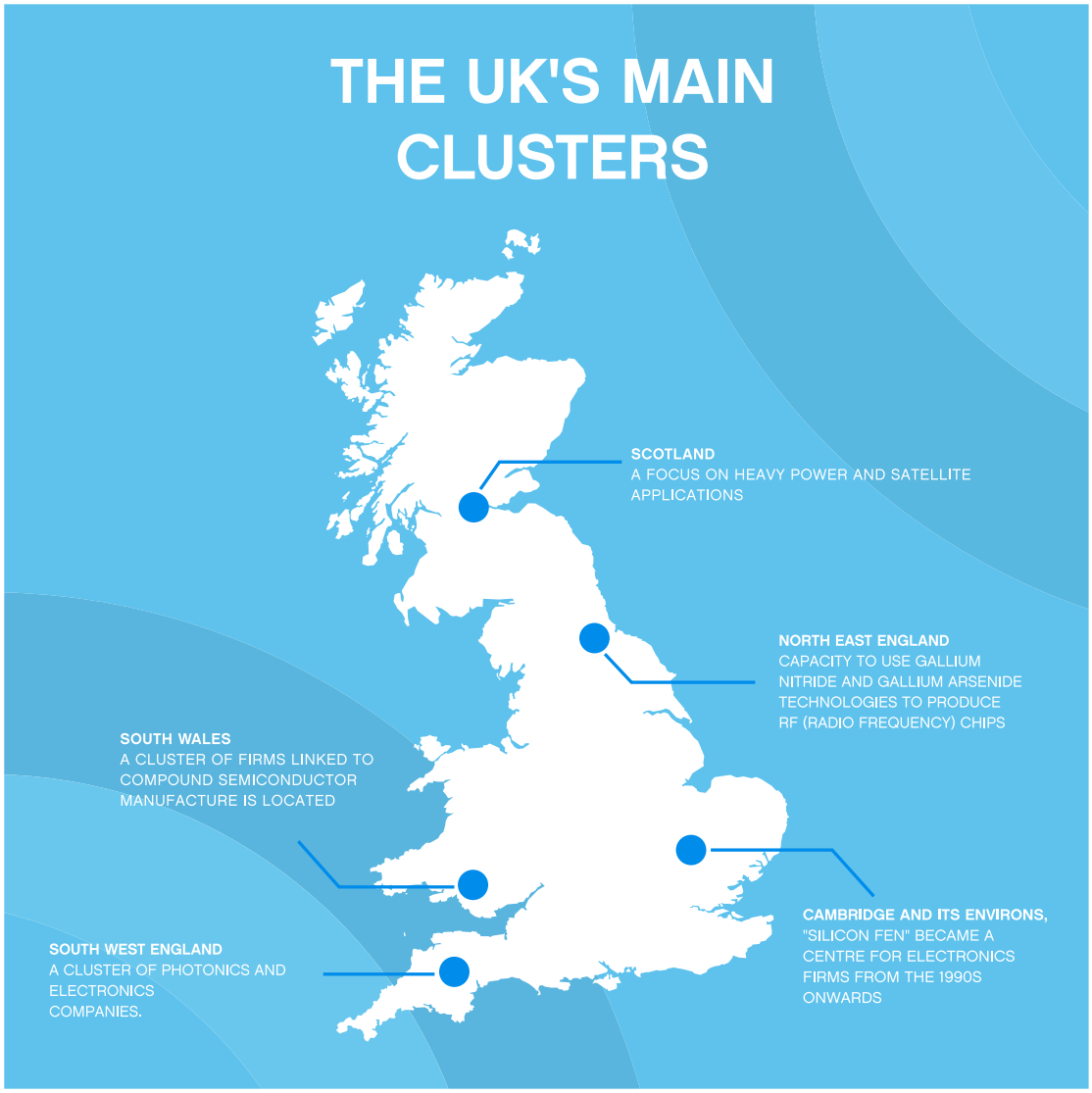
24 Figure 24, Center for Security and Emerging Technology, *The Semiconductor Supply Chain: Assessing National Competitiveness.* Link

25 Compound Semiconductor Application Catapult, *Evidence submitted to BEIS Select Committee on Semiconductors.* Link

- Leading 'emerging/advanced' semiconductors firms, made from non-traditional materials such as graphene.[26] Although these are not in high demand in the current market, analysis by McKinsey & Company suggests *'over the next 10 to 25 years, graphene may replace silicon as the primary material in semiconductors.'*[27]

The UK's semiconductor industry is concentrated in high-intensity clusters around the country, largely outside the South East. Strengthening the sector is therefore aligned with the Government's levelling up ambitions, and would contribute to the Levelling Up Mission of boosting '*domestic public investment in R&D outside the Greater South East... by at least 40%'* by 2030.[28]

The prize to the UK for a supportive policy environment is enormous. Semiconductor firms, much like other emerging technology companies, are extremely productive. Developing even a small number of high-income companies would have an outsized impact on regional development and local employment prospects.



26 New Electronics, *Where next for the UK's semiconductor industry: 31 October 2022.* Link

27 McKinsey & Company, *Graphene: The next S-curve for semiconductors?* Link

28 HM Government, *Levelling Up White Paper.* Link

Successfully building on these strengths will require effective policy. Yet the UK has a chequered history when it comes to industrial strategy. Much of this can be attributed to churn. The UK is on its fifth Prime Minister since 2016. Kemi Badenoch is the eighth Business Secretary in that time, and the sixth since 2019.

The Government's most recent iteration of its industrial strategy is in the form of the Innovation Strategy, published in July 2021 by the then-Department for Business, Energy and Industrial Strategy.[29] There, the Government singled out the semiconductor sector as one of seven *'technology families of UK strength and opportunity'*. The document explicitly explains that *'Electronics, Photonics and Quantum'* includes the semiconductor sector. The Government has doubled down on this approach, with the Chancellor identifying '*advanced manufacturing*' among a number of '*emerging technologies in high growth sectors*' to be focussed on.[30]

The Government has also been clear that semiconductor supply is a national security issue, and has legislated accordingly. Foreign investment in UK semiconductor companies is subject to Government pre-approval under the National Security and Investment Act 2021 (NSIA). This is because regulations issued under the Act explicitly include semiconductors in the 'Advanced Manufacturing' sector of industries for which Government approval is necessary.[31] Transactions or asset transfers involving UK semiconductor firms are 'void' without Government clearance, and potential deals can be blocked.

The Government has repeatedly used this legislation to control investments in the UK chip sector on national security grounds, most notably in the case of Welsh semiconductor manufacturer Newport Wafer Fab, whose acquisition by Chinese-owned Nexperia was unwound last year. That said, the process of intervening in Newport Wafer Fab showed Government decision-making at its least edifying: multiple reviews, repeated missed deadlines and numerous public interventions by politicians.

Case Study: Newport Wafer Fab

In July 2021, the Welsh semiconductor manufacturer Newport Wafer Fab was fully acquired by shareholder Nexperia, which is fully owned by Chinese firm Wingtech.

In response to pressure from Tom Tugendhat, then Chair of the Foreign Affairs Select Committee, Boris Johnson committed to a review of the acquisition.[32] As the NSIA had not yet entered into force – meaning the Government was not yet able to use the powerful measures in the legislation – the review was conducted by then-National Security Adviser, Sir Stephen Lovegrove.[33] The NSIA came into force in January 2022, and in May the transaction was formally 'called in' under the Act's transaction scrutiny powers.[34]

The acquisition had by that time been the subject of further national and international attention:

29 HM Government, *UK Innovation Strategy.* Link

30 HM Government, *Chancellor Jeremy Hunt's speech at Bloomberg, 27 January 2023.* Link

31 Schedule 1, *The National Security and Investment Act 2021 (Notifiable Acquisition) (Specification of Qualifying Entities) Regulation 2021.* Link

32 China Research Group, *Briefing: Takeover of Newport Wafer Fab.* Link

33 FT, *China takeover of UK silicon wafer plant to be reviewed over security: 7 July 2021.* Link

34 HM Government, *Newport Wafer Fab acquisition called-in for national security assessment.* Link

- In April 2022, US politicians wrote to President Biden to urge him to demand security vetting for UK investments in the US if the acquisition was not blocked.[35]
- That month, the Foreign Affairs Select Committee published the report of its inquiry into the acquisition, claiming that *'the [National Security Adviser] review... has not, in fact, been started'*.[36]
- In May, the Business, Energy and Industrial Strategy (BEIS) Select Committee opened its own inquiry into the UK's semiconductor sector, referencing *'concerns over Nexperia's takeover of Newport Wafer Fab'* in its terms of reference.[37]

In November last year, following several delays, the Business Secretary (who had responsibility for NSIA call ins at the time) ordered that the sale be unwound.

Given the salience of the issue, the Government committed in April 2022 to developing and publishing a formal semiconductor strategy. It was initially set for publication in May,[38] then June,[39] then merely 'autumn'[40]. Finally, in December 2022, the strategy's publication date was moved to *'as soon as possible'*.[41] As for the strategy's content, indication has come from a short document issued by DCMS referring to three *'strategic objectives'*: ensuring a reliable supply, ensuring an assured supply, and growing the domestic sector.[42] This approach was confirmed last month in the Government's response to the BEIS Select Committee's report.[43]

Despite the lack of tangible progress, it is right that the Government has identified R&D-intensive sectors, and particularly semiconductors, as meriting special attention – and indeed already given them different status in law. This report therefore recommends a range of policies that would help the UK facilitate the investment, talent and research needed to strengthen the semiconductor sector and other similar industries, in line with the Government's approach.

Importantly, most of the recommendations of this report are not sector-specific. They will therefore have significant effects beyond the semiconductor industry, for example by strengthening the UK's R&D environment, or investment incentives for emerging technology industries. This is the correct approach to boosting the UK's semiconductor sector, which does not have dominant national champions throughout the semiconductor value chain. Instead, the UK should look to strengthen the overall environment for R&D-intensive and national security-critical industries, albeit with an eye on the needs of the UK's semiconductor sector.

The Government has been clear that semiconductors merit specific attention – so much so that the sector will have its own specific strategy. Yet its approach should

35 The Times, *US Politicians press Biden on sale of Newport Wafer Fab to Chinese: 21 April 2022.* Link

36 Foreign Affairs Select Committee, *Sovereignty for sale: follow-up to the acquisition of Newport Wafer Fab.* Link

37 Business, Energy and Industrial Strategy Select Committee, *Inquiry launched into the Semiconductor Industry in the UK.* Link

38 The Daily Telegraph, *Decision on Chinese takeover of Newport Wafer Fab delayed: 8 April 2022.* Link

39 The Times, *Britain risks its chip-making future in tussle over Newport Wafer Fab, 8 May 2022.* Link

40 DCMS, *Written evidence from DCMS to the BEIS Select Committee's inquiry "the Semiconductor Industry in the UK".* Link

41 HM Government, *Government explores national initiatives to boost the British semiconductor industry.* Link

42 DCMS, *Written evidence from DCMS to the BEIS Select Committee's inquiry "the Semiconductor Industry in the UK".* Link

43 Business, Energy and Industrial Strategy Select Committee, *The semiconductor industry in the UK: the Government's response.* Link

still be built around market forces, rather than public spending. A sectoral policy contributed by billions of pounds of direct industrial subsidy is highly unlikely to deliver a strong and growing semiconductor industry, or any other emerging technology industry. But even if there were the appetite to do so, last year's Autumn Statement demonstrated that the UK quite simply does not have the fiscal firepower to fund an industry as capital intensive as semiconductor manufacturing.

> **'Given the salience of the issue, the Government committed in April 2022 to develop and publish a formal semiconductor strategy. It was initially set for publication in May, then June, then merely 'autumn'**

Crucially, therefore, our recommendations (except for certain tax measures) do not require new primary legislation and are fundamentally market-led. It is not for the Government to pick individual winners and losers. This applies as much to companies competing with each other as to different segments of the value chain. It is only by having a broadly firm-neutral environment, facilitated by supportive policy and building on the UK's pre-existing strengths in R&D, IP generation and chip design, that the UK will be able to capture more of the sector.

