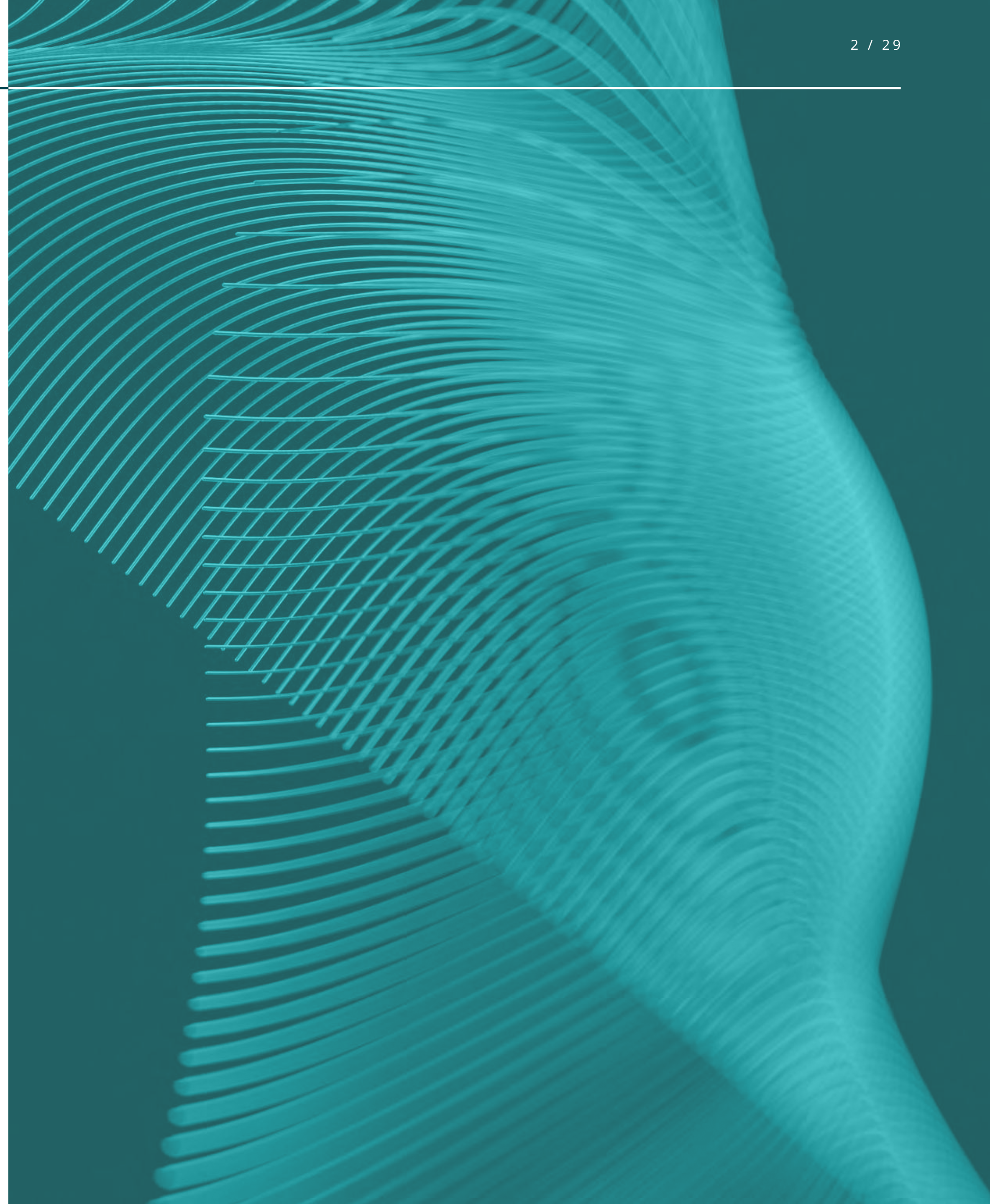


IMPACT EVALUATION REPORT



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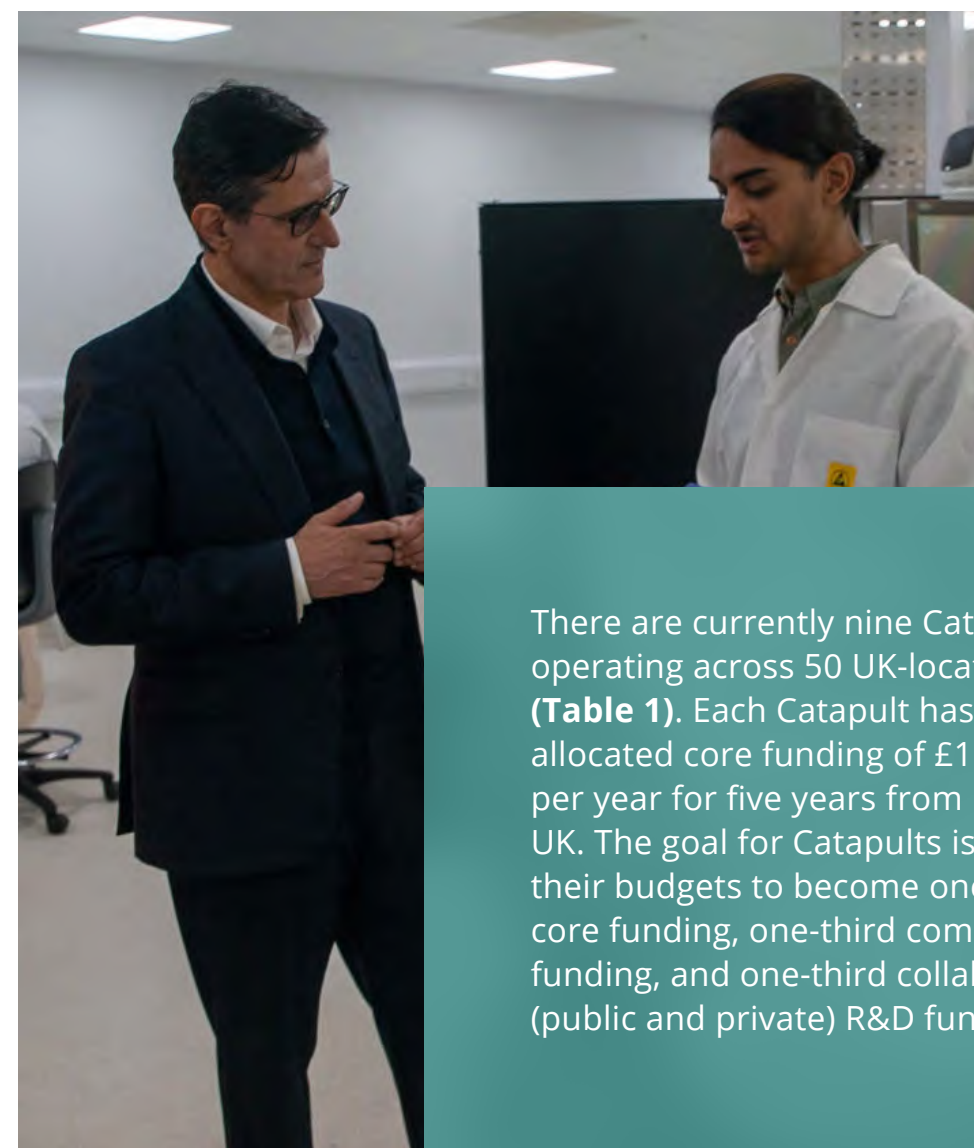
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INTRODUCTION

About the Catapult Network

Catapults are a UK-wide network of world-leading technology centres, designed to promote innovation, research and development in key sectors and stimulate economic and technological growth. Established and core funded by The Technology Strategy Board - later Innovate UK - Catapults create environments for innovation by providing cutting-edge R&D facilities and by fostering collaborations between industry, government, and academia.



There are currently nine Catapults operating across 50 UK-locations (Table 1). Each Catapult has been allocated core funding of £10 million per year for five years from Innovate UK. The goal for Catapults is for their budgets to become one-third core funding, one-third commercial funding, and one-third collaborative (public and private) R&D funding.

Table 1: UK Catapults

| Catapult | Established |
|-------------------------------------|-------------|
| High Value Manufacturing | 2011 |
| Cell & Gene Therapy | 2012 |
| Satellite Applications | 2012 |
| Digital | 2013 |
| Offshore Renewable Energy | 2013 |
| Energy Systems | 2015 |
| Medicines Discovery | 2015 |
| Compound Semiconductor Applications | 2016 |
| Connected Places | 2019 |

1.2 About the Compound Semiconductor Applications (CSA) Catapult

The Compound Semiconductor Applications (CSA) Catapult supports the development of compound semiconductors and their applications through work to accelerate the use of compound semi-conductor devices within five key areas of application: healthcare; digital economy; energy; transport; and defence and security. CSA Catapult operates primarily in four key areas:

- Power electronics
- RF & microwave
- Photonics
- Advanced packaging

Whilst established in 2016 as a legal entity, its five-year grant funding did not commence until July 2018. In the interim period, CSA Catapult recruited its Chairman, CEO, Board members and some members of the senior leadership team. It was initially situated in rented offices before the Innovation Centre was opened in Newport, providing a permanent base. The start-up phase – which included widespread industry engagement, development of consortia bids for collaborative R&D funding and creation of the Strategy and Delivery Plan - was supported via grant funding of £2,801,509 from Innovate UK. KPIs were established for CSA Catapult to take effect from April 2018. The vision for CSA Catapult is for the UK to become a global leader in developing and commercialising new applications for compound semiconductors.

The global compound semiconductor market is forecast to be worth \$200bn by 2027; the UK has approximately 8% share worth \$8bn. CSA Catapult supports economic growth by de-risking and accelerating innovation, enabling access to expertise, equipment, and tools, supporting cluster development, and bringing supply chains together. Based in South Wales, CSA Catapult announced in 2023 plans to open new offices in Bristol, Glasgow and Durham.

This is a vital role; recent research undertaken by the Royal Academy of Engineering and the Institute of Physics¹ indicates the UK's place in the global compound semiconductor industry is constrained by skills shortages, increasing costs and low awareness of semiconductor applications. This report urged the UK Government to publish its semiconductor strategy and indicated that a national 'semiconductor institute' could be a critical part of the solution. The recent Budget failed to address a UK semiconductor strategy despite strong commitment to making the UK a 'tech and science superpower by 2030'.

CSA Catapult has a crucial part to play in supporting the UK's semiconductor industry and enabling it to harness applications; it is essential that there is a clear and robust understanding of its impact, to help secure on-going funding and political support to maintain and enhance its role and remit.

Image: Indro Mukerjee, CEO of Innovate UK visits Compound Semiconductor Applications (CSA) Catapult

¹Institute of Physics and Royal Academy of Engineering Roundtable Report (2023), UK Semiconductor challenges and solutions: access to design tools and licensing; access to skills



“The first time they [customers] come to our offices and see our laboratories and working environment, they're amazed. The sheer, vast amount of equipment. Some of our x-ray machines, probably only one of three people in the country has got one. You're not going to spend a million pounds on one. That's the benefit of the Catapult, offering people the safe working environment of testing their imaginations.”

Catapult feedback

About this evaluation report

The Department for Trade and Industry, formerly the Department for Business, Energy and Industrial Strategy requires an independent external evaluation of its impact (this request has been made to all Catapults) to validate internal monitoring and evaluation findings, identify opportunities for improvement and make any relevant recommendations for change.

