

2019/20



High Value Manufacturing Catapult
Annual Review 2019/20

Leading the UK's green
manufacturing revolution

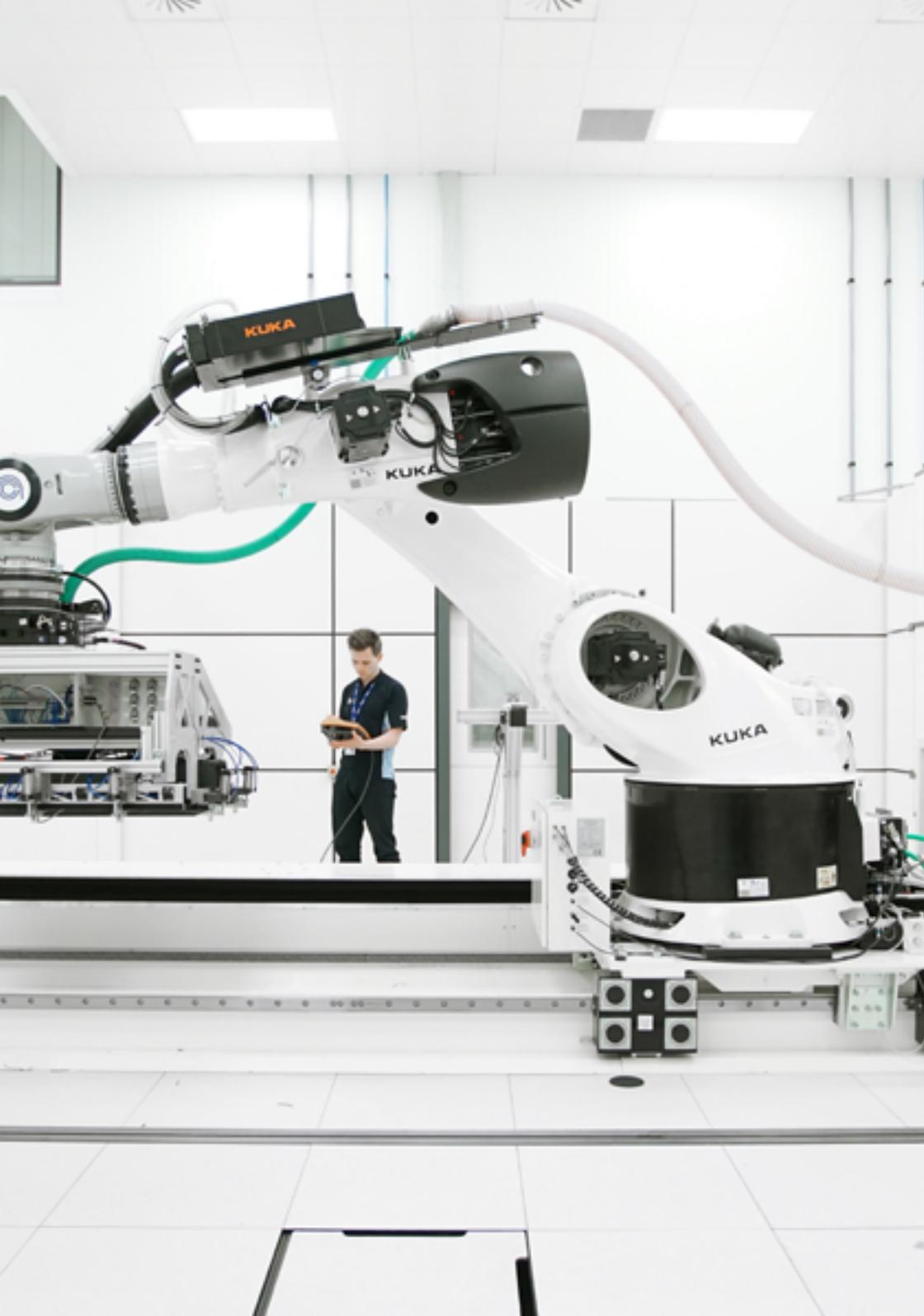
Achieving net zero | Delivering economic impact

Leading the UK's green manufacturing revolution

Our centres

AFRC:	Advanced Forming Research Centre (part of NMIS, the National Manufacturing Institute Scotland)
AMRC:	Advanced Manufacturing Research Centre
CPI:	Centre for Process Innovation
MTC:	Manufacturing Technology Centre
NCC:	National Composites Centre
Nuclear AMRC:	Nuclear Advanced Manufacturing Research Centre
WMG:	WMG Centre





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Allan Cook

Allan Cook CBE
Chairman (2018–)
High Value Manufacturing Catapult

Chairman's statement



Innovation in productive capacity is key to delivering economic growth and resilience from crisis.