Part 1: The UK's Innovation Infrastructure

The UK's own innovation machinery will play a critical role in developing the domestic semiconductor sector. Although there is ample funding for basic research – a fact which has led to the UK's strength in that area – there is a long-standing lack of investment in scaling companies. According to one estimate, the annual funding gap for venture-stage and growth-stage is £3.9bn.[44] Similarly, HMT's Patient Capital Review noted *that 'the challenges faced by high potential businesses seeking to scale up are substantial... in particular, accessing long-term, patient finance.'*[45]

> **'According to one estimate, the annual funding gap for venture-stage and growth-stage is £3.9bn'**

That this lack of funding impacts the UK's semiconductor sector is strongly supported by evidence from industry:

- The Bessemer Semiconductor Manufacturing Group, which comprises more than 40 smaller UK semiconductor players, told the BEIS Select Committee in written evidence: *'Generally, semiconductor innovation is well supported in the UK both through Government support systems and by UK based early-stage technology investors. The complaint heard rather is that not enough support is given to the higher TRLs [technology readiness levels, in which 1 is the least and 9 is the most advanced], that is technology development closer to the point of manufacture where much more of the value-added lies.'*[46]

- Rockley Photonics agreed, telling the committee in written evidence: *'Basic and early-stage research in semiconductors is well-funded and enjoys some excellent infrastructure for practical development, primarily in academia. The core weakness is in applied research where we are looking to the sometimes 'mundane' task of taking a technology from TRL3 to TRL7'*[47]

- Semiconductor firm Paragraf added in their written evidence: *'Focus on delivering the end product, TRL8 and above, is absolutely critical if the UK is serious about its semiconductor strategy. The UK is particularly weak in the pilot stages of product development and roll-out.'*[48]

To deliver a stronger domestic semiconductor sector, this must change. In addition to other tax and investment incentives discussed later in this paper, the Government must consider how to adapt its innovation infrastructure and public funding to ensure they are fully supportive of high-tech research commercialisation and company growth.

44 Deloitte, Innovate Finance & Scale Up Institute, *The Future of Growth Capital Report.* Link
45 Patient Capital Review, *Industry Panel Response.* Link
46 Bessemer Semiconductor Manufacturing Group, *Response to questions raised...* Link
47 Rockley Photonics, *Response to Questions for BEIS Semiconductor Industry Inquiry.* Link
48 Paragraf, *BEIS Parliamentary Committee on the current state of the UK semiconductor industry.* Link

The Department for Science, Innovation and Technology (DSIT) and the Cabinet Office

Following the February 2023 reshuffle, two of the most impactful levers the UK Government has to directly influence innovation in emerging technology companies are in different departments. The first is through direct public funding, and the other involves blocking or placing conditions on funding or partnerships. In practice, the latter are conducted under the legal powers of the National Security and Investment Act (NSIA) 2021, which grants the Government extremely wide powers to call in and intervene in mergers and acquisitions, the creation of academic partnerships and asset transfers on national security grounds.

- UK Research and Innovation (UKRI) is the most significant vehicle for public funding of research and innovation, and is a non-departmental public body operating with DSIT as its parent department.

- The Chancellor of the Duchy of Lancaster is the ultimate decision-maker for NSIA call-ins, with the Investment and Security Unit in the Cabinet Office working to examine cases and deliver advice.[49]

- The Research Collaboration Advice Team (RCAT) works within DSIT to advise academia on international partnerships, and describes itself as *'a first point of contact for official advice about national security risks linked to international research'*.[50]

Public funding and UKRI

UKRI is the primary vehicle through which public money is invested in research and innovation. Established by the Higher Education and Research Act 2017,[51] its main function is to distribute public money to innovative projects through nine funding councils. Although this spending can broadly be influenced by political priorities, any political direction must have regard to the 'Haldane Principle' as articulated in Section 103(3) of the 2017 Act: *'The principle that decisions on individual research proposals are best taken following an evaluation of the quality and likely impact of the proposals (such as a peer review process).'*[52]

> **'In the 2021 Spending Review and the 2022 Autumn Statement, the Government confirmed that UKRI's total annual budget will increase by 23% to £6bn by 2024/25'**

The Government has recognised the importance of properly funding research and innovation in the UK. In the 2021 Spending Review and the 2022 Autumn Statement, the Government confirmed that UKRI's total annual budget will increase by 23% to £6bn by 2024/25. UKRI's own budget allocation explainer[53] states that the lion's share of this funding will be distributed to funding councils Innovate UK, which delivers funding to early-stage businesses, and Research England, which funds academic research and knowledge transfer within the UK's Higher Education sector.

49 HM Government, *Check if you need to tell the government about an acquisition...* Link

50 HM Government, *Research Collaboration Advice Team.* Link

51 Part 3, *Higher Education and Research Act 2017.* Link

52 Section 103(3), *Higher Education and Research Act 2017.* Link

53 UKRI, *2022-3 – 2024-5 budget allocations for UK Research and Innovation.* Link

Collectively, Innovate UK and Research England will account for 55% of UKRI's annual allocation by 2024/25, with Innovate UK alone spending almost £1bn that year.

In addition to direct funding through UKRI, there are other, smaller mechanisms through which the Government funds innovative UK businesses. Historically, this has included the Strategic Priorities Fund, which was managed by UKRI and invested £830m in research across a set of 34 themes.[54] The British Business Bank's National Security Strategic Investment Fund[55] also allocated capital to dual-use technology companies in a number of listed sectors.[56]

'Collectively, Innovate UK and Research England will account for 55% of UKRI's annual allocation by 2024/25, with Innovate UK alone spending almost £1bn that year'

In addition, the Advanced Research and Invention Agency (ARIA), established by legislation in 2022, will distribute £800m of public funds to high-risk projects[57], having regard to contributions to economic growth, promoting scientific innovation and improving the UK's quality of life.[58]

While these other funding mechanisms exist, the Government's existing power to direct UKRI, as well as the stability of its funding envelope, mean that the public spending recommendations in this section largely relate to UKRI.

Recommendation: The Science Secretary should issue a direction to UKRI, obliging it and the funding councils to 'have regard' to the technology families of the Innovation Strategy and to the priorities of the Integrated Review when making funding decisions.

As a result of the terms described above, Government can interact with companies in overlapping and occasionally contradictory ways. Anecdotal evidence suggests more security-conscious elements of Whitehall have advised in cases where funding was potentially being awarded by UKRI's funding councils.[59] This is an inefficient use of resources: one department should not be preparing to give funds with one hand while another threatens to take them away. More importantly, this is a waste of business and academic resources. If a proposed funding agreement conflicts with the UK's national security interests, potential parties to that agreement should be informed by the Government as quickly as possible.

In addition, the Government can and should use its existing powers to ensure that the enormous sums of money deployed by UKRI align with the UK's strategic and sectoral interests. Given the substantial constraints on the public finances, the Government is unlikely to subsidise the semiconductor industry to the tune of tens of billions of pounds in a similar fashion to the USA or EU. It is therefore all the more important that the billions of pounds committed to UKRI are spent in line with strategic priorities.

54 UKRI, *Strategic Priorities Fund.* Link
55 British Business Bank, *NSSIF Guidance Document.* Link
56 British Business Bank, *NSSIF: What we invest in.* Link
57 FT, *UK to launch £800m science research agency: 19 February 2021.* Link
58 Section 2, *Advanced Research and Invention Agency Act 2022.* Link
59 Based on interviews with civil servants conducted by the author

This does not violate the Haldane Principle. Rather, successive Governments have been clear that it is appropriate for ministers to set out strategic priorities for public research funding. For example:

- In 2008, John Denham, in his capacity as Secretary of State for Innovation, Universities and Skills, accepted that '*the Government's role is to set the over-arching strategy*'.[60]

- In 2010, Lord Willetts, in his capacity as Minister of State for Universities and Science, said that '*every Government will have some key national strategic priorities... it is also appropriate for ministers to ask research councils to consider how best they can contribute to these priorities*'.[61]

In short, additional targeting of funding to support strategically important industries can and should be facilitated by UKRI. To implement this, UKRI should be obliged to align its funding with the UK's strategic objectives as described in the Integrated Review, as well as all the specific '*technology families of UK strength and opportunity*' described in the Innovation Strategy 2021, which includes semiconductors.

'Additional targeting of funding to support strategically important industries can and should be facilitated by UKRI'

UKRI's own five-year strategy does list the key technology families highlighted by the Innovation Strategy, and commits the body to '*deliver UK strategic advantage in key technology families... coordinating across UKRI and with government departments, the research base and industries*'.[62] However, subsequent text indicates that this is focused on areas such as quantum, AI and engineering biology. Only one reference is made to electronics and photonics, the family in the Innovation Strategy which covers semiconductors.

In addition, UKRI references the Integrated Review only once, in the context of it being a document which '*[recognises] the vital importance of research and innovation to our futures*'. The Strategy does not explain how or whether the worldview set out in it impacts UKRI's funding decisions.

Formally incorporating those documents, and the technology families, into UKRI's priorities would ensure greater alignment between different aspects of the UK's innovation infrastructure. This need not result in all of UKRI's funding being allocated to these families, but would ensure greater public funding for neglected areas in UKRI's strategy, such as semiconductors.

As described above, Section 102(1)[63] of the Higher Education and Research Act 2017 permits the Secretary of State to '*give UKRI directions about the allocation or expenditure... of grants received*'. The conditions on the use of the power are outlined in Section 103 of the 2017 Act, and are that the minister has regard to:

60 Annex 1, Innovation, Universities, Science and Skills Committee, *Putting Science and Engineering at the Heart of Government Policy.* Link

61 David Willetts, *Written Ministerial Statement: Science Research and Funding.* Link

62 UKRI, *UKRI Strategy 2022-2027.* Link

63 Section 102(1), *Higher Education and Research Act 2017.* Link

- The Haldane Principle
- The balanced funding principle (which requires that a '*reasonable balance*' is achieved between the various funding councils and Research England)
- Any other relevant advice

Subsequently, issuing an order under this power does not require new primary legislation.

Recommendation: The Science Secretary should issue a direction to UKRI and Innovate UK to create a specific multi-year fund for the semiconductor sector, using money already allocated in the 2021 Spending Review and matched with private investment.

Failure by Government to stick to a consistent policy strategy over time damages not just the efficacy of public spending, but private investment by businesses.[64] The Government's funding strategy for the semiconductor sector must reflect this by making a stable and reliable commitment to the sector, signalling to industry and internationally that political attention is not a flash in the pan.

Given its strategic importance, the semiconductor sector merits a distinct approach, even above the earlier recommendation on UKRI's overall priorities. The Secretary of State should therefore direct UKRI (and Innovate UK, as the most relevant funding council for later-stage investment) to set up a specific multi-year fund for the UK semiconductor sector, focused on more developed companies and higher TRLs. This would constitute an annual investment of the order of tens of millions of pounds. The funding council would remain the ultimate decision-maker as to which entities would receive public money, in turn saving the Government from picking winners or losers.

This is a relatively small investment compared to Innovate UK's total spending envelope, given that its annual funding (as described above) will rise to £1bn by the end of the current Spending Review period. However, this would be a substantial commitment to the domestic market: public funding for the sector has averaged roughly £60m per year since 2016,[65] and the Compound Semiconductor Application Catapult was allocated roughly £10m annually (specifically, £51.3m over five years) from 2018[66] (although overall Government support did increase by 35% in last year's Autumn Statement).[67]

This direction would not contravene the Haldane principle regarding the allocation of public research funding. Governments and academia have over the years repeatedly made the case that Haldane does not obstruct mission-driven or directed funding, particularly in areas of applied science.