Harlow Consulting was commissioned to provide an independent impact evaluation of CSA Catapult; this report presents the findings from this study. Fieldwork took place between June and September 2023, and comprised:

- Desk-based analysis of evidence sources provided by CSA Catapult
- Assessment of survey data (survey of organisations that have engaged with CSA Catapult)
- Appraisal of processes and gate matrix used within CSA Catapult
- Depth telephone interviews with selected members of CSA Catapult team and stakeholders (17 in total)
- Depth telephone interviews with a sample of organisations that have engaged with CSA Catapult (13 in total)

2.0

KEY MESSAGES

2.1

Strong, clear strategic direction

One of the strengths of CSA Catapult is its clear strategic priorities right from the start, identifying two key markets at the outset using a prioritisation matrix. The first target was electric vehicles, in light of the importance of compound semiconductors to this industry, and in the context of a government focus on this sector. A second priority was telecoms and 5G. This approach has enabled the Catapult to offer very focused support.

The Catapult is home to one of the UK's four Driving the Electric Revolution Industrialisation Centres in the UK, funded by a £80m Investment from the Industrial Strategy Challenge Fund of UKRI.

CSA Catapult is playing a critical role in the development of supply chains for the decarbonisation of multiple sectors including transport such as electric vehicles in the UK and across the globe – a market in power electronics, motors, and drives (PEMD) predicted to be worth £5 billion in the UK by 2025.



2.2 Significant achievements in a short space of time – despite the pandemic

It should be noted that the Catapult was at early stages of development and on the verge of moving into its Innovation Centre when the pandemic hit. Expensive equipment had to be procured and commissioned via video-conferencing, and the Catapult's team had to quickly adapt to a home-working environment, and all of the associated pressures that this can bring. Employers engaging with the Catapult faced funding delays as R&D investment UK-wide was put under pressure.

In spite of the pandemic, the Catapult has made significant achievements in a relatively short timeframe:

- Grown in-house capacity/expertise
- Opened access to world-leading facilities, equipment, and industry experts
- Development of a sector-specific skills strategy currently being implemented
- Relationships developed with large, global organisations as well as a range of SMEs
- Critical enabling role in bringing together and building the UK compound semiconductor supply chain

2.3 Increases observed in Technology Readiness Levels (TRLs)

Three-quarters of the projects supported by the Catapult over the last five years have experienced a positive increase in their Technology Readiness Levels.

67%

of projects supported during this time achieved an increase between 1-3 TRL levels.

7% of projects supported during this time achieved an increase between 4-8 TRL levels.



Image: Ning Zhang, Photonics Engineer

CSA Catapult is able to accelerate positive outputs and outcomes for organisations

A number of employers have emphasised the role the Catapult has played in accelerating their route to market. CSA Catapult does not necessarily provide services and support that is unique; employers acknowledge that alternative organisations like universities and the National Physical Laboratory (NPL) could offer similar services (though it's not always a direct overlap), but for most employers interviewed the Catapult has been able to save them a great deal of time – therefore achieving cost savings. The strength of the relationship between the Catapult and the employer is critical – where there is very comprehensive understanding of the employer need, the Catapult team supporting them have been able to provide more bespoke advice and guidance.

“ Could we have achieved similar results without the Catapult? Yes, probably – but would we have achieved those results as quickly? No, we wouldn't. The Catapult definitely accelerated our journey and added value.”

Employer feedback

“ I can't say enough good things about the Catapult, by pointing us at the relevant funding they've saved us hours of time.”

Employer feedback

A number of employers have reported that their engagement with the Catapult has led directly to powerful impacts for their organisation – which they do not believe could have happened without this relationship.



“It's [our work with the Catapult] made a fundamental difference. Our 'go to market' strategy has shifted completely.”

Employer feedback



“It [our work with the Catapult] really set us on this particular journey that we're still on now. We would have never been here if it wasn't for the Catapult.”

Employer feedback

2.5

Evidence of job creation and increase to GVA, building the UK semiconductor supply chain

Assessment of new jobs created and safeguarded is based on analysis of CSA Catapult CRM data. This analysis has found between 2018 and 2023 a total of 2827 jobs have been created or safeguarded within organisations that have engaged with the Catapult.

The actual figure is likely to be higher on the basis that there are gaps in the dataset. CSA Catapult estimates that its “collaborative projects and other activities are forecast to create or safeguard more than 5000 jobs”. This figure has been based on internal intelligence and evidence within bid applications. It is recommended that CSA Catapult should ensure all data gaps are rectified, drawing on internal intelligence, to ensure a full and complete dataset for further impact analysis in due course.

On average, companies that have engaged with the Catapult have secured annual private investment of £107m and £11m of annual public sector investments.

◀ **2827** jobs have been created or safeguarded within organisations that have engaged with the Catapult.

2.6

Influence on national and international semiconductor strategy and policy

CSA Catapult has positively influenced the UK’s semiconductor strategy and policies – notably in the form of evidence and recommendations provided to central Government on a range of topics. One of these included the Telecoms Security Act, and following a case for change submitted to DCMS, a £250m intervention for telecoms diversification was announced.

CSA Catapult also provided oral evidence to the House of Lords Science and Technology Committee Inquiry, which looked at the Catapults’ contribution to delivering the UK’s R&D Roadmap. Written and oral evidence was provided to the Department for Business, Energy and

Industrial Strategy (BEIS) which informed their Committee report into the semiconductor industry in the UK. This report concluded that the UK government should be working to represent the UK’s expertise and to entrench and expand the UK’s role in the global semiconductor supply chain.²

The UK’s first ever National Semiconductor Strategy was subsequently launched at the Catapult.³ A representative of the Catapult has been recently appointed to the UK government’s Semiconductor Advisory Panel. Strong international relationships have also been developed, notably in India.

2.7

Impacts on cluster and innovation ecosystem

Employers are positive about the impact on the compound semiconductor cluster; the Innovation Centre and its four laboratories in particular are highlighted as centres of excellence, playing a critical role in enabling the innovation ecosystem.

The ecosystem and the Catapult’s interaction and strong relationships with partners in the South Wales cluster have been cited by employers as important factors influencing their decisions to engage with the Catapult

“

The Catapult provides a huge benefit to the UK PLC.”

Employer feedback

2.8

Focused approach to sector skills development

CSA Catapult is taking a leading role in skills development, underpinned by a clear skills strategy informed by comprehensive evidence gathered about specific needs.

Of significant value is the 'foresighting' research which has been undertaken to understand the skills requirements – not just for now, but for the future. Taking the time to understand the landscape before producing a detailed plan means the Catapult is able to directly respond to sector needs.

2.9

Opportunities to maximise impacts through internal process improvements

There are clearly many positive impacts to report in relation to CSA Catapult's journey to date. Analysis of the evidence gathered for this evaluation has identified a number of opportunities for the Catapult to address, in order to maximise and sustain positive impacts moving forward:

- Retention of staff, particularly engineers and project managers, can be a challenge and can have a knock-on effect on project delivery and employer experience. A sustained focus on recruitment and employee engagement may help to offset this.
- A centralised approach to project management, led by a PMO office, would ensure time spent by the technical teams could be ring-fenced, with customer relationships and project management handled by another part of the organisation.
- The perception held by some SMEs that engaging with the Catapult can be expensive could be explored, with evidence gathered over time to ascertain the extent to which this is a barrier, and how this can be overcome.
- Employers that have engaged with CSA Catapult emphasise the importance of *"ploughing their own furrow – the worse thing they could do is copy other Catapults"*.

2.10

Catapult employees are justifiably proud of the part they have to play

There is a strong sense of purpose within the Catapult team; interviewees recognise the impact their work is able to have on the sector and are keenly interested in understanding the long-term effects of the Catapult's work as the organisation continues to expand.

“The team working with us at the Catapult is worlds apart. It's not just the level of professionalism – it's also the energy and excitement for what we're doing.”

Employer feedback

IMPACTS TO DATE

Impacts for organisations engaging with the Catapult

The highest proportion of projects won are in collaborative R&D (Figure 1).