- In giving evidence to the Commons Science and Technology Committee in 2009, the Royal Academy of Engineering said: *'The Haldane Principle [...] has different meanings when applied to the direction of science and engineering research. For pure science, it seems reasonable that researchers themselves should be best placed to understand what direction their research should proceed in and they should not be constrained in their academic endeavours. For engineering, on the*

64 Institute for Government, *Business investment: not just one big problem.* Link

65 Compound Semiconductor Application Catapult, *Evidence submitted to BEIS Select Committee on Semiconductors.* Link

66 BBC, *Semiconductor catapult gets £51m funding share: 10 August 2018.* Link

67 UKRI, *Boosting growth and productivity through innovation.* Link

other hand, it seems reasonable that Government should express requirements... that can be met through directed research.'[68]

- The Government's own response to the committee noted that: *'Far from hindering the ability to do both blue-skies and challenge-driven research, the Haldane Principle facilitates it.'*[69]

To ensure that this fund is deployed most effectively, UKRI or Innovate UK should be directed to hold a consultation with industry stakeholders in order to identify specific sub-sectors of the UK semiconductor industry where the funding should be targeted, provided they are sufficiently competitive. The funding body would then publish a statement of priorities for this fund.

While the fund itself would not be a step-change in national semiconductor investment (with the sector's own investments comprising hundreds of millions of pounds), it would be an important signal that the Government is taking the sector seriously and over a prolonged period of time. It would also provide a valuable mechanism for industry to directly feed into public funding allocations, while preserving the funding councils' independence.

This approach would meet demands by the industry for direction, as well as boosting investor confidence in industry demand for matched funding. Dr Ian Phillips, formerly of Arm, was critical of the UK's historical approach to research funding in written evidence to the BEIS Select Committee:

'The current strategy seems to be to pour money into arbitrary research and leave the market to decide what it takes advantage of. The market is a variable tool, it will only exploit the science and knowledge that offers immediate business potential. The Government has to intervene to make sure that market failure does not cause strategic damage.'[70]

As described above, this direction could be issued under Section 102(1) of the 2017 Act, and would not require new primary legislation.

Recommendation: A business engagement unit should be established in DSIT to advise businesses on potential national security risks of academic partnerships. This could be similar in function to, or part of, the Research Collaboration Advice Team in DSIT.

The role of the Research Collaboration Advice Team (RCAT) is to advise the academic and research community on the national security risks associated with academic partnerships. Many research partnerships involve private sector participants, for instance funding university laboratories, specific PhDs or post-doctoral research placements in exchange for rights over the IP generated. However, RCAT does not provide advice to private sector participants in potential partnerships.

68 Volume 1, Innovation, Universities, Science and Skills Committee, *Putting Science and Engineering at the Heart of Government Policy.* Link

69 Government Response, Innovation, Universities, Science and Skills Committee, *Putting Science and Engineering at the Heart of Government Policy.* Link

70 BEIS Select Committee, *Written submission from Professor Ian Phillips.* Link

Despite this, there have been numerous occasions where semiconductor investment from allied countries has resulted in national security risks, real or perceived:

- In 2021, the attempted acquisition of UK chip designer Arm by US firm Nvidia ultimately fell apart after it was subject to an intervention under the Enterprise Act 2002 on national security grounds.[71] [72]

- As detailed above, in 2022 the transfer of ownership of Welsh semiconductor manufacturer Newport Wafer Fab to Dutch firm Nexperia was unwound under the National Security and Investment Act 2021 after national security concerns were raised due to Nexperia's Chinese ownership.[73]

It is clear that investment, even by firms based in friendly countries, can trigger national security concerns when particularly sensitive, or depending on the ownership structure of the firm in question. Yet while private firms involved in corporate transactions can seek advice from the ISU, there is no equivalent for academic or research partnerships, which can nevertheless be called in and blocked under the NSIA. This should be remedied, with a specific team set up in DSIT, or incorporated into existing structures. This would save time and help disseminate understanding of the UK's national security apparatus, including the operation of the NSIA.

71 Nvidia, *NVIDIA and Softbank Group Announce Termination of NVIDIA's Acquisition of Arm Limited.* Link

72 HM Government, *Proposed acquisition of ARM Limited by NVIDIA Corporation.* Link

73 HM Government, *Acquisition of Newport Wafer Fab by Nexperia BV: notice of final order.* Link

Part 2: Tax and Investment

As we saw earlier, the amount of direct public funding for semiconductor firms by foreign governments has hugely increased. Yet as we also saw, mirroring this approach is not the right strategy for the UK. Bearing in mind the UK's strength in emerging parts of the semiconductor supply chain, entering an international competition to funnel public money into the industry – a competition the UK would not win – would be counterproductive and likely a waste of resources. So given the global backdrop, and the lack of domestic fiscal space to emulate anywhere near the scale of what is being done elsewhere, the Government must pull other policy levers to ensure it is not permanently left behind in this global race.

The priority should therefore be to boost the semiconductor sector with well-crafted, pro-market reforms, alongside other R&D-intensive, national-security-critical sectors. Above all, this should be done by creating a conducive environment for private investment. At the moment, we do not have as many companies coming into or growing in the UK as we could or should, because there are insufficient incentives or mechanisms to do so.

'Rishi Sunak stated as Chancellor in his Mais Lecture that 'our overriding challenge is increasing the amount of business investment in R&D'

Serious and targeted tax and financing reforms are more sustainable than direct funding. And at a time when the industry is urging the UK to come up with a strategy, they would make emphatically clear that Britain wants to be – and indeed is – an attractive place for semiconductor investment. It has the added benefit of not just looking in the rear-view mirror, but helping facilitate the development of the next generation of chips, where UK's real opportunities lie. As Andrew Rickman, founder of Rockley Photonics, told the BEIS parliamentary committee, the UK is '*not going to catch up any time soon*' with advanced silicon chipmakers such as TSMC and should instead ask '*what is coming up next?*'.[74]

In short, policy proposals need to be targeted not only what the UK already has, but to where the industry is going.

On the plus side of the ledger, the UK has some well-developed clusters which by their very nature are sticky. This is because capital funding, time, and the complexity of the manufacturing process create high barriers to moving facilities. But given the lack of notable investment into building semiconductor facilities over the last 20-30 years, these clusters – and the UK's wider semiconductor ecosystem – are more distinct than they are strategic.

74 FT, *The semiconductor boom: has the UK missed its chance? 15 August 2022.* Link

Encouragingly, it is clear from the industry that there is both the ambition and potential to expand these sites – but investment is needed.

Such investment does not just support infrastructure and facilitate job creation. It also funds vital R&D. Government incentives for money to be spent in this way most commonly come through providing direct financial support, for instance through grant funding (as described in earlier sections), but also subsidies, intellectual property protections, or tax credits which allow companies to claim an enhanced corporation tax deduction or payable credit on their R&D costs.

Of course, there is a free-market case that the Government has no business subsidising R&D, as it will distort the market. The counter-argument is that government funding for R&D is needed because such spending creates 'spillovers', in which the benefits of innovation are also felt by competitors to the original firm. As a result, the state has an interest in higher R&D spending than businesses find desirable. The conclusion is that left to its own devices, the private sector will persistently underinvest in R&D.

'In 2021, 34 of the 38 OECD countries offered some form of R&D tax relief in order to increase private investment in innovation – as did 22 of the EU27'

Tellingly, in 2021, 34 of the 38 OECD countries offered some form of R&D tax relief in order to increase private investment in innovation – as did 22 of the EU27.[75] The Government certainly believes in its significance, with its Innovation Strategy noting that R&D tax credits *'are an important part'* of its plan to increase innovation. Meanwhile, Rishi Sunak stated as Chancellor in his Mais Lecture that *'our overriding challenge is increasing the amount of business investment in R&D'*.[76] This need is nowhere more apparent than with the historically capital-intensive semiconductor industry.

While the Government has formed Catapult Centres to help address the funding gap, the reality is that to fully tackle the problem – or mimic international equivalents such as Germany's Fraunhofer Society – funding would need to increase tenfold.[77] Tax and relief reform therefore cannot be the whole solution: rather, the UK's existing investment architecture needs to be revisited to solve the bigger funding issues facing the country's semiconductor and emerging technology sectors. In particular, although more certainly needs to be done to attract internationally mobile capital, the UK has to be better at mobilising its own deep pools of finance to fill these gaps.

In our recent report *Why Choose Britain?*, the CPS detailed how the UK's funding gaps – notably, growth and patient capital – are having an adverse impact on the country's competitiveness, and provided policy recommendations for how the Government could help divert some of the UK's deep pools of domestic capital into scale-ups and illiquid assets.[78] For context, the long-term capital available in the form of UK pension funds, insurance assets and private savings is estimated to be worth

75 OECD, *R&D tax incentives database.* Link

76 HM Government, *Chancellor Rishi Sunak's Mais Lecture 2022.* Link

77 Rockley Photonics, *Response to Questions for BEIS Semiconductor Industry Inquiry.* Link

78 Centre for Policy Studies, *Why Choose Britain?* Link

£6 trillion – making it by far the largest and deepest pool of capital in Europe. Yet, only a tiny fraction of it is in productive investment.[79]

Again, this provides further impetus for the Government to make investment more attractive and to seize the opportunity to develop the semiconductor footholds the UK already has.

Recommendation: The Government should offer a bespoke R&D tax credit for companies in sectors that fall within the 'families of UK strength and opportunity' as set out in the Innovation Strategy. In addition, amendments to the RDA scheme, and streamlining the application for the credits themselves, should be considered.

The UK's R&D tax credits have become increasingly expensive, with the full range of reliefs costing the Treasury over £9 billion each year.[80] Although this is to be expected given increasing business R&D investment, there is also a fraud issue.

> **'Recent changes to ONS methodology show that the UK has actually been hitting its 2.4% of GDP target since 2019 – but Germany sill invests 3.1%, South Korea 4.8% and Israel 5.4%'**

Despite this, the UK, relative to other OECD countries, relies more on R&D tax reliefs than direct public investment – with the ratio of tax relief to direct investment almost three times greater than the OECD average.[81] At the same time, UK business spending on R&D is just four times the value of R&D tax relief. The OECD average is 15 times. Clearly, as the Government has recognised, there is a problem with the value for money we are getting.

But that is not the only problem. Overall R&D investment is also far lower than in other major OECD economies. Recent changes to ONS methodology show that the UK has actually been hitting its 2.4% of GDP target since 2019 – but Germany sill invests 3.1%, South Korea 4.8% and Israel 5.4%.[82] Indeed, since the target was set, the OECD average has risen to 2.7%. So, while UK R&D spending has risen, the same challenges still exist.

The existing UK R&D tax credit

The UK offers three types of R&D schemes, which each have five categories of cost that can be claimed for. These schemes are:

- SME Scheme
- Research and Development Expenditure Credit (RDEC)
- Research and Development Capital Allowances (RDAs)

79 Atlantic Council, *The future of UK banking and finance.* Link

80 Page 238, HMRC, *Annual Reports and Accounts 2021 to 2022.* Link

81 Investing 4.1 times more in R&D tax reliefs compared to direct investment in R&D. The OECD average, by contrast, is 1.5 times more.

82 OECD Data, Gross domestic spending on R&D – Total, % of GDP, 2021 or latest available. Link

The categories of qualifying R&D expenditure under these schemes consist of: capital expenditure, staffing costs, externally provided workers, software and consumable items, and payments to subcontractors.

In the Autumn Statement, the Chancellor announced cuts to the rebates available to small and medium sized businesses in a bid to reduce fraudulent claims, while increasing credits for larger companies. From April 2023, the SME Scheme will allow qualifying companies to deduct 186% (down from 230%) of relevant R&D expenditure from their yearly profit, lowering their corporation tax bill.[83] Alternatively, eligible loss-making companies can claim an in-year tax credit worth up to 19% (down from 33%) of relevant expenditure.[84]

The Research and Development Expenditure Credit (RDEC) for large companies (i.e., those that do not qualify as SMEs), which replaced the large company scheme in 2016, will provide a 20% credit on R&D that can be used to lower a company's corporation tax bill or be claimed in cash if it is loss-making.

'Eligible loss-making companies can claim an in-year tax credit worth up to 19% (down from 33%) of relevant expenditure'

Lastly, the Research and Development Capital Allowances (RDAs) scheme, which is available to both SMEs and large companies, benefits profit-making firms with corporation tax liabilities by providing a 100% deduction for capital expenditure in the year the costs were incurred. This can improve cash flow significantly compared with other capital allowances, which give relief over much longer periods.