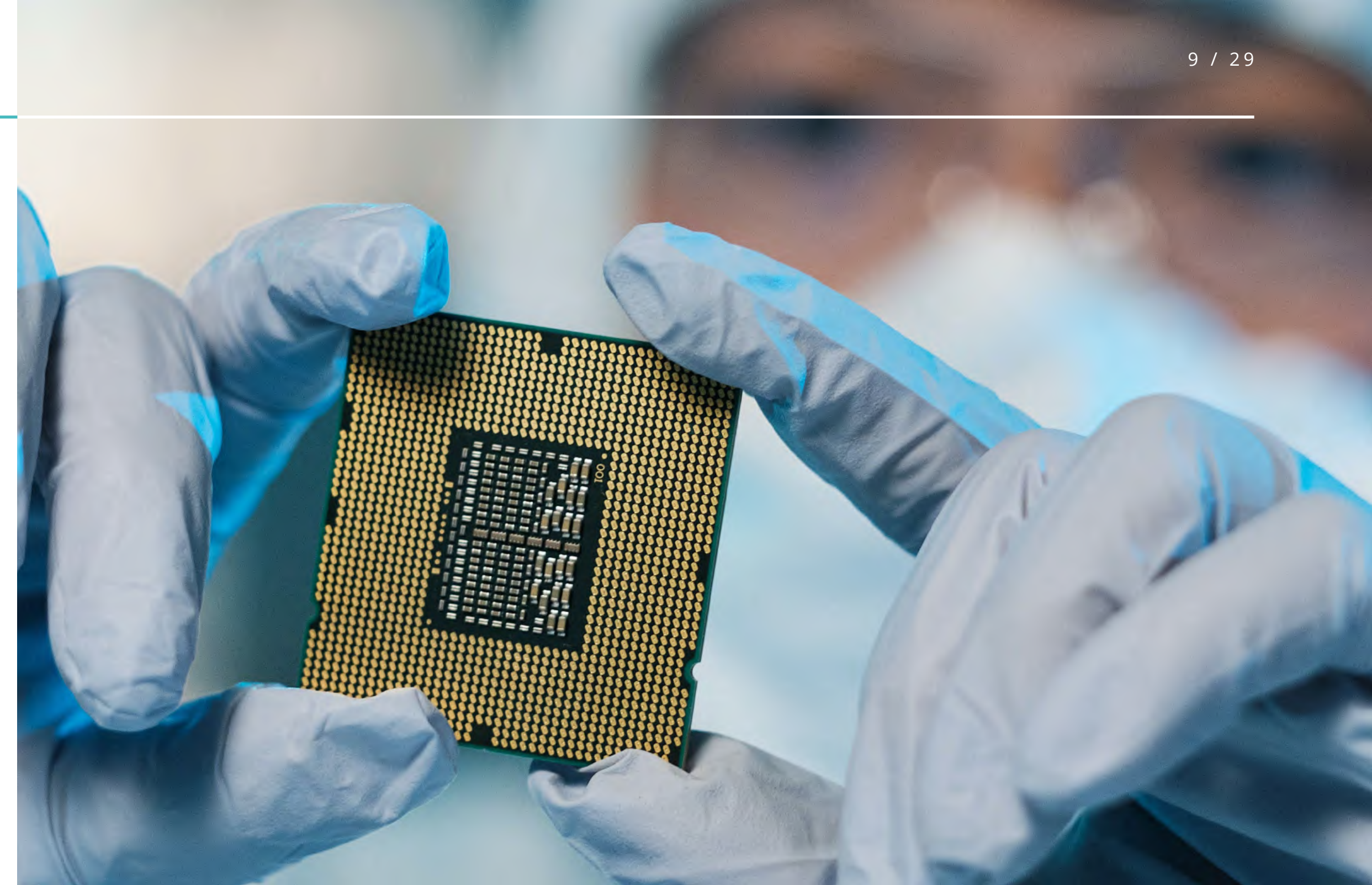
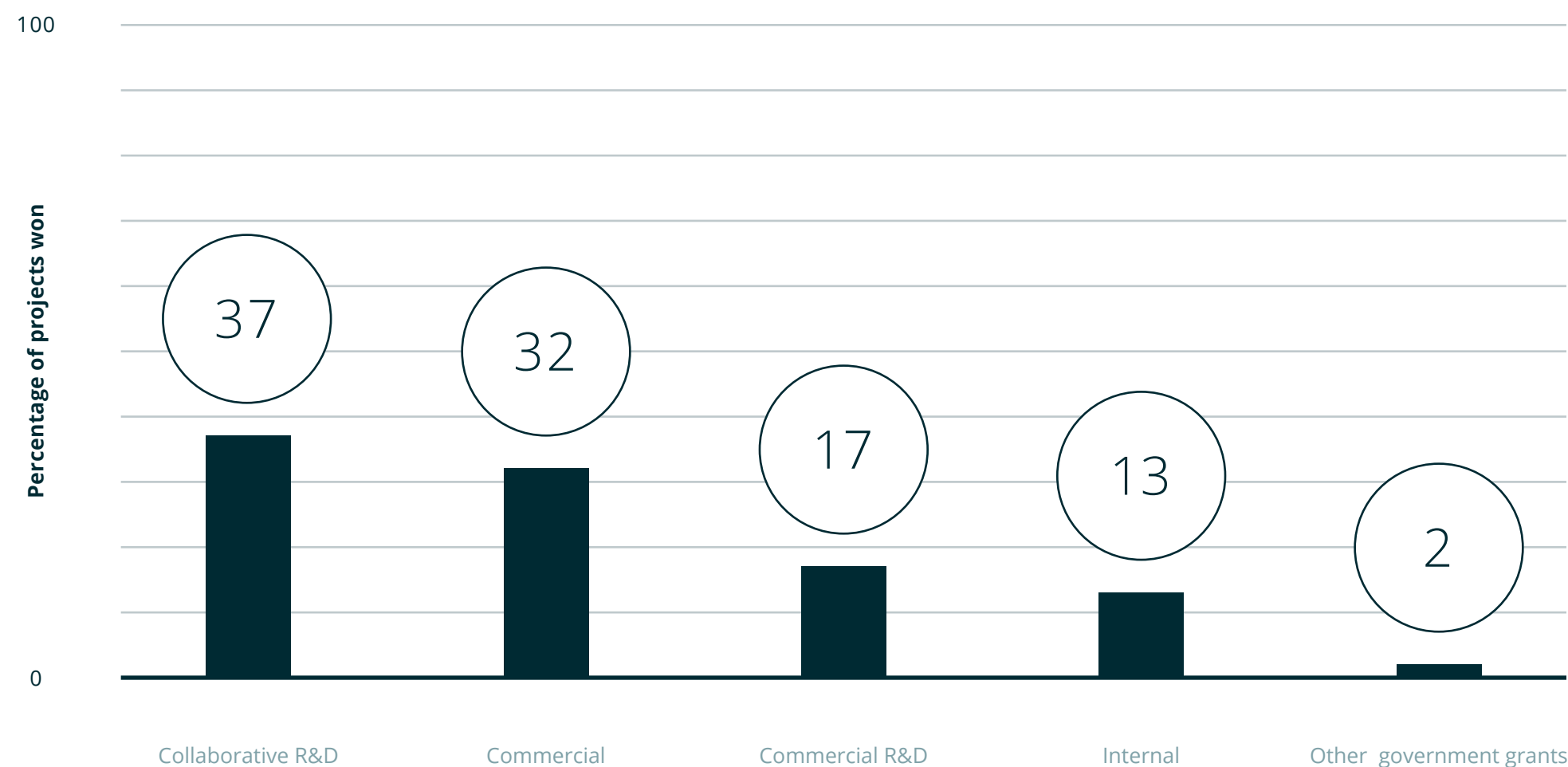


Figure 1: Number of projects won by CSA Catapult (by project type) July 2018 – February 2024



3.1.1 Bid writing

Employers engaging with CSA Catapult are extremely positive about its expertise in bid writing – notably the extent of support provided with all aspects of bids and grant applications, and the strong likelihood of success in securing monies as a result.

“It’s pretty easy to draw the links. We probably wouldn’t be here as a company if we didn’t win that grant. You can then probably reasonably say everything subsequent to that has been helped a lot by that first interaction.”

Employer feedback

Access to facilities, equipment, and expertise

Organisations engaging with CSA Catapult acknowledge its value as an “enabler – a safe place to fail and learn lessons about next steps” – i.e., it is effective in de-risking adoption of new products and technologies by providing access to facilities, equipment and expertise required to conduct comprehensive tests.

The Catapult has adapted the evaluation module (EVM) approach traditionally taken with new chip design to de-risk the adoption of new compound semiconductor chips. Our EVMs focus on the riskier aspects of product development, reducing uncertainty at the outset, where the market is risky and reluctant to invest. Our double-pulse EVM, originally developed to characterise the performance of new SiC power devices, uses high-precision metrology operating at elevated voltages and currents.

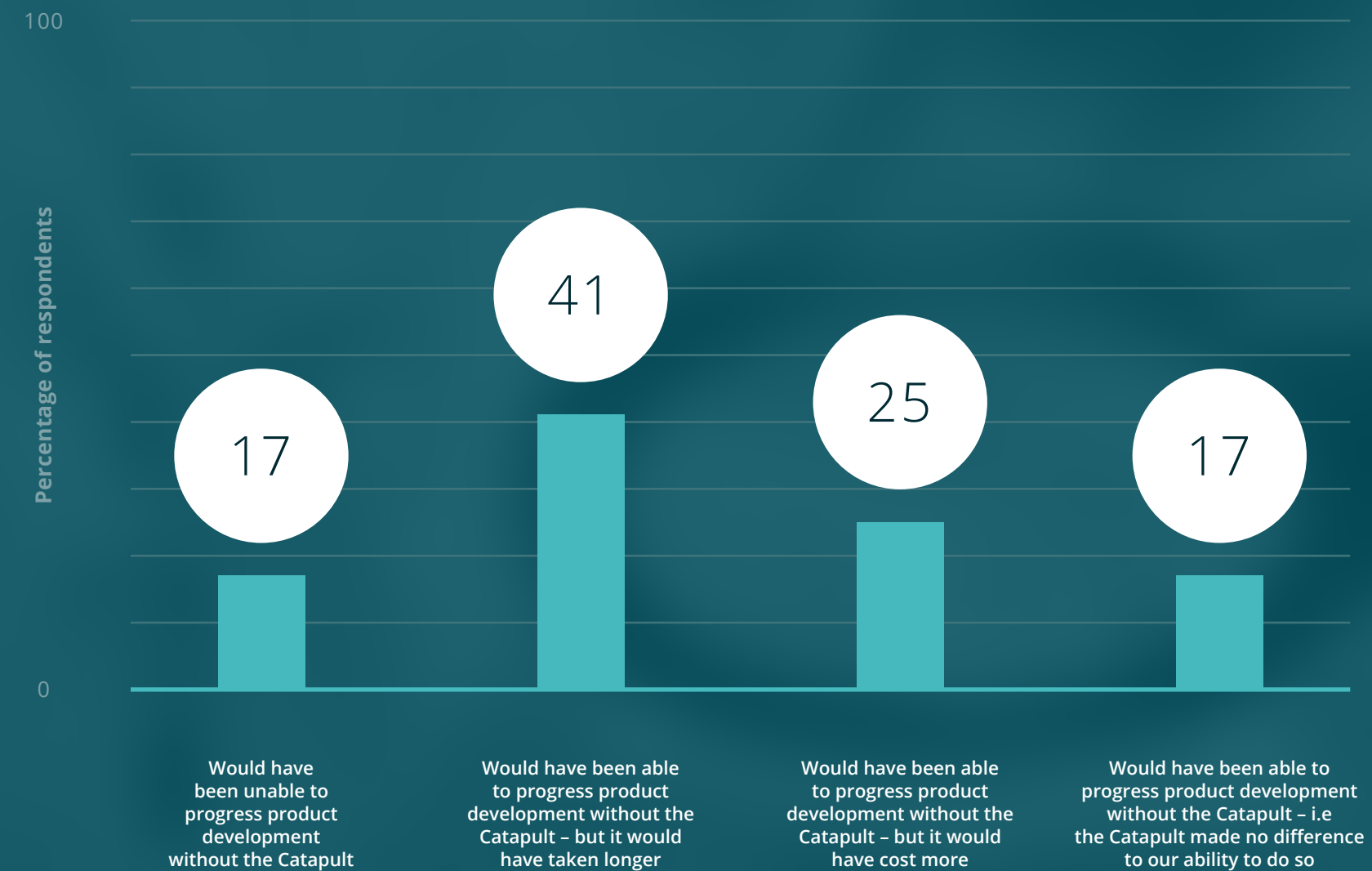
This innovative approach to device characterisation was recognised by the UK's trade association TechWorks, winning their R&D Excellence award in 2019. The double pulse tester is the cornerstone of several projects, include ESCAPE and @FutureBEV. It is also the basis of our future developments around Artificial Intelligence (AI).

Taken from CSA Catapult: the Story so Far

Notably, organisations value access to expensive equipment that they would be extremely unlikely to be able to invest in themselves. In some cases, certain organisations would have been able to access similar facilities/equipment in other places – for example universities or the National Physical Laboratory (NPL), i.e., CSA Catapult does not always provide unique access which could not be obtained elsewhere. However, it can sometimes be faster to access Catapult facilities compared with academic facilities – although some SMEs interviewed perceive that this can come at a higher cost. Several SMEs stated that CSA Catapult can be expensive, although acknowledge the need for it to generate revenue in line with requirements set by Innovate UK. Furthermore, the costs are also covering the skillset and expertise of in-house CSA Catapult engineers and other professionals. As well as testing, organisations can commission market intelligence; this resource is valuable to small start-ups which lack this research capability.

Of a sample of 12 employers responding to a 2023 survey about their experience of engaging with the Catapult, nearly a fifth (17%) say they would have been unable to progress their product development without the Catapult. A further 41% say they could have progressed this alone, but it would have taken more time, which a quarter of respondents say product development would have progressed without the Catapult – but incurring higher costs (Figure 2).

Figure 2: To what extent has the Catapult enabled your business to progress with product development over the last 12 months? (Base 12)



Over a fifth (21%) of respondents to the same survey state that product testing enabled by the Catapult mean they are now able to take the product to market (base = 14).

“ We can provide materials into CSA, and they have all the facilities that we can’t afford to purchase here right now, and they can do a lot of testing work for us.”

Employer feedback



3.1.3

Widening networks

CSA Catapult is recognised as having strong relationships in the supply chain, across employers, academia, stakeholder bodies in the UK and internationally. This has helped them to build strong partnerships and consortia, with a positive knock-on effect among the organisations with which they engage.

“Even at just the application stage the Catapult team were excellent. They arranged letters of support; they can extend the network”.

Employer feedback

3.1.4 Access to investment

On average, companies that have engaged with the Catapult have secured annual private investment of £107m and £11m of annual public sector investments.

Analysis undertaken by CSA Catapult identified differences between SMEs’ access to investment – based on whether they had, or had not, engaged with the Catapult (**Tables 2 and 3**).