Are these various schemes working as intended? The evidence, at least for cutting-edge technology firms, appears to be no. Between 2018 and 2020, UK R&D-intensive companies received investment equal to 0.17% of GDP, substantially lower than their US equivalents which received investment of 0.32% of GDP.[85]

Of course, the fact that UK deep tech firms cannot raise investment on the scale of their US rivals is not just to do with tax credits, but the wider finance environment. But our flawed R&D model does not appear to be helping. And while we can understand why the Treasury felt the need to crack down, many companies will have set their budgets and hiring plans based on the previous, more generous scheme.

It is a good thing that the Government has acknowledged the problems created by the recent changes, admitting in its recent consultation on the new R&D tax relief scheme that they *'[create] challenges for some R&D-intensive SMEs'* and that *'the Government believes there is merit to the case for further support'*.[86]

83 86% of the deduction comes from the SME-specific R&D relief, whereas an additional 100% is the usual relief on such expenditure.

84 This is a simplified description of the SME scheme. For loss-making companies, the in-year tax credit is calculated by taking 186% of the qualifying expenditure (creating the 'enhanced' expenditure), and then 'surrendering' that figure to HMRC against the losses incurred by the firm in that year. Losses 'surrendered' in this way cannot be used to offset against profits in future years. Eligible firms then receive 10% of the 'surrendered' total back in tax credits from HMRC. For firms at or near break-even, parts of their enhanced expenditure can be used to offset profits, and other parts can be used to surrender losses.

85 British Business Bank, *Small Business Equity Tracker 2021.* Link

86 HMT & HMRC, *R&D Tax Reliefs Review: Consultation on a single scheme.* Link

Ultimately, if the UK is serious about being a science and technology 'superpower' – and boosting industries it has already identified as strategic – then it must double down on R&D incentives for these sectors. For this reason, we recommend the creation of a more generous, tailored R&D tax credit for companies in the *'families of UK strength and opportunity'* as set out in the Innovation Strategy. (If there is any uncertainty, the potential beneficiaries could be defined with reference to the National Security and Investment Act regulations.)

The Government should also consider other measures to improve its existing R&D schemes. For example, the RDAs could be extended to make capital expenditure eligible for a cash credit for loss-making firms in the relevant sectors. This would be in keeping with other countries – such as France, Belgium, Ireland and the Netherlands – which offer a cash credit for capital spending for loss-making firms.

'Between 2018 and 2020, UK R&D-intensive companies received investment equal to 0.17% of GDP, substantially lower than their US equivalents which received investment of 0.32% of GDP'

Additionally, as MakeUK suggested in its evidence to the BEIS Committee, the Government should consider streamlining the application processes and reducing the complexity of how firms apply for R&D tax credits. MakeUK's research has highlighted how firms often have to employ agents to secure the credits.[87]

The Government should also consider reform of the Patent Box scheme, introduced in April 2013, which encourages companies to keep and commercialise intellectual property in the UK. Specifically, it provides a lower effective corporate tax rate of 10% on profits attributable to UK or certain European patents. This brings tangible benefits to the UK and it is the only R&D scheme that currently incentivises this activity. However, since its inception there have been notable changes in how companies innovate. So the Patent Box should be updated to reflect modern software and data-based R&D that relies increasingly on iterative innovation rather than patents.

Equally, the Patent Box could be widened to include more IP rights such as software, copyright materials and inventions that may not be patentable. The model for this is the Dutch Innovation Box. This is like the UK's Patent Box in that companies report profits made from innovations in their corporate tax returns, and eligible profits are liable to a reduced rate of corporation tax – 9% compared to the headline rate of 25%. Where the Dutch system differs is that the eligibility is much broader than just patented inventions: any innovation is eligible for this relief if it was done in-house.

Critics of the Patent Box have pointed to its narrow targeting, skew towards large multinationals and cost. Yet, the firms that benefit from it tend to be strategically important to the UK. Moreover, HMRC's evaluation of the Patent Box suggests that firms using the relief display a 10% increase in investment.[88] We need to ensure that our system keeps us internationally competitive – especially with an increasing number of European countries introducing attractive Patent Boxes too, most notably Ireland at a rate of 6.25% and Belgium at 3.75%.[89]

87 MakeUK, *Call for Evidence: response to the semiconductor inquiry.* Link

88 HMRC, *Patent Box Evaluation.* Link

89 Tax Foundation, *Patent Box Regimes in Europe.* Link

Recommendation: Permanently introduce full expensing for non-R&D related plant and machinery, in addition to structures and buildings, for companies in sectors that fall within the 'families of UK strength and opportunity'.

As the CPS has argued ad nauseam, the most significant thing the Government can do in the immediate term to fix the UK's longstanding lack of business investment is address the fact that the UK has one of the worst taxation systems in the OECD for capital cost recovery, which is the ability of firms to write off investment against tax.

> **'According to the Office for National Statistics, the UK had the lowest average business investment of all OECD nations between 1995 and 2015'**

According to the Office for National Statistics, the UK had the lowest average business investment of all OECD nations between 1995 and 2015.[90] Over the last seven years, the UK has had one of the two lowest investment-to-GDP ratios among G7 countries. For the last four years, it has been the lowest among the G7. In 2021, gross fixed capital formation in the UK was just 17.1% of GDP, compared to 22% in Germany and 24.4% in France.

Ideally, as the CPS has consistently argued, the Government should be as bold as possible when it comes to permanent reform of capital allowances. Specifically, the CPS has been a long-term proponent of permanent full expensing – for plant and machinery, as well as structures and buildings – across the whole economy. While there would be large initial revenue losses for the Exchequer, these should not necessarily be prohibitive given their transitory nature, and can in fact be reduced using an approach known as 'neutral cost recovery' – something expanded on in our paper 'After the Super-Deduction'.[91]

The Tax Attractiveness Index, compiled by the Institute for Taxation and Accounting at LMU Munich, ranks the UK 98th out of 100 in terms of its depreciation regime for fixed assets.[92] Meanwhile, the US-based Tax Foundation ranks the UK 33rd out of 36 on weighted average of capital allowances available as a percentage of the net present value of a given investment.[93] Added to this, as the CPS has shown in previous research, the UK's investment allowances in recent years have been best characterised by their yo-yo nature.[94] This is the very opposite of the stability and predictability investors need.

While the Government does currently have a super-deduction in place, it covers only companies investing in specific plant and machinery assets, and does not include structures and buildings. It also expires in April of this year, even though the investment decisions involved in the semiconductor industry (like other emerging

90 Office for National Statistics, *An analysis of investment expenditure in the UK and other Organisation for Economic Co-Operation and Development nations.* Link

91 Tax Foundation & Centre for Policy Studies, *After the Super-Deduction: Assessing Proposals for the Reform of Capital Allowances.* Link

92 Institute for Taxation and Accounting, *Tax Attractiveness Index.* Link

93 Tax Foundation, *Capital cost recovery across the OECD, 2019.* Link

94 See, for example, Centre for Policy Studies and Tax Foundation, *A Framework for the Future: Reforming the UK Tax System.* Link

technologies) are years in the making.[95] It is true that outside of the super-deduction, the Annual Investment Allowance (AIA) allows companies to write down some of their capital expenditure. But while it was a good thing that the Government committed to maintaining the limit at £1 million, this is peanuts in terms of the capital expenditure required in most advanced sectors.

In short, as of April this year, the tax system will become far less generous for capital expenditure overnight unless there is a suitable replacement for the super-deduction. So given the strategic significance and vast economic opportunities presented by emerging technologies, the Government should at the very least implement permanent full expensing for non-R&D related plant and machinery, as well as structures and buildings, for companies involved in emerging technology sectors. This measure, effectively a super-deduction style investment incentive, would support companies (including those in the semiconductor industry) to scale up, providing incentives for important investments that do not fall within the remit of R&D.

> **'While it was a good thing that the Government committed to maintaining the limit at £1 million, this is peanuts in terms of the capital expenditure required in most advanced sectors'**

Indeed, while R&D incentives are fundamental in developing the expertise and products companies offer, they are less useful when a company attempts to expand its footprint and operations. It would therefore in part address the funding gap described in earlier sections: supporting capital-intensive commercial businesses as they expand their manufacturing capacity, rather than more narrowly focused R&D-specific expenditure by early-stage firms.

One of the crucial things about this new incentive would be that it would be permanent. The Office for Budget Responsibility's assessment of the super-deduction was that it would mainly serve to shift investment forward, rather than driving a much-needed increase in overall capital expenditure.[96] A form of permanent full expensing would remove any incentive to just shift investment forward, and could instead lead to longer-term shifts in sectoral spending patterns. Added to this, our recommended version of full expensing would further encourage investment in structures and buildings, which is currently not covered by the existing super-deduction. This is significant because structures comprise a large portion of the UK corporate capital stock.

The investments that the UK should be aiming to attract - given their sheer size and ongoing nature – require permanent changes to the capital taxation system if existing and future companies are to commit to the long-term future of their UK operations, or bring investment here instead of prioritising activities elsewhere.

This approach is also likely to prove more sustainable for the UK than any alternative. Industry experts have warned that current government-led efforts to increase chip manufacturing, for example, may prove unsustainable given this process is not a one-off cost, but it will instead be a capital-intensive recurring expenditure to stay at the cutting edge. So if the UK is to successfully leverage its position in the sector, as well as improve domestic capacity in other parts of the semiconductor supply chain, it should be treating capital investment far more generously than it currently does.

95 HM Government, *Guidance: Super-deduction.* Link

96 OBR, *Supplementary forecast information release: Capital allowances super-deduction costing.* Link

But if we are going to introduce a targeted form of full expensing, how should it be targeted? While the semiconductor sector is strategic, there are also other cutting-edge sectors where the UK hopes to place itself in the strongest position for the future. Therefore, we have opted to take the Government at its word, and single out the technology families identified in the July 2021 Innovation Strategy as the focus of attractive investment allowances.

> **'If the UK is to successfully leverage its position, as well as improve capacity in other parts of the semiconductor supply chain, it should be treating capital investment far more generously'**

Specifically, the Government in its Strategy identifies *'the key seven technology families that will transform our economy in the future'* before adding that *'the purpose of these technology families is to focus domestic and international attention on the potential of UK tech'.*

The seven technology families are:

- Advanced materials and manufacturing
- AI, digital and advanced computing
- Bioinformatics and genomics
- Engineering biology
- Electronics, photonics and quantum
- Energy and environment technologies
- Robotics and smart machines

The Strategy goes on to say that *'we will need to prioritise investments at a granular level, considering factors like UK comparative advantage, transformative potential, and security and social need'*. Given the Government itself recognises the need to act decisively in these areas, it makes most sense (given the financial constraints we face) for the investment allowances to target these seven families – which semiconductors fall within. These can be defined with reference to the relevant portions of the National Security and Investment Act regulations, which define a number of sensitive sectors subject to heightened investment restrictions, and include all of the above technology families.

Recommendation: Establish an Emerging Technologies Strategic Investment Fund (ETSIF) within the British Business Bank, which actively courts international capital to be invested in the UK's emerging technology industries.

As detailed previously, commercialised high-tech businesses – i.e., those conducting applied research, including many semiconductor firms seeking to scale up or grow further – are losing out as a result of the UK's longstanding lack of patient capital. This is not a unique issue to the semiconductor sector, but affects all capital-intensive emerging technologies in the UK.

While we have recommended changes to the distribution of public funding in this and other sections of this report, the UK's public finances are simply unable to match the scale of investment needed by these sectors. Moreover, while the Government should be praised for the creation of the British Business Bank's subsidiary

British Patient Capital (BPC), with its £2.5 billion budget,[97] the reality is the existing architecture within the Bank is insufficient.

Luckily, in additional to domestic private funding, there is ample international demand. In the words of science minister George Freeman: *'There is a wall of money out there wanting to invest in UK science and technology, but we need to make it easier for UK and international investors to invest in tangible "investable propositions" – whether that be companies, funds, science parks, infrastructure or clusters.'*[98]

We recommend the creation of an Emerging Technologies Strategic Investment Fund (ETSIF) which should sit within the BBB and be funded by international and domestic investors wanting to put money into UK tech.

The ETSIF would be a fund targeted at the UK's emerging tech sector, focusing on mobilising private capital into scale-up and growth-stage businesses in these sectors. As with other recommendations in this section, these sectors should be defined with reference to the Innovation Strategy and NSIA regulations.