Table 2: Average funding on an annual basis secured by SMEs with whom CSA Catapult *has* engaged

| SMEs worked with | % | Total average funding on an annual basis |
|------------------|----|--|
| Private funding | 36 | 107 million |
| Public funding | 71 | 11 million |

Table 2: Average funding secured by SMEs with whom CSA Catapult *has not* engaged

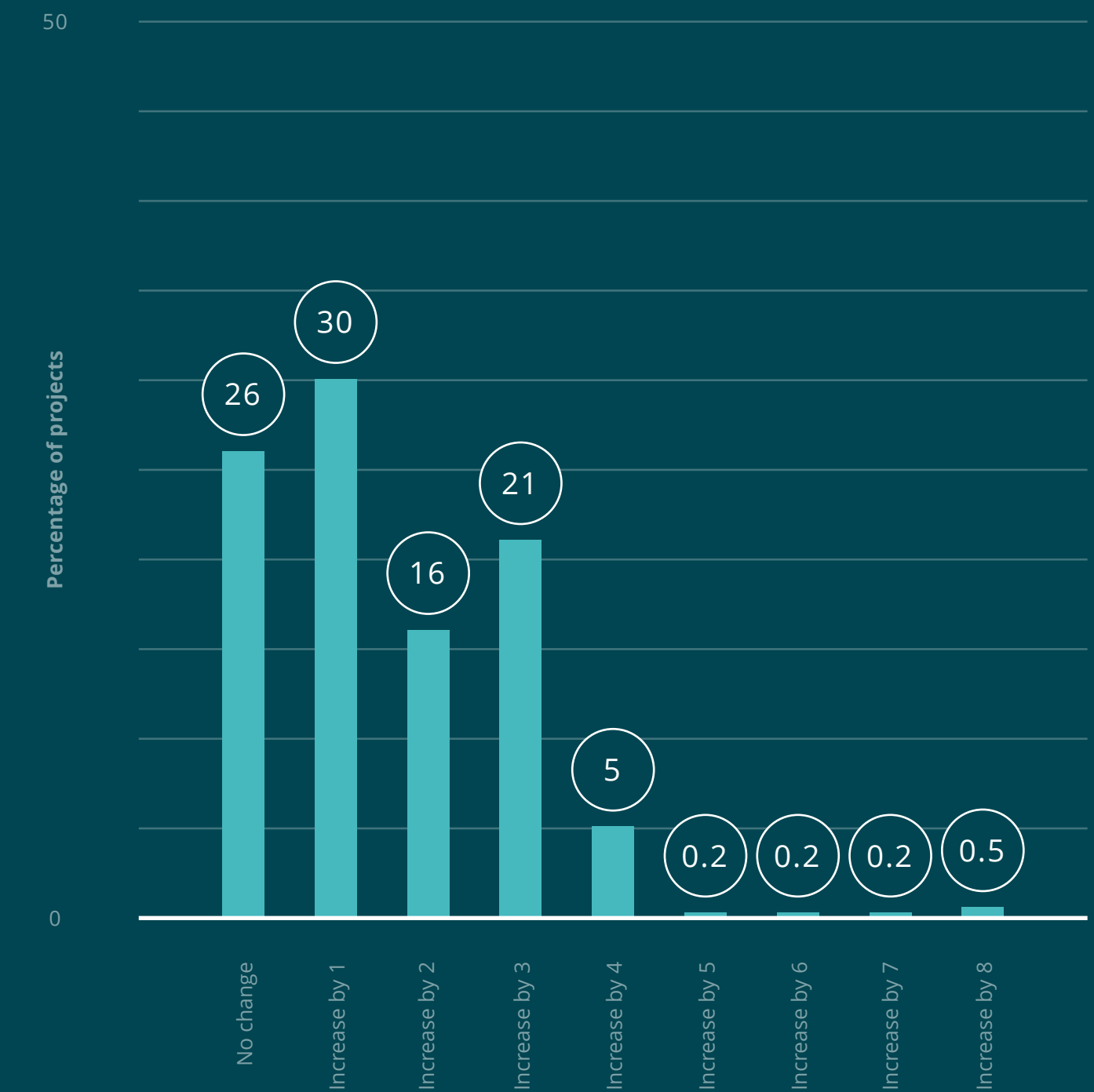
| SMEs not worked with | % | Total average funding on an annual basis |
|----------------------|----|--|
| Private funding | 16 | 16.5 million |
| Public funding | 46 | 12.5 million |

30% of employers surveyed in 2023 say the Catapult has helped them to target new markets, while **100%** say the Catapult has helped them to develop new partnerships.

3.1.5 Change to Technology Readiness Levels (TRLs)

Three-quarters of the projects supported by the Catapult over the last five years have experienced a positive increase in their Technology Readiness Levels (TRLs). 67% of the projects supported by CSA Catapult between March 2018-2023, increased between 1-3 TRL levels. 7% of projects supported during this time achieved an increase between 4-8 TRL levels (**Figure 3**).

Figure 3: Change in TRLs (projects supported by CSA Catapult March 2018-March 2023)



⁴Base = 10 ⁵Base = 12

Impact on jobs and GVA

Gross Value Added (GVA)

Over 95% of manufacturing output is classed as export, representing 2.5% of total Welsh exports. The cluster directly contributes £194m pa to Welsh GVA (Gross Value-Add), but this grows to £277m pa once supply chain and household effects are considered.

Over the next ten years, the activities of the Catapult are forecast to generate over £500m gross value added to the UK economy, as the companies we are working with grow their businesses.

We focus on two key areas, Future Telecoms and Net Zero, where the transformational potential of compound semiconductor applications is both understood and prioritised internationally. It is also where they can make the most significant economic impact.



Taken from CSA Catapult: the Story so Far

Assessment of new jobs created and safeguarded is based on analysis of CSA Catapult CRM data. This analysis⁶ has found between 2018 and 2023 a total of **2827 jobs have been created or safeguarded** within organisations that have engaged with the Catapult.

The actual figure is likely to be higher on the basis that there are gaps in the dataset. CSA Catapult estimates that its “collaborative projects and other activities are forecast to create or safeguard more than 5000 jobs”. This figure has been based on internal intelligence and evidence within bid applications. It is recommended that CSA Catapult should ensure all data gaps are rectified, drawing on internal intelligence, to ensure a full and complete dataset for further impact analysis in due course.

Employers interviewed for this research are able to link the impact of job creation / safeguarding with the association with CSA Catapult (noting it is not always possible to directly attribute as there are a wide range of other factors to take into account).

Image: Daniel – Lab Tech, Sofia – Lab Manager and Omar – Power Electronics Engineer



3.2.2 Building the supply chain

Analysis undertaken by CSA Catapult has found the two biggest impact themes supported – to date – are net zero and building the supply chain. This is based on analysis of bid documentation. Economic modelling undertaken in the US has identified that for every job funded in semiconductors – there is a consequence of 5.7 jobs created in the supply chain. This suggests CSA Catapult will be able to have a strong impact as their work grows and job creation is realised – in terms of the net effect of building the supply chain.



We’re still a very small company, so we only have five jobs. Did those five jobs come on after winning that grant [with CSA Catapult’s support?] Yes”.

Employer feedback

⁶CRM data analysis undertaken by Harlow Consulting + analysis of bid documentation undertaken by CSA Catapult.

Ongoing working relationships

Many employers were very positive about the strength of the relationships developed with the team at the Catapult and anticipate these to be retained and strengthened over the longer-term.

For some employers, their experience has been less positive because of staff turnover – notably either the project manager or engineer with whom they were working – moved on, which has been a factor in project delays and gaps in communications. As the Catapult has grown quite quickly, processes and infrastructure have been developing and evolving; for some employers the processes were not as tightly defined or embedded as they would have liked.

Most organisations that experienced this do acknowledge that the pandemic played a part in delaying process implementation; earlier projects were less well supported by internal infrastructure – during the early days when the Catapult was effectively being established in the midst of a global pandemic.

Employers would like to see a more centralised approach taken to project management, supplementing the technical expertise effectively. The project team allocated to work with an employer – and in particular the consistency of that team – has a major effect on the experience the employer has with the Catapult.

“ I would have thought that there should really be some kind of execution model, a model for project management. But CSA had just started really, we worked with them very early on and not everything was set up.”

Employer feedback



Most employers interviewed would work with the Catapult again – although a number of SMEs state that it can be expensive; while the benefits of working with them are clear, the costs can feel prohibitive, particularly among start-ups.



“Using the report, they [the Catapult] did, it’s started off quite a bit of work for us. It was useful. We’ve tried to engage in other areas, but I think, CSA – like all Catapults – is very expensive. We could have engaged a lot more than we did, but it was just unrealistic for an SME basically. We’re more likely to engage in collaborative projects together than we are to do anything directly.”

Employer feedback



“I think sometimes they [the Catapult] are a victim of the way the government tells them to work – it makes them too expensive.”

Employer feedback



“I see this as hopefully the start of a partnership where we can do more and more together. We just want to accelerate things with them, bigger and better projects.”

Employer feedback



Wider impacts: national and international strategy and policy

CSA Catapult has positively influenced the UK's semiconductor strategy and policies – notably in the form of evidence and recommendations provided to central Government on a range of topics. One of these included the Telecoms Security Act, and following a case for change submitted to DCMS, a £250m intervention for telecoms diversification was announced.

CSA Catapult also provided oral evidence to the House of Lords Science and Technology Committee Inquiry, which looked at the Catapults' contribution to delivering the UK's R&D Roadmap. Published in July 2020, the roadmap set out long-term objectives for R&D in the UK, including investment in science and research with an aim to deliver economic growth and societal benefits. It included a target from the UK government's 2017 industrial strategy to increase investment into R&D to 2.4% of GDP by 2027.

The Committee considered the role played by Catapults⁷ in stimulating long-term private investment and supporting new innovation collaborations between organisations. The findings were published in February 2021: Catapults: Bridging the gap between research and industry.

Written and oral evidence was provided to the Department for Business, Energy and Industrial Strategy (BEIS) which informed their Committee report into the semiconductor industry in the UK.

This report concluded that the UK government should be working to represent the UK's expertise and to entrench and expand the UK's role in the global semiconductor supply chain.⁸

The UK's first ever National Semiconductor Strategy was subsequently launched at the Catapult. A representative of the Catapult has been recently appointed to the UK government's Semiconductor Advisory Panel. The panel's role is to help grow the domestic semiconductor sector, mitigate the risk of supply chain disruptions, and protect national security.⁹

International relationships have also been developed, notably in India. The Future Telecoms Programme has been a substantial collaboration between UK and India, involving representatives from Government, industry and academia culminating in a reciprocal week-long delegation in June 2022 (funded by UKRI).

CSA Catapult also played a strong role in the foundations of a bilateral agreement with India on power electronics with electric vehicles – and anticipates new projects will be forthcoming as a result.

“CSA Catapult plays quite an important role in the compound semiconductor industry... they're really big supporters and advocates with government about speaking out about the UK semiconductor ecosystem. They can be very vocal about getting the UK to support the industry. It has a really important part to play, there's no doubt about that.”