The ETSIF would function similarly to the BBB's existing National Security Strategic Investment Fund (NSSIF), in which public and private capital invests in dual-use firms through a series of private sector NSSIF-accredited fund managers with access to Government expertise and insight into the relevant sectors. NSSIF accreditation requires security clearance, as well as for the Government to approve the fund manager's proposed investment strategy.[99]

'While the Government should be praised for the creation of the British Business Bank's subsidiary British Patient Capital (BPC), with its £2.5 billion budget, the reality is the existing architecture within the Bank is insufficient'

As with NSSIF, ETSIF fund managers would have their investment strategy approved by the Government, and would have access to Government expertise in emerging technology sectors. This could include access to Government regulatory advisers, cluster and sector mapping, as well as regular dialogue with relevant teams in UKRI or Innovate UK where interests overlap, and matching with international investors via DIT.

In addition, Government could provide some one-off seed funding (in the order of tens of millions of pounds) as a marker of intent. Fund managers, supported by Government, could apply for ECF/BBFL commitments as with other schemes, and could also seek large-scale private sector investment in their areas of interest.

97 British Business Bank, *£2.5bn British Patient Capital Programme launched to enable long-term investment in innovative companies across the UK.* Link

98 Onward, *George Freeman MP, Science Superpower: the UK's Global Science Strategy beyond Horizon Europe, 11 January 2023.* Link

99 British Business Bank, *NSSIF Guidance Document.* Link

The ETSIF would provide several benefits to investors:

- Fund managers could have different strategies, meaning that some may focus on sectors and others on specific geographic clusters.
- ETSIF would provide a one-stop shop for international investors interested in emerging technologies (subject to relevant NSIA clearances or other checks).
- ETSIF investors and fund managers would be in regular dialogue with policy-making parts of Government, potentially granting greater insight into relevant sectors.

Features of the proposed ETSIF compared with existing BBB/BPC funds

	HMG owner	Firm-level investment decision-maker	Investment mechanism	Sectoral coverage	Total public funding
Life Sciences Investment Programme	BPC	Private-sector fund managers	HMG invests in venture growth funds	Life sciences only	£200m
Future Fund: Breakthrough	BPC	HMG	HMG co-invests in firms directly during funding rounds	R&D intensive sectors	£375m
National Security Strategic Investment Fund	BBB	Private-sector HMG-accredited fund managers (since 2020, NSSIF also makes direct investments)	HMG invests in funds with pre-approved strategies, with HMG providing insight and expertise in support	12 specific dual-use areas	£135m[101]
Proposed Emerging Technologies Strategic Investment Fund	*BBB*	*Private-sector HMG-accredited fund managers*	*HMG makes limited investments in funds with pre-approved strategies, with HMG providing insight, mapping and regulatory expertise*	*R&D intensive sectors in emerging technologies*	*Dependent on appetite, in the order of tens of millions*

Crucially, ETSIF would operate differently to existing BBB schemes covering emerging technology and growth-stage businesses, which include the Future Fund: Breakthrough (FF:B), and Life Sciences Investment Programme (LSIP), while complementing their welcome work. These funds' primary purpose is to provide government money to directly address funding gaps, and largely rely on approaches from investors themselves. In the FF:B's case, the fund serves to top up existing deals with public money (for example, in December 2022 the FF:B invested £10 million in Pragmatic Semiconductor, a Cambridge-based designer and manufacturer of flexible electronics as part of its $125m Series C funding round).[101]

100 British Business Bank, *Written evidence submitted by British Business Bank.* Link

101 British Patient Capital, *British Patient Capital invests £10m in semiconductor specialist PragmatIC.* Link

While FF:B and LSIP both make valuable contributions to the scale-up space, the fact that they spend public money fundamentally limits their size. Their total spending is £575m (£200m in LSIP and £375m in FF:B), far less than the estimated UK funding gap mentioned in earlier sections.

> **'Government should make a determined effort to secure reliable international investment. In addition, it could also seek to coordinate with friendly foreign powers to secure funding'**

So the Government should make a determined effort to secure reliable international investment. In addition, it could also seek to coordinate with friendly foreign powers to secure funding for the ETSIF. This could include bidding for some of the $500m in the US CHIPS Act specifically allocated to non-US semiconductor manufacturing and development.[102]

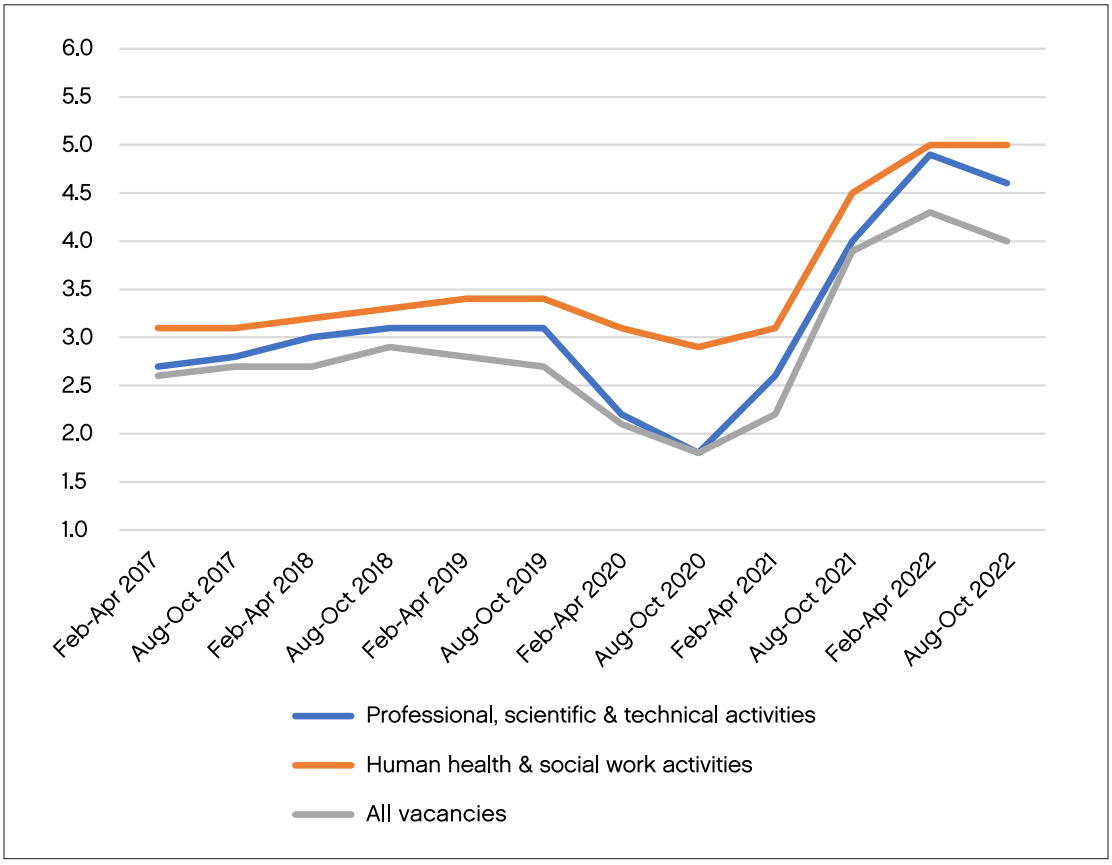
102 Section 102(c), *CHIPS Act of 2022*. Link

Part 3: Immigration and Talent

In line with other emerging technology industries, the semiconductor sector does not employ large numbers of people relative to its economic contribution. In the United States, the sector employs roughly 250,000 people,[103] almost four times fewer than car manufacturing,[104] and less than one sixth of the number of estate agents.[105] Strengthening the UK semiconductor sector does not, therefore, rely on mass immigration, but targeted employment of talented and highly skilled individuals.

Yet despite the relatively small numbers of people employed in the sector, the UK has for years suffered from shortages. Granular data specific to semiconductors is difficult to find, but vacancies within the scientific and technical sector have consistently been above the UK average for the past five years, and are now at similar levels to the well-publicised shortage of NHS and social care staff.[106]

Vacancies per 100 employees in selected sectors



103 Page 2, Semiconductor Industry Association & BCG, *Strengthening the global semiconductor supply chain in an uncertain era.* Link

104 US Bureau of Labour Statistics, *Automotive Industry: Employment, Earnings, House.* Link

105 National Association of Realtors, *Monthly Membership Report.* Link

106 ONS, *Vacancies by industry dataset November 2022.* Link

These shortages have grown more pronounced since the pandemic, despite the fact that electrical engineers have been on the Migration Advisory Committee's Shortage Occupation List (SOL) since 2019,[107] and scientific researchers since the list's inception in 2008.[108]

The UK semiconductor sector is not exempt from these serious scientific skills shortages. A report by the BEIS Select Committee on the UK's semiconductor sector quotes firms who are *'running approximately 10% below headcount, despite a major recruitment drive'*, with another telling the Committee they *'have 161 open vacancies at the moment, and [do] not expect to have those all filled this year'*.[109]

> **'Given that the UK is in what has been described as the 'decisive decade' for international technology competition, migration policy must urgently ensure that the UK does not lose out in the race for talent'**

Increased high-skilled migration must not detract from boosting skill levels among the UK's own population. The UK should actively encourage more students to study engineering, support universities to expand intakes and boost the number of graduates going on to secure Masters- or Doctorate-level qualifications in these areas. However, an immediate increase in the supply of UK engineering PhD graduates is not within the gift of any government.

In the short and medium term, boosting productivity and innovation in this sector means focusing on those recruitable by firms already. In the words of the Prime Minister, announcing 'People' as one of the three pillars of his economic strategy: *'the people we want to support are already working in companies today, not sitting in classrooms'*.[110]

Given that the UK is in what has been described as the '*decisive decade*' for international technology competition,[111] migration policy must urgently ensure that the UK does not lose out in the race for talent.

Recommendation: The UK should expand its High Potential Individual Visa scheme to all advanced degree-holders in STEM fields who are graduates of top 20% ranked universities in allied countries and blocs, such as the European Union, USA, other Five Eyes countries, and Taiwan. The health surcharge should also be waived for these applicants.

Last year, the Government introduced the High Potential Individual Visa (HPIV),[112] which permits recent graduates of the world's top 50 universities to live and work in the UK for up to two years. The scheme was created through changes in March 2022 to the Immigration Rules, issued under the Immigration Act 1971.[113] Immigration statistics from November last year showed that, in the first four months of the scheme,

107 Migration Advisory Committee, *Full review of the Shortage Occupation List, May 2019.* Link
108 Migration Advisory Committee, *Skilled, Shortage, Sensible, September 2008.* Link
109 BEIS Select Committee, *The semiconductor industry in the UK.* Link
110 HM Government, *Chancellor Rishi Sunak's Mais Lecture 2022.* Link
111 The White House, *National Security Strategy, October 2022.* Link
112 HM Government, *High Potential Individual (HPI) Visa.* Link
113 HM Government, *Statement of Changes in Immigration Rules: 15 March 2022.* Link

more than 700 HPIVs were granted to applicants from a mix of different nationalities, although predominantly from the US, China and India.[114] The HPIV therefore in part delivers the Prime Minister's aim, as stated in his Mais Lecture last year, to *'create one of the world's most attractive visa regimes for... highly skilled people'*.[115]

However, as currently designed, the HPIV is too narrowly focused to bring individuals with relevant skills for high-end technology manufacturing and commercial research – needed by the semiconductor industry – into the UK. This is because roles in these sectors often require advanced degrees – such as Masters or Doctorates. As a result, the relatively narrow focus of the HPIV on the world's top 50 universities excludes many world-class institutions where relevant advanced degrees are regularly awarded. Simply put, the current rules would permit a recent languages graduate from Harvard to enter the UK without a job offer, but would prevent an engineering PhD from Carnegie Mellon (currently ranked 4th in the US by *US News and World Report*[116] but absent from the Government's global universities list[117]) from doing the same.