Employer feedback



⁷Catapults themselves were not reviewed
⁸The semiconductor industry in the UK (parliament.uk)
⁹CSA Catapult - CSA Catapult comment on National Semiconductor Strategy

Cluster impacts

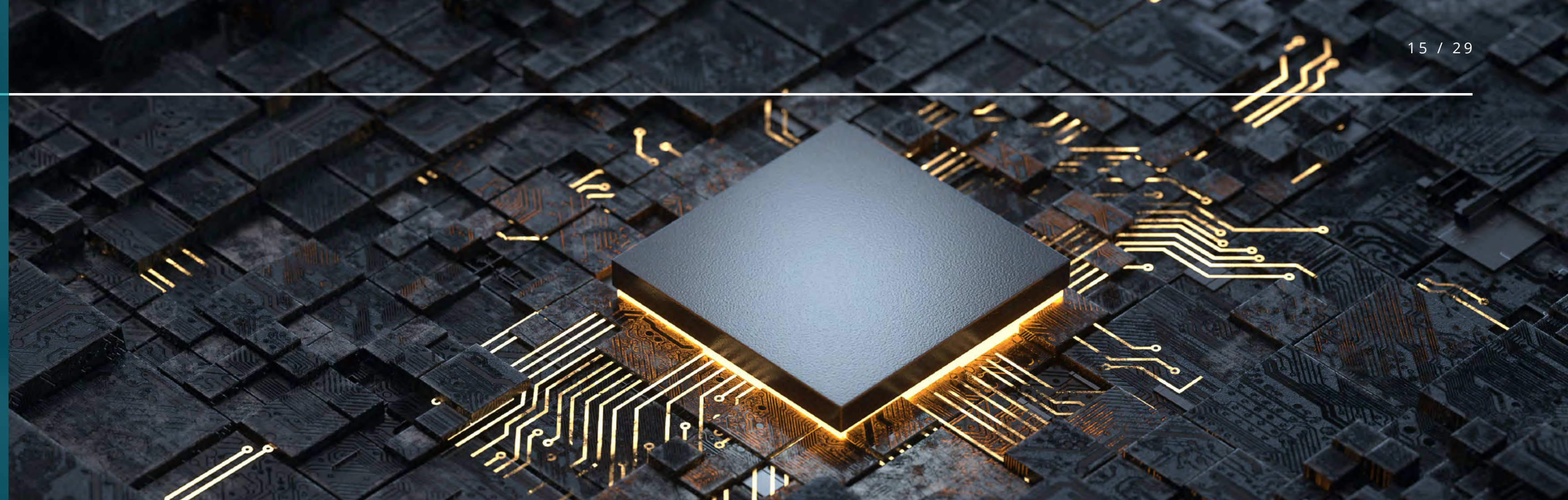
Employers are positive about the impact on the compound semiconductor cluster; the Innovation Centre and its four laboratories in particular are highlighted as centres of excellence, playing a critical role in enabling the innovation ecosystem.

The ecosystem and the Catapult's interaction and strong relationships with partners in the South Wales cluster have been cited by employers as important factors influencing their decisions to engage with the Catapult.

Employers also note the UK presence as a positive, as this enables investment to be retained in this country rather than investment leaving the UK.

“There aren't that many places to go in the UK for this type of expertise – great to keep the investment in this country rather than somewhere else.”

Employer feedback



3.6 Skills development

CSA Catapult is taking a leading role in skills development, underpinned by a clear skills strategy informed by comprehensive evidence gathered about specific needs. Of significant value is the 'foresighting' research which has been undertaken to understand the skills requirements – not just for now, but for the future. Taking the time to understand the landscape before producing a detailed plan means the Catapult is able to directly respond to sector needs.

The Catapult has elected to include primary schools in its skills activities – initially introducing pupils to simple electronic engineering. Working directly with children – and notably their parents as well – at one of the first points on the education journey is an exceptional start to the skills strategy work, with longer-term impacts of these initiatives to be closely

monitored over time. Skills interventions are wide-ranging, and critically are including engagement with secondary school teachers on how to support the introduction of compound semiconductor technologies into the STEM curriculum across the UK. Interactive sessions with children and their parents are also seeking to inspire a larger female cohort into science and engineering careers. The Catapult sponsored the UK Electronics Skills Foundation's Girls into Electronics Summer School in 2022, across 10 UK universities for 230 girls aged 15-18.

Outreach activities plan to reach around 1,000 schools; the skills team at the Catapult is clearly focused on developing strategies which are scalable and sustainable. Key to this is the engagement with parents alongside pupils. The team recognises there

may be more opportunities to utilise the Catapult's in-house resource, for example bringing in groups for tours, asking their own engineers to give talks and visit schools.

Industry-facing activities are also in progress with more planned; demonstrating the Catapult's holistic approach to sector skills development. Internally, the Catapult has invested heavily in capacity building, rapidly growing a team of experienced and capable individuals. Retention of experienced people, particularly engineers, can be a challenge, but the Catapult is also looking at supporting people at an early stage of their career through support to PhD students, researchers in residence and an intern programme.

“We've been able to get the foresighting programme up and running and get some really clear issues that we're going to try and work on – that's really important.”

Catapult feedback

4.0

ANNEX: CASE STUDIES

Case studies about the employer experience collated by CSA Catapult's Impact team are included in this Annex to further illustrate the impacts of the work of the Catapult to date.



Enabling groundbreaking gas sensing technology to reduce the effects of climate change

Methane leaks are posing a major societal and environmental problem for the oil and gas industries. Leaks can not only cause a serious public health hazard but are a significant contributor to climate change. As the main component of natural gas, methane is nearly 100 times as potent as carbon dioxide at trapping heat in the atmosphere, accounting for about 20% of global greenhouse gas emissions.

It is estimated that the global natural gas industry leaks around 3% of its total supply each year, with a value of more than \$30 billion. Projections show that natural gas leakage will make up more than 10% of global carbon emissions in the coming decades.

Effective ways of visualising, monitoring, and detecting natural gas leakages at industrial sites is therefore of upmost importance, yet current solutions remain expensive, labour intensive and unsuitable for widespread application.

This has accelerated the search for a safe and affordable system that can be easily implemented to provide fast and reliable gas monitoring over a large area.



20% of global greenhouse gas emissions can be attributed to methane



□ Tackling the problem

CSA Catapult was a key member of the SPLICE project, an Innovate UK project consortium, working as part of the National Quantum Technologies Programme, designed to bring a state-of-the-art gas imaging system to full commercial readiness.

Led by UK-based QLM Technology, the project also included Aston University, Bay Photonics, bp, Land Instruments International, National Grid Gas, NPL, STL Tech, University of Bristol and University of Sheffield.

The aim of the SPLICE project was to optimise and commercialise QLM's revolutionary single photon quantum gas sensor through research, development, field trials and manufacturing optimisation.

QLM's Tuneable Diode Single Photon Lidar (TDSPL) sensor system offers a significant advance over existing gas imaging systems in terms of sensitivity, range, small size, and low cost. The gas imaging system projects a low power laser beam over an area of interest and collects the scattered return signal, using a sensitive high-speed single photon avalanche detector (SPAD) to count the incoming photons. High-speed electronics and image processing algorithms turn the returned signal into a 3D map of leaking gas across the scanned area. As part of the project, CSA Catapult helped test several commercially available single photon detectors and optical amplifiers to determine which ones performed best in the gas imager system.

The Catapult also performed environmental tests on the optical amplifiers to determine how well they performed in extreme conditions, such as high and low temperatures, and to test the limits of their operation.

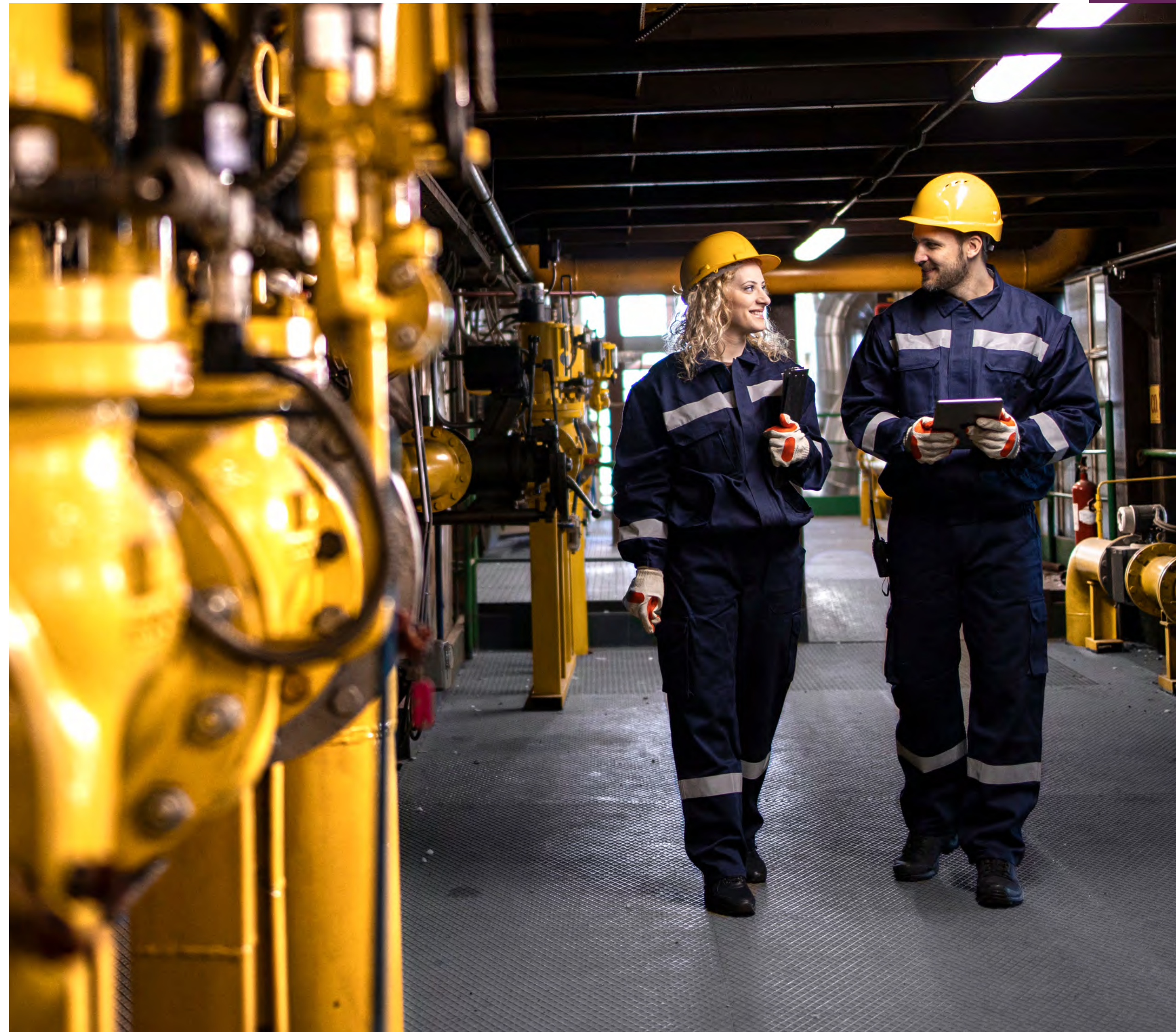
Taking it to market

As a result of the SPLICE project, QLM Technology's gas imager system is now being fully commercialised, providing natural gas producers, distributors, and service providers with a fast, accurate and low-cost gas leak identification product with industry-leading performance.

QLM Technology have also signed a Collaboration Agreement with SLB (formerly known as Schlumberger), one of the world's largest oil and gas services companies, who provided lead investment in a £12m round of Series-A funding. Existing investors in the technology such as Green Angel Syndicate, Enterprise100 Syndicate, Development Bank of Wales and Newable Ventures, also joined in this round of funding.

QLM's gas imaging sensor will be part of the new SLB End-to-end Emissions Solutions (SEES) business offering for the oil and gas industry, complementing existing satellite, airplane, and drone-mounted sensors offered by SEES.

QLM Technology are creating jobs and expanding their operations for manufacturing in Cardiff and Paignton, UK and have established a site near San Francisco, US to support international sales and operations. Through a series of new funding agreements with SMEs and start-ups in the UK, QLM is also establishing a supply-chain to help support the development of its ground-breaking product.



"Working with CSA Catapult on the SPLICE project has provided us with a good understanding of, and confidence in, the critical compound semiconductor laser and detector components that underpin our quantum gas lidar camera. Making these components in the UK is the next step in our development and we are working with CSA Catapult to enable that."

Murray Reed
CEO at QLM Technology

LED-based Ultraviolet exposure for Safe Surfaces (LUSS): Development of automatically self-cleaning door panels



The problem

The Covid-19 pandemic presented the UK economy with several unprecedented challenges, one of these being the transfer of germs and bacteria from communal surfaces. During a time when the population was concerned about contracting coronavirus, the general public became much more aware of the importance of clean surfaces and stopping the spread of harmful bacteria.

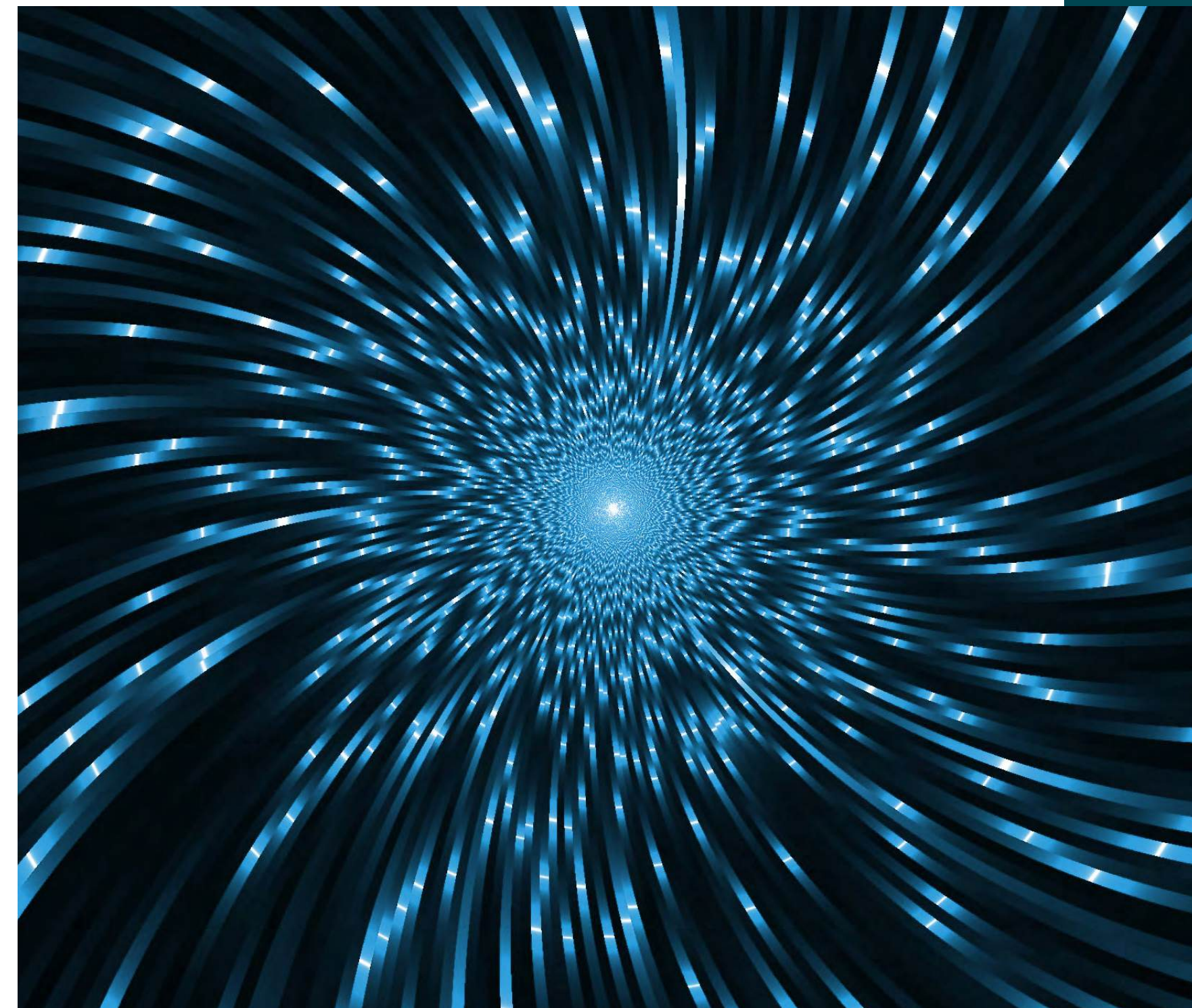
Everyday surfaces such as door handles are interacted with by large numbers of people daily, and present opportunities for growth of bacterial colonies. A 2016 study at Penn State University included a swab of a local cafe door. Fourteen different colonies of bacteria were living on the door handle. Each colony contained more than a million bacteria. In 2014, a study undertaken by researchers at the University of Arizona, showed that a single door handle can spread multiple germs throughout office buildings, hotels, and health facilities within hours.

To eliminate this, chemical disinfectants are utilised that must be applied frequently. However, it is impractical to disinfect surfaces after every use, moreover, creates potentially hazardous waste. UV-LEDs have

recently become more affordable, efficient, and available in compact packaging enabling potential use in disinfection systems.

In 2020, Innovate UK set up a funding competition to combat the effects of Covid-19. CSA Catapult identified this competition as an opportunity and with their industry knowledge and connections, brought together a small consortium to develop a cost effective, self-contained, safe, and compact LED module as a disinfectant tool that could easily be installed around a wide range of commonly touched or exposed surfaces/fittings around doors.

Industry-facing activities are also in progress with more planned; demonstrating the Catapult's holistic approach to sector skills development. Internally, the Catapult has invested heavily in capacity building, rapidly growing a team of experienced and capable individuals. Retention of experienced people, particularly engineers, can be a challenge, but the Catapult is also looking at supporting people at an early stage of their career through support to PhD students, researchers in residence and an intern programme.



The solution

Microlink Devices as lead industrial partner, with support from WideBlue and the Compound Semiconductor Applications Catapult (CSA Catapult) embarked on the LUSS (LED based Ultra-Violet exposure for Safe Surfaces) project to develop an automatically self-cleaning door panel, exploiting specific UV (Ultraviolet) light, that aimed to kill viruses/bacteria and prevent the spread of infection. This would allow surfaces to be disinfected automatically between uses, reducing the need for frequent manual cleaning, and reducing the transmission of viruses/bacteria.

LUSS aimed to provide an economical solution to combat COVID-19, whilst also targeting other viruses and bacteria, and reduce the requirement for cleaning with chemical disinfectants and the associated clinical waste, leading to environmental benefits.

Wideblue, located in Glasgow, provided bespoke design capabilities, whilst Microlink Devices located in Port Talbot was able to provide expertise in LED lighting. CSA Catapult, located in Newport provided testing capabilities. Together these industry experts were able to produce a demonstrator which were installed within:

- **CSA Catapult, Newport:**
Laboratory door (pictured below)
- **Wideblue Ltd, Glasgow:**
Main thoroughfare door
- **Microlink Devices UK Ltd, Port Talbot:** Office door



The project

The project started on the 1st of January 2021 and ran for 12 months, with total funding of £489,998 (including match funding). All planned work was delivered within the planned timescale and to planned budgets.

The project consortium collaboration was successful throughout the 12-month period. CSA Catapult provided informative and useful testing to assess optical emission profiles and estimations of surface covering. As Covid variants continue to emerge, further tests of the scanning and virus/bacteria killing effectiveness are needed to prove and demonstrate confidence to the public.

Key factors that were investigated include:

- Disinfection dose and any potential hazards to the public
- Product sensors
- Pauses of dose
- Viability and efficacy of the UV-C disinfection
- Suitability for other target markets

In 2022, the LUSS project was submitted at the Wales Tech Awards. The project won 'Best Photonics Application,'. In addition to this award, the project created five new jobs and safeguarded at least three jobs.

This product now needs further refinements and adaptations to improve and overcome its weaknesses to make it a product ready for widespread use. There is enormous potential for this technology and application within multiple sectors, that can be provided with further research, development, and modifications.

In summary

Despite the product not being commercially available yet, this technology has demonstrated an alternative to manual cleaning. This project has highlighted the benefits of using UV-C led alternatives that are safer than gases and has the possibilities to be used for other applications and viruses (e.g., MRSA). The current market forecast looks promising as in the past few years UV-C led performance has improved while the cost has gone down, and the positive trend looks likely to continue.

Microlink Devices are investigating potential further funding to raise the TRL (Technology Readiness Level) of this product and develop it to a place where it can be commercially available.

This project has created and safeguarded jobs as well as developing a real-world solution to an on-going problem. In addition to this it has the potential to reduce waste, contributing to net zero targets.



“At Microlink Devices, we are delighted with the outcome of the LUSS project. This was

Microlink Devices’ first time working with CSA Catapult and we have thoroughly enjoyed working with the team on this project.

The award win at the Wales Tech Awards for Best Photonics Application was fantastic recognition for the innovative technology we developed during the project, and we are delighted to share this with the consortium. Moving forward, we would like to enhance and accelerate the technology development of LUSS as it has huge potential to benefit a wide range of sectors. We look forward to working with CSA Catapult in the near future.”

Julie Fazackerly
CEO at Microlink Devices

SiC-MAP: Enabling a UK supply chain

Silicon Carbide MOSFET Applications unlocked by PDK (Process Design Kit)

□ Overview

SiC-MAP is integral to the future of Power Electronics, enabling a step-change in the technologies that are the focus of the Clean Growth Challenge. Low-Carbon energy technologies such as Automotive, Wind and Solar will be able to more efficiently convert and store power. Increased efficiency of Clean Power technologies will lead to growth in this industry, creating jobs and helping to transition the UK's energy supply to sustainable sources.

The purpose of Project SiC-MAP (Silicon Carbide MOSFET Applications unlocked by PDK) was to deliver a Process Design Kit (PDK) for Silicon Carbide (SiC) MOSFET devices, which are high efficiency power switches, key to building high efficiency power electronics for energy conversion applications including motor drives, more electric aviation, and a more efficient power grid, more suited to micro-energy generation and home electric charging of, for example, EV's. Prior to this project choices were restricted to off the shelf devices.

The objective was to enable a UK supply chain using standard design elements, process modules and processes – currently there is no UK source of SiC MOSFET's, so this project's aim was to unlock that capability and reduce reliance of the supply chain on overseas suppliers.

□ The challenge

The UK PEMD (Power Electronics Machines and Drives) supply chain has no UK source of SiC MOSFETs. Clas-SiC's existing PDK platform will fill the gap for the 1200V class, but still leave a void for the higher classes. Clas-SiC's PDK will address the need where there is value in customised MOSFETs for lower volume requirements for the PEMD industry. There was not a plan however to address the high volume, low margin, SiC MOSFET market, which is currently served by big international players.

The innovation in Clas-SiC's approach means that for the first-time, designers will be able to access an existing reliability proven process platform and have their own customised SiC MOSFETs fabricated on it. As a common platform will be used, this standardises the manufacturing processes, reduces manufacturing complexity and cost. Competitors to Clas-SiC, do not actively offer a PDK and instead fabricate a unique process for every customer. Each X-fab device therefore must create its own customised processes, leading to a multitude of processes being required to service multiple clients, contributing to manufacturing inefficiency and cost increases.