> **'Last year, the Government introduced the High Potential Individual Visa (HPIV), which permits recent graduates of the world's top 50 universities to live and work in the UK for up to two years'**

To resolve this, the HPIV should be expanded, such that any advanced degree holder in a STEM field from a top 20% university in a set of named countries is eligible. This list of countries should include allied nations, such as the US, EU members, Japan, New Zealand, Canada, Australia, India and Taiwan. As the HPIV was established via statutory instruments issued under the Immigration Act 1971, this change will not require new primary legislation.

In addition, applicants under this part of the HPIV should be exempt from having to pay the health surcharge, introduced in the Immigration Act 2014 and currently imposed by the Immigration (Health Charge) Order 2015.[118] These charges – currently £624 per year for adults[119] – amount to an up-front cost of £1,248 in addition to other application and relocation fees, and may be a significant deterrent for individuals with the right qualifications. Again, this change can be enacted through the broad powers held by the Home Secretary under Section 38(3)(e) of the 2014 Act to issue exemptions to the Health Surcharge.

Recommendation: The UK should waive or refund visa application fees and health surcharges for emerging technology companies for employees on a Skilled Worker Visa.

The main route for foreign nationals to work in the UK is the Skilled Worker Visa. Government statistics from last year show that – excluding the sector-specific Health and Social Care visa and temporary workers – the Skilled Worker Visa accounted

114 Home Office, *Why do people come to the UK? To work.* Link
115 HM Government, *Chancellor Rishi Sunak's Mais Lecture 2022.* Link
116 US News and World Report, *2023 Best Engineering Schools.* Link
117 UK Visas and Immigration, *High Potential Individual Visa: global universities list 2021.* Link
118 Section 3, *The Immigration (Health Charge) Order 2015.* Link
119 Schedule 1, Ibid.

for 53% of all work-related visas granted in the year ending September 2022.[120] This is therefore the main route through which semiconductor firms would look to hire international talent.

However, as described above, the fees associated with visa applications are substantial. For Skilled Worker Visas, where the fees are typically borne by the employer, hiring an engineer would require the hiring firm to pay the application fee of at least £624 (or £479 if the role is on the Shortage Occupation List), as well as £624 per year for the health surcharge.[121] For a three-year post on the SOL, hiring a non-British national will therefore cost a company an additional £2,351: a frictional cost which could otherwise have been spent on higher salaries or business investment.

> **'For a three-year post on the SOL, hiring a non-British national will therefore cost a company an additional £2,351: a frictional cost which could otherwise have been spent on higher salaries or business investment'**

The Government should therefore either waive or refund visa application fees and health surcharges for emerging technology firms, to ensure that UK firms can hire flexibly and without needless administrative costs. As these sectors are relatively small, waiving these fees would have a relatively limited impact on public finances: filling 5,000 vacancies with the fees waived would cost the Government approximately £12.5m – less than a rounding error in the national accounts.

Again, the Government can waive these fees without primary legislation. The Health Surcharge can be amended via the process previously described. Skilled Worker Visa fees are set by the Immigration and Nationality (Fees) Regulations 2018,[122] and can be amended (or exemptions added) through general fee-regulating powers in the Immigration Act 2014.

If waiving the fees themselves is decided against – potentially for administrative reasons, or because of a perceived risk of fraud – the Government should at the very least introduce a mechanism to refund the fees to semiconductor firms via the annual Finance Bill.

Recommendation: The UK should actively seek to foster specific mobility arrangements with allied countries for the semiconductor sector, including short-term work placements, knowledge exchanges and fellowships.

In addition to changes to the UK's visa policy, the Government should seek to create structured programmes for knowledge exchange and mobility across allied countries for the semiconductor sector. These could build on pre-existing diplomatic relationships, such as the G7, Five Eyes or the AUKUS partnership.

These would help boost network effects within the industry, ensuring a wider range of exposure both to UK firms and to international partners. Depending on international appetite, the UK could push for regular, industry-specific fora where ministers, officials and industry participants are in attendance, with the purpose of strengthening cross-border networks.

120 Home Office, *Why do people come to the UK? To work.* Link

121 HM Government, *Skilled Worker visa.* Link

122 Schedule 1, Section 2, *The Immigration and Nationality (Fees) Regulations 2018.* Link

In addition, the UK could set up specific semiconductor fellowships, modelled on the Turing AI Fellowship,[123] which is aimed at *'retaining, attracting and developing the best and brightest AI international researchers'*. Recognising the international nature of the industry, these fellowships should not be inconsistent with academic or industrial commitments in other countries, and could have minimum working requirements in the UK (for instance, six months out of every 12).

'Depending on international appetite, the UK could push for regular, industry-specific fora where ministers, officials and industry participants are in attendance, with the purpose of strengthening cross-border networks'

The UK should also negotiate with the United States to ensure that any UK scheme is exempt from the CHIPS Act's provisions on international recruitment,[124] which blocks any US Government-appointed *'Visiting Scientist, Engineering or Educator appointments'* as well as other officials from participating in any yet-to-be-defined *'foreign talent recruitment program'*.

123 BEIS, DCMS, Office for AI & UKRI, *Turing Artificial Intelligence Fellowships.* Link
124 Section 10631, *CHIPS Act of 2022.* Link

Part 4: Planning and Infrastructure

Developing a strong semiconductor industry requires infrastructure. This ranges from physical and engineering laboratories, where basic and early-stage research can be carried out, through to large-scale manufacturing plants for commercial and industrial production.

Historically, the UK has welcomed large-scale laboratory and scientific infrastructure, even on relatively undeveloped land. The most notable example is the construction of the 'Albertopolis' complex in South Kensington in the late 19th century. The proceeds from the 1851 Crystal Palace exhibition were used to purchase and develop acres of largely empty London land for the purposes of establishing *'four institutions corresponding to the four great Sections of the Exhibition: Raw Material, Machinery, Manufactures & Plastic Art'*.[125] Centred on Exhibition Road, the area today is the site of scientific and academic institutions such as Imperial College London, the Science Museum and the Natural History Museum.[126]

> **'Historically, the UK has welcomed large-scale laboratory and scientific infrastructure'**

In a modern context, the specific mix of research infrastructure needed is best left to the industry and market forces to determine. However, government can and should do more to get out of the way and permit the construction of the laboratory and industrial infrastructure needed by dynamic British businesses.

Laboratory space

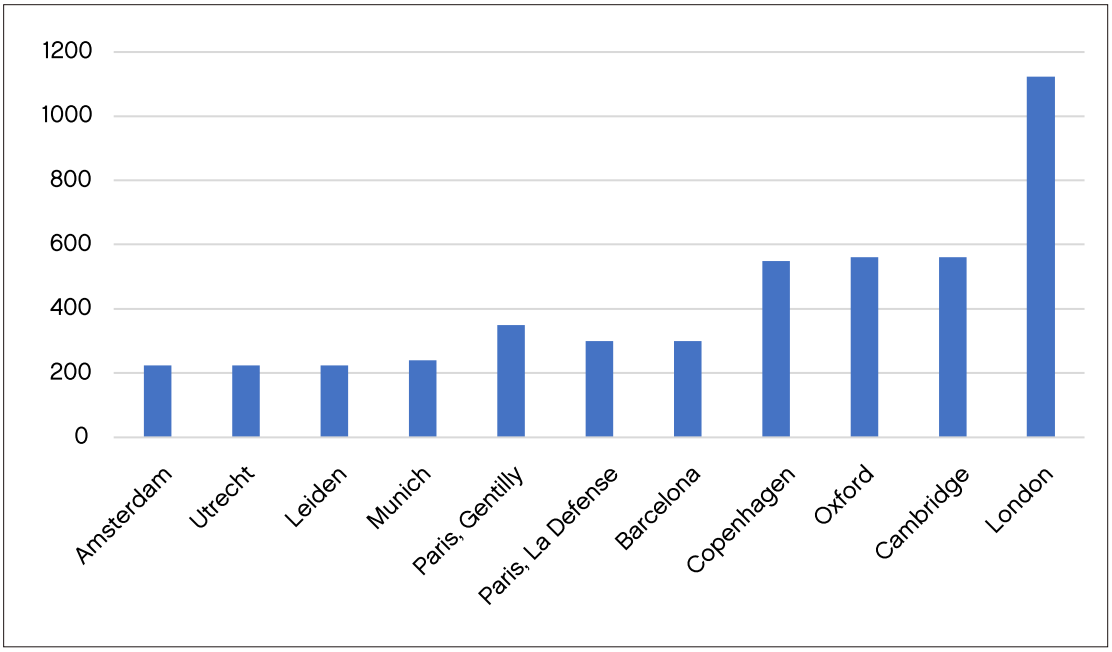
The UK's planning failures are exemplified by its persistent inability to deliver the laboratory space required for basic research and scaling companies. While this demand is led by life science firms, all companies requiring laboratories – including semiconductor and other physical science companies – suffer from a lack of available space. This shortage is reflected in elevated laboratory rents in London, Oxford and Cambridge, where rates are far above other European centres.[127] In addition to this demonstrating high levels of demand, it also increases company inefficiency: money spent on rent could otherwise be reinvested or used to pay salaries.

125 Web Archive – RIBA, *Albertopolis.* Link

126 Royal Albert Hall, *Prince Albert's cultural vision and the history of South Kensington: What is Albertopolis?* Link

127 Savills, *Spotlight: Oxford Offices & Laboratories – March 2022.* Link

Lab rents/sqm in €



These rents are also far in excess of office rents or residential space. Average rents for lab space across London are £991/sqm, almost 25% higher than average Grade A office rents in the City (£802/sqm)[128], and orders of magnitude above prime London residential areas such as Kensington and Chelsea or the City of Westminster.[129]

Taking the example of Oxford and Cambridge (for which robust data is available): average annual laboratory demand since 2022 for the two towns has been estimated 335,000 sq ft per year. Despite this, average annual availability since 2017 has been less than 150,000 sq ft, meaning that on average, almost 200,000 sq ft of demand has gone unmet each year.[130] [131]

Case Study: Temporary Sequencing Laboratory, Cambridge

In August 2021, the Wellcome Sanger Institute (WSI) applied for planning permission for a temporary genome sequencing laboratory of roughly 1,600 sq m on its existing site outside Cambridge.[132] The laboratory's intended location was adjacent to an existing laboratory, and is surrounded by nothing but empty fields, car parks and more laboratory buildings for approximately 150m in every direction.

In making the application, WSI had to prepare 30 separate documents,[133] which included a computer-rendered three-dimensional analysis of the impact on sunlight for adjacent buildings that would be caused by the

128 Oktra, *The Cost of Office Space in London 2023.* Link

129 Nested, *Rental Affordability Index (2017).* Link

130 Bidwells, *Arc Market Databook: Offices and Labs, Cambridgeshire Summer 2022.* Link

131 Bidwells, *Arc Market Databook: Offices and Labs, Oxfordshire Summer 2022.* Link

132 Urban & Civic Development Limited, *Application for Planning Permission: 11 August 2021 (accessible as "Application Form" at* Link)

133 Greater Cambridge Shared Planning, *Planning Application Documents.* Link

temporary laboratory.[134] This does not include fees for legal and consultancy representation for managing the application, which would have increased WSI's costs by thousands – if not tens of thousands – of pounds.

WSI also undertook pre-application engagement, including consultation with Hinxton Parish Council, who represent a nearby town of approximately 330 residents whose councillors were all elected uncontested in 2022.[135]

South Cambridgeshire District Council did grant planning permission, but subject to a number of conditions.[136] These included:

- No construction site machinery could be operated, nor construction deliveries received or dispatched from the site, except from 8am-6pm on Mondays to Fridays, and 8am-1pm on Saturdays, excluding all public holidays. The purpose of this condition was to '*protect... people living... nearby*', despite the nearest home being more than 400m from the site, as well as over both a river and a train track.

- No external lighting could be erected unless approved separately by the council as part of an 'artificial lighting scheme', requiring identification of areas *'particularly sensitive for bats'*, as well as layout plans, diagrams and a schedule of technical details to be approved separately by the council. The purpose of this condition was to '*protect the amenities of nearby residential properties'*, and to '*ensure the protection of on-site biodiversity'*. As described above, there was nothing but laboratory buildings, car parks and empty fields within 150m in every direction of the site, and no residential properties for over 400m.

- The building must use Scandinavian redwood cladding to protect *'the character and appearance of the area'*.

It is true that it is extremely rare for planning authorities for Oxford and Cambridge to reject applications for new laboratory space (with applications having only been declined a handful of times over the past decade). But this tallies with the structure of the UK's planning law: the prohibitive cost and discretionary nature of the planning system mean that developers are highly risk-averse, and avoid submitting controversial applications that are not likely to be accepted. This has the net effect of reducing applications for, and therefore availability of, new space. As one analyst has written: *'there is an unknown number of applications which are never made as firms suspect they will not succeed.'*[137] And the enormous gulf between the price of lab space and the cost of building more lab space, and indeed a discussion with any developer, implies that that number is very large indeed.

Most concerningly for growth, demand for increased space is now driven by larger companies, rather than smaller start-ups. In 2021, 58% of demand for space in Cambridge was from companies seeking more than 30 units. In Oxford, 61% of all

134 Wellcome Sanger Institute, *3D Views – Solar Analysis, 11 August 2021 (accessible via* Link)
135 South Cambridgeshire District Council, *Notice of Uncontested Election.* Link
136 Greater Cambridge Shared Planning, *Decision Notice.* Link
137 Centre for Cities, *Planning for the future.* Link

demand for laboratory space came from firms seeking more than 50 units. This is clear evidence that, at least in Oxford and Cambridge, larger growing companies are disproportionately suffering from their areas' failure to deliver the infrastructure supply that they need. Nor are other countries standing still. In Boston alone, ground was broken on more than 3.9 million sq ft of laboratory developments in 2022.[138]

Industrial development

As with laboratory space, the national picture for industrial land development shows that the planning system is failing to ensure supply keeps pace with demand. Data from Knight Frank shows that industrial and logistics land values have increased by 163% in the three years to 2022.[139] Evidence also shows real-terms rent increases every year since 2013, as well as falling vacancy rates, reflecting suppressed demand for an estimated 10 million sq ft of industrial space which was never constructed.[140]

'Data from the ONS shows that only 6.5% of the UK's private sector construction activity since 2010 has been industrial development'

Data from the ONS shows that only 6.5% of the UK's private sector construction activity since 2010 has been industrial development.[141] In the words of industry specialists: '*The UK planning system is restricting growth in the industrial and logistics sector by not allocating enough land in the right locations.*'

While the national picture is clear, the local environment is more mixed. Although Oxford has more than delivered the 500,000 sq ft demanded annually by industrial businesses in the area,[142] Cambridge has delivered far less, on average meeting only 74% of industrial demand in the past six years – and that was itself a level which was needlessly suppressed by unnecessarily high rents.[143] And the trends for laboratory space hold true for industrial space: 51% of demand in Cambridge and a staggering 75% in Oxford comes from companies requiring more than 50 units.

This disparity between areas is exacerbated by the UK's dysfunctional planning system. Each council is able to assess development need according to its own criteria, and will have a different appetite for permitting construction. This would be more defensible if industry's needs were being met at a national level. However, the overall picture shows countrywide shortages of space, indicating systemic failure by planning authorities. This also reflects the failure of the nationwide planning system to allow planning authorities to reap the enormous potential economic incentives of permitting development – something which works much better in Switzerland or the United States.

The question for Government is whether nationally significant industries, such as the semiconductor sector, should have their prospects hamstrung by the vagaries of

138 Bisnow, *The 6 Boston-Area Localities That Saw The Most New Lab Construction This Year: 20 December 2022.* Link

139 Knight Frank, *Research 2022: Industrial Land Values.* Link

140 Savills, & BPF, *Levelling Up – The Logic of Logistics.* Link

141 ONS, *Construction statistics, Great Britain: 2021.* Link

142 Bidwells, *Arc Market Databook: Industrial Oxfordshire Summer 2022.* Link

143 Bidwells, *Arc Market Databook: Industrial Cambridgeshire Summer 2022.* Link

local politics, or by national rules that prohibit local authorities from receiving more benefit from granting permission.

We believe the following recommendations would reduce cost and bureaucracy for laboratory and industrial developers, as well as increasing certainty of outcome.

Recommendation: HMG should use the powers in the Levelling Up and Regeneration Bill to issue national development management policies affecting laboratory and industrial construction which have supremacy over local plans.

Section 87 of the Levelling Up and Regeneration Bill (LURB), which is currently before the House of Lords, grants the Government the power to create national development management policies (NDMPs) for the use of land across England. Crucially, other measures in the LURB ensure that planning authorities' local plans cannot be inconsistent with NDMPs (contained in Section 15C, Schedule 7 of the draft Bill, which amends the relevant section of the Planning and Compulsory Purchase Act 2004).[144]

This is in contrast with the planning authorities' relationship with the National Policy Planning Framework (NPPF) under current legislation. Section 19(2)(a) of the PCPA 2004 says that councils must 'have regard' to 'national policies… issued by the Secretary of State', when drawing up local plans, but not that these plans cannot be inconsistent with, for instance, the NPPF.[145] The LURB's measures will therefore place a stronger obligation on local councils to abide by national planning policy than the status quo. By extension, they will give national government more powers to regularise and influence planning policy around laboratory and industrial space of which, as described above, there are intense national shortages.

For these reasons, the relevant clauses of the LURB should be retained, and the recommendations below should, where applicable, be issued under the powers used to designate planning policies as NDMPs so that local authorities must abide by them.

Recommendation: HMG should amend the NPPF such that, for areas within three miles of university campuses, there shall be a presumption in favour of laboratory development.

The NPPF as currently drafted maintains the *'presumption in favour of sustainable development'*,[146] which obliges planning authorities' local plans to promote environmental protection, mitigate climate change and expedite planning decisions where those needs are met by proposals. In the press release when the presumption was introduced in 2011, the Government characterised the pre-existing system as *'slow, costly and gives [applicants] no certainty',* adding that *'the presumption will be a key tool in helping to turn this situation round'*.[147]

144 Section 87, *Levelling Up and Regeneration Bill.* Link

145 Section 19(2)(a), *Planning and Compulsory Purchase Act 2004.* Link

146 Paragraph 11, *National Planning Policy Framework.* Link

147 HM Government, *Positive planning: a new focus on driving sustainable development.* Link

The Government already uses the NPPF to promote policy goals such as environmental protection, human health and sustainability. But other policy objectives, such as promoting the UK as a science superpower, boosting R&D and strengthening the economy, should surely be reflected and incorporated as well.

For example, given the national shortage of industrial and research space, a 'presumption in favour of research development for areas near universities' could be introduced. This would ensure that local authorities must incorporate into their local plans the requirements of research-intensive businesses. To avoid unintended consequences, the impact of this change would be limited to a certain geographic distance from universities, meaning that only the most R&D-intensive areas of the country would be forced to account for research concerns when making local plans.

'The Government already uses the NPPF to promote policy goals such as environmental protection, human health and sustainability'

Amendments to the NPPF are issued under the general power to issue national planning policies contained in Section 19(2)(a) of the PCPA 2004, although this may be subject to consultation requirements to reduce the risk of judicial review. Subsequently, issuing amendments to the NPPF does not require primary legislation.

Recommendation: HMG should amend Section 44 of the NPPF to reduce local authority discretion over local information requirements for laboratory and industrial planning applications, and introduce clauses elsewhere in the NPPF to encourage national standardisation.

In addition to national requirements for submitting planning applications, local planning authorities can also require specific submissions, called 'local validation requirements'. These are influenced by Section 44 of the NPPF, which says that such validation requirements should be 'relevant, necessary and material to the application in question', and in general interact with other areas of the NPPF which state that local planning should aim to deliver generalised outcomes, such as 'enable and support healthy lifestyles', and 'support an appropriate mix of [transport] uses across an area'.

As a result of the NPPF's vague language, local validation requirements are a substantial obstacle on applicants for planning, often requiring dozens of additional documents containing images, drawings, pictures and detailed statements. Birmingham City Council requires up to 42 supplementary documents for a planning application.[148] Manchester City Council requires up to 40 additional documents and pieces of information. In the case study above regarding the Temporary Sequencing Laboratory in Cambridge, local validation requirements were responsible for almost 200 pages of additional documentation being submitted prior to obtaining planning permission.

148 Birmingham City Council, *Local Validation Criteria 2021.* Link

On top of this, documents required by some councils are not required by others, increasing cost by requiring potential developers to seek out specialised advice for each local authority. For instance:

- Cambridge City Council may require a Public Art Strategy.[149]
- Oxford City Council may require a Tree Canopy Cover Assessment.[150]
- Manchester may require a Blue and Green Infrastructure Statement and a Crime Impact Statement.[151]
- Birmingham City Council requires Health Impact Assessments (HIAs) for all applications that also require an Environmental Impact Assessment.
- Cambridge City Council requires HIAs only for aviation development at Cambridge Airport.
- Oxford City Council has two different types of HIA, 'rapid' and 'full', which are required for developments above 10 dwellings or 1000 sq m, depending on other characteristics of the proposed development.[152]

'Through amendments to the NPPF, the Government could state clearly what considerations councils should be able to take into account when demanding additional information'

Through amendments to the NPPF, the Government could state clearly what considerations councils should be able to take into account when demanding additional information. As an indicative example, the current wording of Section 44 of the NPPF could be amended to include the sentence: 'For applications for research or industrial land use, local planning authorities should only request supporting information that is relevant, necessary and material to the application in question and relates to health, environmental, economic and construction-related impacts.'

This could be combined with obligations via the NPPF on councils to create standard templates for local information requirements with maximum page lengths, which will only be deviated from under exceptional circumstances. For commonly used assessments such as the HIA, the NPPF could set national standards for the type of development for which these requirements would be appropriate. As described above, the issuance of this policy as a NDMP would increase its impact over local planning policy.

Recommendation: Relevant governments should issue development orders granting permitted development rights in areas identified as semiconductor clusters.

Even without new primary legislation, national governments have enormous powers to improve the current planning system via secondary legislation. Section 59 of the Town and Country Planning Act 1990 (TCPA 1990) grants relevant ministers in

149 Cambridge City Council, *Planning application validation requirements for Cambridge City Council.* Link

150 Oxford City Council, *Planning Application Requirements.* Link

151 Manchester City Council, *Full, Outline, Reserved Matters & Variation/Removal of Conditions Planning Application.* Link

152 Appendix 4, Oxford City Council, *Adopted Oxford Local Plan 2036.* Link

England and Wales the power to issue development orders, which may 'provide for the granting of planning permission'.[153] These orders can be specific in geographic scope: Section 59(3)(a) of TCPA 1990 gives that orders may be *'applicable only to such land or descriptions of land as specified in the order'*.

These powers have been used before, most notably in the creation of Permitted Development Rights, which were issued in the General Permitted Development (England) Order 1995 and later consolidated in a 2015 Order.[154] The Housing Secretary at a stroke granted planning permission for entire categories of property improvement, including:[155]

- Larger domestic rear extensions
- Conversion of shops into financial and professional services premises
- Conversion of storage and distribution buildings to residential dwellings
- The installation of solar panels on non-domestic buildings

To support the growth of the UK's semiconductor sector, the relevant governments should issue development orders for England and Wales covering semiconductor clusters. These could include the clusters identified by the BEIS Select Committee in their inquiry, which include:[156]

- The North East England cluster
- The South Wales Semiconductor Cluster (including Newport Wafer Fab)
- The South West England cluster
- Cambridge and its immediate surrounding area

These development orders could, for instance, provide planning permission for conversions from retail or commercial space to research or industrial sites, extensions of existing industrial and laboratory sites, or construction of new sites (provided they are no larger than a given size).

Recommendation: HMG should update the Permission in Principle Order to allow for development of laboratories or research space on brownfield sites.