The new PDK approach will allow Clas-SiC to diverge to a more competitive and cost-efficient model. SiC-MAP is unique globally. Without this funding and this project, this work would have taken over several years, thereby missing the opportunity to drive and lead this market. This would result in slower supply chain growth.



The solution

SiC-MAP outputs were a PDK, presenting potential customers with a menu of options from which the designer can choose to construct their device, along with a set of limitations they must abide within so that the device can be feasibly fabricated and expected to pass basic reliability testing.

This project brought together a strong consortium made up of Clas-SiC wafer fab, that has been working on SiC technology since 2004 and has a unique team of highly experienced engineers, CSA Catapult's objective is to bridge the gap between companies developing novel CS (Compound Semiconductors) materials such as GaN (Gallium Nitride) and SiC, topologies and devices, and those developing systems for end-user applications, via its dedicated Power electronics lab at its state of the art Innovation Centre.



Image: Power Design Studio at CSA Catapult

Results and impact

This technology is of national strategic importance and will have huge economic, environmental, and societal benefits. The project is expected to make a positive environmental impact by increasing the availability of high efficiency SiC MOSFET switches for higher efficiency energy conversion, reducing at the same time the reliance on fossil fuels and thereby helping to limit contribution to global warming.

Clas-SiC revenues will benefit by securing a network of customers using the common PDK, thus safeguarding and creating jobs at Clas-SiC, it is expected that 16 FTE (Full time equivalent) jobs will be created between 2021/2024. Clas-SiC are also active in supporting STEM at the local (Lochgelly) High School, so Clas-SiC's being successful would enable this initiative to continue.

SiC-MAP will have transformative effects on consortium partners for varied reasons. For Clas-SiC it will provide an average sales increase of 28% over 3-years by accelerating growth by 12-months and will accelerate CSA Catapult's research impact. SiC-MAP will see increased spend and activity as several further markets and capabilities open-up with likely additional investment, reduced the time-to-market and enabling a sovereign supply chain.

This project represents value for money as it:



Utilises existing UK national assets (CSA Catapult) to help stimulate the market.



Demonstrates the potential for UK supply chains to deliver these technologies.



Enhances the opportunity for job creation at Clas-SiC growing by 16 FTE staff between 2021/2024.



Carbon Forest Products: supporting their journey

“ We have gone from 3D printing our carbon to needing to be able to 3D print our carbon with these specific property targets... that fundamentally has to be led to this point by real world applications and customer requirements, without necessarily exposing ourselves to customers commercially. We know exactly what to aim for and we iteratively move towards that.”

Carbon Forest Products

Overview

A by-product of the paper industry, lignin is a wholly sustainable feedstock. Finding an alternative use for lignin is allowing Carbon Forest Products to add carbon and carbon-carbon composites to the world of additive manufacturing as a new palate of materials.

Carbon Forest Products is working on developing a lignin 3D printing process to create pure carbon or, carbon-carbon composites and graphite. While the company specialises in the technology, the company is working with CSA Catapult to define the specific applications and properties that the company should be targeting. Carbon Forest Products engaged with CSA Catapult to look at the applications within the automotive industry where 3D graphite could be used, particularly in thermal management devices.

“ When CSA Catapult are happy that we're delivering the technology, we feel confident, they feel confident and therefore the OEMs that we're wanting to work with longer term can feel confident that the technology is ready to start customising for their specific requirements.”

Carbon Forest Products

What happened

Initial discussions with CSA Catapult in Spring 2022 indicated that the technology being developed had positive opportunities and could be pushed further. CSA Catapult worked with Carbon Forest Products to write a bid for a PEMD grant, obtained in October 2022. Now four months into the 12-month project, ongoing testing and development is being worked through.

CSA Catapult assisted Carbon Forest Products in getting OEM support for the grant. OEM support now comes from Ford Technologies, McLaren Applied and Impel Systems, Tier 1 supplier into the PEMD industry. The CSA Catapult partnership has been beneficial for introductions, and as a gate between Carbon Forest Products and potential customers.

Results

A strongly R&D driven company still in the pre-revenue phase, access to funding through grants has been integral. The company worked with CSA Catapult to prepare a framework together to access matched funding from Angel Investors.

Working with CSA Catapult also made a fundamental difference to Carbon Forest Products. Their go-to-market strategy completely shifted:

“The team grasped immediately what our technology was. We're only one-quarter in, but already we can see that it is moving forward at a much faster rate than it has previously. Through the Catapult not only do we have the security of knowing that we can refine the technology within their framework and their oversight, but we also get those introductions into much larger potential customers with confidence.”

Carbon Forest Products is now looking at expanding, moving to a bigger facility, starting to engage in consultancy, leading R&D as well as hopefully obtaining other grants. It anticipates creating two new jobs by the end of the current PEMD grant.

Driving the Electric Revolution Industrialisation Centre for Wales and the South-West

In 2022-23 CSA Catapult delivered three collaborative projects funded by Driving the Electric Revolution.¹

GaNTT

Gallium Nitride Trench-FET Development for Automotive Power Applications

One key project was GaNTT (Gallium Nitride Trench-FET Development for Automotive Power Applications). As a partner, CSA Catapult undertook the development of a new Gallium Nitride (GaN) packaging process platform for automotive power electronics.

Outcomes:

- The development of a UK source of thick GaN epi substrates required for the vertical device
- Damage-free GaN etching to form a suitable vertical channel
- Successful materials integration of the gate dielectrics and gate electrode.

The project is highly innovative from a design perspective and Swansea University have filed a patent application for the device design.

High-T Hall

Developing new supply chains for sensors for power electronics

The vision for this project was to develop and provide a supply chain for high-temperature operation Hall effect sensors. These detectors can measure high-frequency electromagnetic field switching for electric motors and drives, using a completely innovative Hall sensor element made from graphene. Until now it has not been possible to create monolayers of graphene suitable for electronic devices at scale which has inhibited the commercial uptake of graphene electronic devices.

Paragraf Ltd solved this issue. The graphene created by Paragraf is a single layer of carbon atoms deposited direct on a semiconductor wafer and is suitable for standard electronic device processing and packaging.

In this project Paragraf used its proprietary graphene material and subsequently processed it using standard manufacturing techniques, resulting in a fully packaged graphene Hall sensor product. The project achieved the aim of graphene Hall sensors working at elevated temperatures proven through testing in end-user applications.

Outcomes:

The Hall sensors were used to detect magnetic fields, and current levels in specific use cases. This has opened huge avenues for exploitation into the automotive market for graphene devices, and work continues beyond the project to facilitate this.

Partners: Paragraf Ltd, Rolls-Royce plc, Aero Stanrew Limited.

HiCap

Developing a new UK supply chain for power electronic converters

The opportunity was to develop new technology to test and develop modelling for DC link capacitors which are a fundamental block of almost all power electronic converters, typically used in battery electric vehicles. This development is important as it opens a new UK supply chain opportunity for higher power densities and higher operating temperatures in power electronic converters.

The HiCap project developed a UK manufacturing capability for readily scalable, in terms of capacitance and shape, thin film capacitors capable of operating at sustained temperatures of approximately 125°C. These devices are aimed at EVs and other demanding industrial applications, and so, must be viable to economically manufacture in short lead times for low to medium volumes.

CSA Catapult carried out durability testing, using a new prototype design was to be operated at temperatures and currents which are beyond the capability of standard technologies, and used data modelling techniques that effectively simulated years of operation in an EV.

Outcomes:

CSA Catapult was able to demonstrate that the high-temperature dielectric material could withstand this abuse with minimal change in its electrical properties, which is a great step forward for the UK power electronics supply chain.

Partners: API Capacitors and Integral Powertrain (now HELIX UK)

¹The Catapult is home to one of the UK's four Driving the Electric Revolution Industrialisation Centres in the UK, funded by a £80m investment from the Industrial Strategy Challenge Fund of UKRI

4.6

Investment in power electronic equipment leads to market-leading expertise to benefit UK companies



The opportunity

When CSA Catapult was set up in 2018, the first key market was identified as vehicle electrification, as the UK market in power electronics, machines and drives is estimated to grow significantly to deliver electrification of the transport sector. According to market research commissioned by the CSA Catapult, the estimated power electronics and transport market would be \$18.1bn by 2023 globally.

The Catapult's Power Electronics laboratory is one of the UK's most advanced to enable innovation through comprehensive modelling, characterisation, integration, and validation facilities for power components, modules and sub-systems with higher efficiency and reliability with reduced size, weight, and system cost.

Power electronics innovation will help accelerate the development of new technology for battery electric vehicles, a key part of delivering Net Zero commitments. Power electronics is used to control the efficient flow of power and ensure stability and reliability, allowing for more efficient and effective energy management.

The approach

To support the UK industry, CSA Catapult invested in power electronics equipment and since then has developed the capability and know-how to support companies developing power electronics converters.

Part of the investment was in the double pulse test, a standard characterisation method in power electronics for silicon, silicon carbide and gallium nitride semiconductors to assess energy loss during device turn-on and turn-off. This characterisation supports power electronics design decisions to optimise reliability, efficiency, and thermal management. A total of 29 companies have used the power electronics equipment.

Outcomes: By investing and developing CSA Catapult's power electronics equipment this has created supply chains across the UK via the @FutureBEV projects and the ESCAPE projects. This capability has been further exploited by over 20 collaborative research and development projects worth around £62m, working with a wide range of academia and industry.