The Town and Country Planning (Permission in Principle) Order 2017 creates 'permission in principle', intended to be an expedited route to achieve planning permission on sites on councils' brownfield registers.[157] The Government said during consultation on the measures that 'permission in principle' would *'help to make the planning system more certain and efficient',*[158] with Gavin Barwell, then-Housing Minister, adding that the route would *'[give] up-front certainty for developers'.*[159]

The 2017 Order only applies to land on brownfield registers, which councils are ordered to publish under the Town and Country Planning (Brownfield Land Register)

153 Section 59, *Town and Country Planning Act 1990.* Link

154 *The Town and Country Planning (General Permitted Development) (England) Order 2015.* Link

155 Paragraph 7, DCLG, *Explanatory Memorandum to [various planning-related statutory instruments].* Link

156 BEIS Select Committee, *The semiconductor industry in the UK.* Link

157 *The Town and Country Planning (Permission in Principle) Order 2017.* Link

158 DCLG, *Government response to the technical consultation on implementation of planning changes: Permission in principle and brownfield registers.* Link

159 Gavin Barwell, *CPRE Annual Lecture.* Link

Regulations 2017.[160] In the register, councils must, depending on the characteristics of the land, also publish for each identified brownfield site a minimum (and potentially a maximum) figure of 'net dwellings' capable of being supported by the site.

This method of securing planning permission, where an in-principle permission is obtained from the planning authority followed by technical negotiations on the detail, should be extended to laboratory and research facilities on brownfield sites. To ensure that housing delivery does not unduly suffer as a result of this expansion, brownfield sites subject to laboratory or research redevelopment under permission in principle could have minimum new dwelling requirements, for instance 50% of the planning authority's assessment in the brownfield register.

'Even without new primary legislation, national governments have enormous powers to improve the current planning system via secondary legislation'

Where proposed brownfield developments include a significant proportion of laboratory or research space, the restriction on granting permission in principle for "major development" (which, for instance, limits its application to proposals of no more than 1000sqm or 9 new dwellings) should also be relaxed.[161]

Amending the 2017 Order does not require new primary legislation, as it was originally issued under regulatory powers contained in, among others, Sections 59 and 59A of TCPA 1990.

160 Section 3, *The Town and Country Planning (Brownfield Land Register) Order 2017.* Link

161 Section 5B(1)(a), *The Town and Country Planning (Permission in Principle) Order 2017* (as amended by *The Town and Country Planning (Permission in Principle) (Amendment) Order 2017*, Link)

Part 5: Machinery of Government

Even after the February 2023 reshuffle, no fewer than six different Whitehall departments are responsible for different parts of semiconductor policy. This is emblematic of the UK's fractured and insufficiently transparent approach to emerging technology sectors in general, and semiconductors in particular.

On the economic front, encouraging investment into the UK,[162] as well as responsibility for the Export Control Joint Unit,[163] sits with the Department for Business and Trade. As already described, control of HMG's innovation funding,[164] sits with the Department for Science, Innovation and Technology. However, approval of any new tax incentives and concurrent spending must go through the Treasury.

> **'No fewer than six Whitehall departments are responsible for different parts of semiconductor policy'**

On national security, the set of responsibilities is equally divided. Given the direct military applications of the most cutting-edge semiconductors, it is unsurprising that the Ministry of Defence takes an interest. However, the National Security Secretariat,[165] containing the National Security Adviser (who has at times been responsible for determining the risk from certain investments in the UK semiconductor sector)[166] sits in the Cabinet Office, as does the Investment and Security Unit which screens transactions under national security legislation. In addition to these two, the Foreign, Commonwealth and Development Office administers the Academic Technology Approval Scheme,[167] which vets international students and researchers applying to the UK to study or work in sensitive fields.

And despite this crowded array of interests, the UK's formal Semiconductor Strategy was (until the February 2023 reshuffle) led by the Department for Digital, Culture, Media and Sport, rather than one with specific policy levers over the sector.[168]

This lack of coordination has led to semiconductor firms receiving contradictory messages from the Government. In an oral evidence session with the BEIS Select Committee, Simon Thomas, CEO of UK semiconductor firm Paragraf, said that his company had been asked by the Department for International Trade to consider relocating assembly and testing outside the UK:

162 DIT, *About us.* Link

163 DIT, *Export Control Joint Unit.* Link

164 HM Government, *UK Research and Innovation.* Link

165 Cabinet Office, *About us.* Link

166 National Security Adviser, *Newport Wafer Fab: 17 December 2021.* Link

167 FCDO, *Academic Technology Approval Scheme.* Link

168 DCMS, *Written evidence from DCMS to the BEIS Select Committee's inquiry "the Semiconductor Industry in the UK".* Link

'We were approached by the DIT a few weeks ago. "Why don't you outsource your OSAT business – outsourced assembly and testing – to a company in Malaysia?" "I am sorry. We want to be in the UK". UK DIT is telling us, "No, go and do it in Malaysia".'[169]

Even after the welcome creation of DSIT and rationalisation of Government departments, the remaining division of responsibility is still greater than that in other jurisdictions. In the United States, for example, last year's CHIPS Act allocates funding for direct subsidies and loans for the semiconductor sector. It gives responsibility for the design of these programmes to just one department: the Department of Commerce (DOC).

'The priority must be to establish a clear and visible forum for coordination of semiconductor policy across Whitehall, and indeed emerging technology policy more generally'

That same department is also responsible for other functions which in the UK are managed across Whitehall. It manages the US entity list, which has some of the functions of the ECJU. It distributes funds through the National Institute for Standards and Technology, analogous in some respects to UKRI's funding councils. DOC is also responsible for the SelectUSA programme, encouraging FDI from around the world. In addition, the Commerce Secretary is a member of CFIUS, the US' national security investment clearance apparatus and analogous to the UK's Investment and Security Unit. This concentration of powers means that US policy can be far more easily coordinated, and therefore is far more likely to be coherent and effective.

Investors also benefit from the clear articulation that the US government provides of its policy priorities. In September last year, Jake Sullivan, the US National Security Adviser, announced a shift in US strategy as it relates to high-end chips:

'We have to revisit the longstanding premise of maintaining "relative" advantages over competitors in certain key technologies... Given the foundational nature of certain technologies, such as advanced logic and memory chips, we must maintain as large of a lead as possible.' [170]

This is an unambiguous statement providing useful, predictive clarity regarding how the US will act with regards to domestic technology. By comparison, the UK has given at least five distinct reasons as to why certain foreign investments into the semiconductor sector might damage the UK's national security. And these were not disclosed in major, departmental strategy documents or public speeches, but drip-fed in obscure, technical filings:

- *'Market effects... that may lead to... lower incentive to innovate or a reduction in diversity'*[171]
- *'Market effects that may... further decrease the economic motivation to prioritise security'*[172]

169 Q54, BEIS Select Committee, *Oral Evidence: the semiconductor industry in the UK Questions 46 – 98.* Link

170 The White House, *Remarks by National Security Adviser Jake Sullivan: 16 September 2022.* Link

171 Paragraph 11(a), DCMS, *Proposed Acquisition of Arm Ltd by NVIDIA corporation: Consultation on Phase 2 reference.* Link

172 Paragraph 11(c), Ibid.

- *'Exposure to regulatory processes that could alter current governance structures'*[173]
- *'Technology and know-how that could result from a potential reintroduction of compound semiconductor activities at [the named site], and the potential for those activities to undermine UK capabilities'*[174]
- *'The location of the site [which] may prevent [sites nearby] being engaged in future projects'*[175]

Given the slim likelihood of any further reorganisation of the machinery of government or ministerial responsibilities, the priority must be to establish a clear and visible forum for coordination of semiconductor policy across Whitehall, and indeed emerging technology policy more generally.

Recommendation: HMG should use the National Science and Technology Council (NSTC) to actively coordinate semiconductor and other emerging technology policy across Government. The NSTC should publish a formal, public and clear statement of national security policy as it relates to emerging technology investment and development. To operate effectively, the NSTC should also meet at least twice monthly.

Compared with previous administrations, the Sunak Government has taken steps to rationalise coordination across government on these issues through the recreation of the NSTC, which has key Cabinet ministers as members.[176] This committee could be the driving force behind a coordinated approach to semiconductor policy, and the Government should seize the opportunity to make it so.

To assist third parties, such as investors, semiconductor firms, researchers and international partners, the NSTC itself (or Downing Street) should publish a statement of national and economic security policy as it relates to emerging technology. This should provide actionable clarity for business as to how the Government will approach its role as a regulator in these sectors, comparable with the speech by US NSA Jake Sullivan quoted above.

The diffuse nature of responsibility for emerging technology across Whitehall, particularly for semiconductors, has practical consequences for the NSTC's operation. The NSTC has 12 members, of which 11 are Cabinet rank. If each member were to speak for just five minutes, the meeting would last an hour. To ensure that the NSTC has the capacity to fully address its broad terms of reference, and to allow for substantive discussion on topics as needed, the NSTC should meet at least twice monthly.

Recommendation: The Chancellor of the Duchy of Lancaster should create a forum for the departments for science and business to input into national security investment decisions, with the goal of ensuring a coherent approach to national security and innovation across the department.

173 Paragraph 11(d), Ibid.
174 Paragraph 5 (i), BEIS, *Publication of notice of Final Order.* Link
175 Paragraph 5 (ii), Ibid.
176 Cabinet Office, *List of Cabinet Committees and their membership.* Link

As a result of the February 2023 reshuffle, the Investment and Security Unit was moved from BEIS to the Cabinet Office. While this is a welcome rationalisation of the UK's national security apparatus, it means that decisions on FDI into the UK and on emerging technology research will no longer be taken by a department with a focus on economic growth.[177]

As such, it runs the risk that there is insufficient input from growth-facing departments, as well as those with specialisms in emerging technology areas, into investment or research-partnership clearance decisions. This is particularly important as new departments have specifically been tasked with boosting international investment and scientific collaboration:

- The new Department for Business and Trade's remit includes *"[strengthening] our offer to international investors"* and a priority outcome is to *"attract high-value investment"*.

- One of the Department for Science, Innovation and Technology's priority outcomes is to *"strengthen international collaboration on science and technology"*.

Given that the stated policy outcomes of these departments intersect with the new powers of the Cabinet Office, it is vital that one arm of Government does not pull against the other. In addition, key teams issuing advice on national security, such as RCAT, no longer sit in the same department as the decision maker on those risks. This could result in coordination issues, with some parts of Government becoming less effective due to key decision-makers being located elsewhere in Whitehall.

To minimise the likelihood of this occurring, the Chancellor of the Duchy of Lancaster should create a forum or mechanism to ensure the perspectives of key economic departments are considered when making national security decisions, and to share views and perspectives. This should be more formalised than simple consultation on a case-by-case basis, to ensure that national security concerns are integrated into departmental thinking.

177 HM Government, M*aking Government Deliver for the British People.* Link

Conclusion

Semiconductors underpin almost every electronic device on the planet, and the UK has internationally recognised strengths in key parts of the supply chain. This report has argued not only that there is a need to act as semiconductor and other emerging technology supply chains play an increasing geopolitical role in coming decades, but also that these sectors present a notable economic opportunity for the UK to deliver economic benefits across the whole country.

This overlap between industrial strategy and national security has led to a volatile global landscape for the technologies of the future. Governments around the world are increasingly interfering with routine business transactions on national security grounds, as well as pouring billions into directly funding private enterprise.

‘Semiconductors underpin almost every electronic device on the planet, and the UK has internationally recognised strengths in key parts of the supply chain’

In this report, we have presented policy recommendations to assist the Government in answering the question of how it should respond. Rather than relying on inefficient, unaffordable and market-distorting subsidies, the UK should choose a market-led, investment friendly approach to attract international capital into exciting British industries.

This can be accomplished with a primarily deregulatory approach: lowering taxes on investment, reducing barriers to construction, and reducing obstacles to hiring and cross-Whitehall coordination.

Of course, there is no single silver bullet to creating a world-leading semiconductor industry in the UK. Each of the barriers to growth must be tackled individually, gradually improving the business environment. This is also true for other technology sectors such as AI, quantum and life sciences – for while this report has been drafted with the semiconductor industry primarily in mind, the proposals are intentionally not specific to that sector alone.

Adopting these recommendations would be a step-change for some of the fastest-growing and most strategically important sectors in the UK. It could be accomplished in a matter of months at relatively little cost to the Exchequer. In doing so, the UK Government would have acted firmly to support key areas of national advantage, and position the UK economy for the future.

57 Tufton Street, London, SW1P 3QL
February 2023
ISBN 978-1-914008-33-7