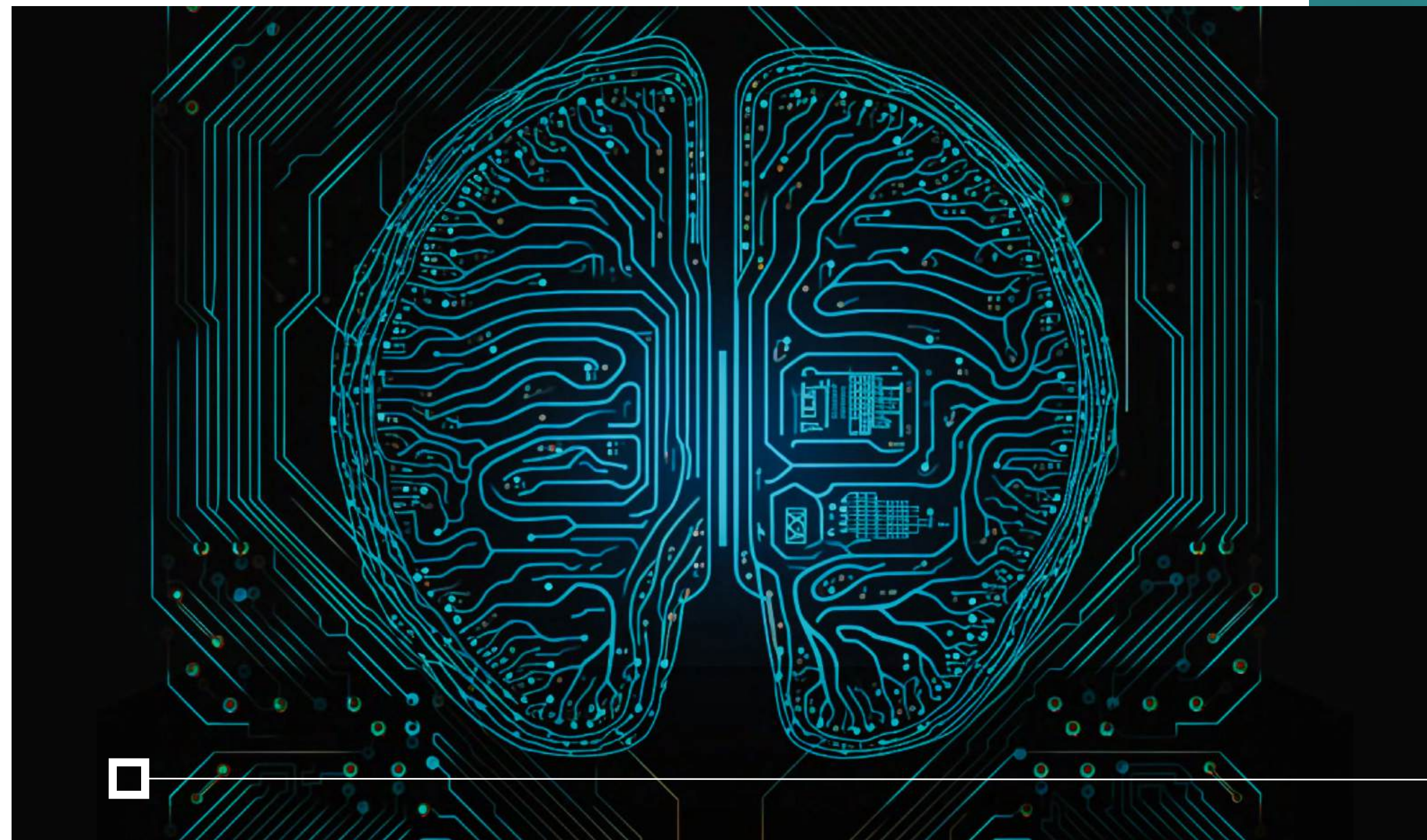
£17.7m

of Public Funding leveraged by companies working with the Catapult since using the power electronics equipment.

Average Increase in TRL of 4.



Working with Cardiff University to develop research to accelerate commercialisation



The opportunity

Since last year, CSA Catapult and Cardiff University have worked on a new and more efficient way of modelling and designing power electronic converters using artificial intelligence (AI). The new method has reduced design times for technology by up to 78% compared to traditional approaches and was used to create a device with an efficiency of over 98%.

In the study, the team explored a new design method using a type of AI known as artificial neural networks (ANN), which uses algorithms and computing systems that mimic the interconnected neural networks of the human brain.

The ANN was trained on an existing dataset of over 2,000 designs, so the team were able to select the most appropriate design for their desired efficiency and power density.

The team selected four major components for the ANN-based design, including the power gallium nitrate (GaN) field-effect transistors (FETs), inductors, capacitors, and heat sinks

The approach

The design approach was validated through experimental tests on a GaN-based single-phase inverter that was created using the specified design. The efficiency and power density of the devices were well-matched to the design and within the range of existing devices, making the inverter technically competitive and commercially viable.

Working strategically with academic partners like Cardiff University, CSA Catapult bridges the gap between research and application development.

Outcomes

The new method has reduced design times for technology by up to 78% compared to traditional approaches and was used to create a device with an efficiency of over 98%.

The team's findings have been published in the [IEEE Open Journal of Power Electronics and IEEE Transactions on Power Electronics](#).

In January 2023, the Catapult signed a memorandum of understanding (MoU) with Cardiff University. The MoU will lay the foundations for a long-term partnership to promote research in areas of common strength and create a lasting public impact in the UK and beyond. The MoU sets out a framework to develop joint research projects and funding bids, exchange staff, share facilities and equipment, develop teaching initiatives, and create a pipeline of skills and talent.

“Automated power electronics design optimisation enables the full exploitation of wide bandgap power semiconductor advantages when compared to their silicon counterparts. We are excited to be working with Cardiff University in this innovative area.”

Co-author of the study **Dr Ingo Lüdtke**
Head of Power Electronics, CSA Catapult

CSA Catapult Skills

The challenge

There is a challenge in developing a future workforce for the compound semiconductor sector. The demand for appropriate skills is rising. Market analysis suggests that the industry's aggregate annual growth could average from 6% to 8% a year up to 2030 and this means there will be a demand for more skilled workers.

Partners/collaborators: UK Electronics Skills Foundation, CS Connected and the cluster companies it represents, Innovate UK, Gatsby Foundation.

The Year 8 outreach programme in schools across South Wales is delivered using the core grant – approximate cost is £12,000.

The Year 11-13 project co-developed and delivered with the UKESF, is funded by Innovate UK – our direct funding is £125,000 and it will be delivered in Wales. An initial grant of £10,000 was awarded by the Gatsby Foundation to carry out a skills Foresighting scoping report. Next phase research is being funded through the Innovate UK Workforce Foresighting Hub. Location: South Wales and nationwide.



Activities

CSA Catapult has three STEM (Science, Technology, Engineering and Maths) outreach interventions:

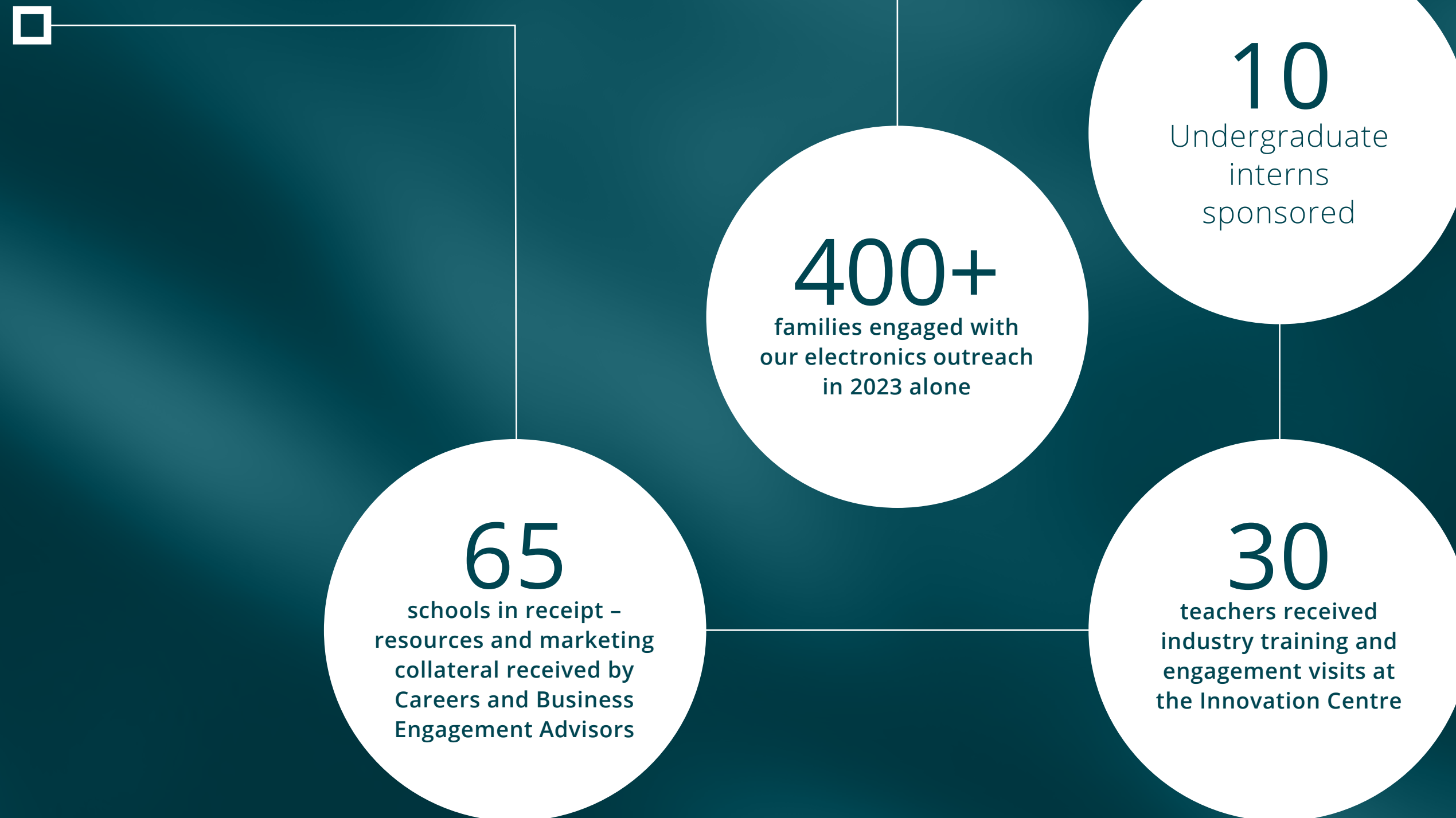
- A primary school initiative delivered by Primary Engineer, funded by Innovate UK Driving the Electric Revolution. This was supported by engineers from across the cluster, and beyond, including KLA, and Swansea University
- A programme designed for Year 8 around conductivity, compounds and circuits funded from core grant delivered by SparkLab.
- “Spark their Imagination; Power their future” is delivered in partnership with UKESF (UK Electronic Skills Foundation). Funded by Innovate UK, it will be delivered in conjunction with FE and HE partners in Wales and provide school resources, teacher CPD, “Demystifying Semiconductor” teaching days, and provide 24 bursaries to year 13 learners going on to study EEE at university.

As members of the UKESF Scholarships Scheme, CSA Catapult supports electronics undergraduates in several ways, including an annual bursary, mentoring and networking opportunities. During summer 2021, five scholars joined the team, each specialising in a specific technology area. These interns play an active role in our STEM outreach delivering sessions at events such as Cardiff Science Festival.

CSA Catapult sponsors PhD student research at the CS (Compound Semiconductor) Centre for Doctoral Training and the Sustainable Electrical Propulsion CDT (Centre for Doctoral Training). We currently have four Researchers in Residence carrying out projects funded through the EPSRC Researcher in Residence Scheme.

Outputs

One of the outputs in the logic model is the accurate assessment of future need and interventions within Catapult target sectors. This is evidenced in the work of the programme and it will help develop foresighting activity.



Outcomes

One of the outputs in the logic model is the accurate assessment of future need and interventions within Catapult target sectors and this is evidenced in the work of the programme and will help develop a system wide foresighting activity. Over the longer term there will be evidence of knowledge transfer.



“Thank you so much for organising our visit and workshop yesterday. As a team, we found it all really fascinating, and the teachers and PGCE students that also joined us for the day expressed their amazement at the work that goes on at Catapult. Their experience certainly gave them food for thought for when they talk about career possibilities to their students.”

Keith Jones, Institute of Physics



“The engineers working here are specialists in their fields and the technical knowledge and learning you can get from them is fantastic! It has been an exciting and eye-opening opportunity working here.”

Sharon, Photonics Scholar 2021/22 MEng Electric and Electronic Engineering, University of Bristol



“The idea of taking research and developing it into technology is why I entered engineering, and the Catapult’s aims and structure really matched well with that. Being surrounded by really experienced people from a broad range of technical backgrounds, every conversation I’ve had has been a great learning opportunity.”

Alice, Electronics Scholar 2021 BSc Engineering, University of Cambridge



A progressive organisation working on interesting projects and cutting-edge technologies, they provide fantastic opportunities for undergraduates. For the Catapult, our Scholarship Scheme is a great way of, not only, connecting with students but raising awareness and generating interest in compound semiconductors at universities.”

Stew Edmondson, CEO of UK Electronics Skills Foundation