The UK has a very strong research and development sector, renowned on a worldwide basis. Increasingly, however, industrial leaders and policymakers in government are recognising that unless the UK can translate this world-leading knowledge into the products, processes and services that will add to the value of the UK economy and help us address the many challenges we face, the full benefit of our research excellence will not be achieved. For the past nine years, the High Value Manufacturing (HVM) Catapult has helped industry, academia and government to exploit more of the UK's expertise in manufacturing research and development. This review of our activity for the 2019/20 year demonstrates how this work has helped manufacturers of all sizes harness this expertise and use the knowledge obtained to address the future challenges of a changing business environment: improving productivity, reducing carbon emissions, developing more resilient supply chains, and creating more agile manufacturing techniques.

In the closing weeks of the 2019/20 operational year, the HVM Catapult also showed how it can use its unique position in the UK economy to help the nation respond to unprecedented challenges. The coronavirus (COVID-19) pandemic demanded decisive leadership to ensure that the NHS front line had the tools and equipment it needed to care for critically ill patients and limit the spread of the virus within the healthcare system. The HVM Catapult immediately stepped forward. It used its established and trusted relationships with the UK's manufacturing community to provide the leadership and expertise required to build ventilators, manufacture Personal Protective Equipment (PPE) and to develop new tools and equipment that will protect the NHS staff who are battling the virus on a daily basis. Without doubt, this swift and effective action by HVM Catapult staff saved many lives.

Now, as we slowly and cautiously emerge from the pandemic, the HVM Catapult will begin to turn its attention from the requirements of the NHS to the work needed to stimulate an economic recovery. In 2019/20 the HVM Catapult helped industry with over 4,600 innovation support projects, bringing world-leading expertise to bear in partnership with companies of all sizes, improving their productivity, efficiency and profitability and helping them to be more competitive in their international markets. The world has changed and post the COVID-19 pandemic – whenever this may be – the UK will require a completely new approach to business and manufacturing. The HVM Catapult stands ready to bring its expertise to work even more closely with government, academia and industry to stimulate an economic renaissance in all parts of the country and drive progress on the important factors which may threaten our future.

We have learned many things from our experience of the COVID-19 pandemic. One of them is the importance of a sovereign UK manufacturing capability. The HVM Catapult has the knowledge, capacity, expertise and relationships needed to lead the challenges within our sectors.



We are an essential part of a more confident and resilient future for the UK.





Dick Elsy CBE
Chief Executive
High Value Manufacturing Catapult

Chief Executive's statement



Our work has shown the importance of the manufacturing community in responding to a global crisis.

This was not the report that I was expecting to write as my final covering note to our annual review before my retirement in August 2020. The whole world has changed, and my retirement was postponed to focus on the task in hand.

Times of crisis tend to bring out the best in people and organisations and I am immensely proud of the tireless commitment of our Centres in stepping up to help. We have some fine examples of the way in which they have helped included in this review. They range from our involvement in the Vaccines Task Force to the engineering and production of protective screens to be used to protect clinical staff in an intensive care environment. There was also my personal involvement in the UK Ventilator Challenge.

When faced with the crisis of insufficient ventilators to meet the forecast peak demand driven by COVID-19, the UK government put out a call to arms to manufacturers to repurpose production lines to build ventilators.

The HVM Catapult responded immediately. As the natural go-to place to build collaborations and provide overall leadership, we formed a national consortium of some of the biggest UK industrial companies to rise to the challenge. Our Centres also stepped up with engineering resources, factory space and the know-how to deliver complex remote training tools using virtual and augmented reality.

The results from the Ventilator Challenge UK consortium have been extraordinary and show the convening capability of the HVM Catapult and the deep trust placed in it to organise the delivery of a programme of true national scale in a breathtakingly short timeframe. It has shown British industry and the HVM Catapult at its best.

COVID-19 has not been the only challenge we have faced this year. The first three quarters of the year were dominated with the uncertainty around international trade which had a clear impact on our business



With leadership and investment, the country can emerge from the pandemic in a strong global position.

and that of our client companies, battling with uncertainty and investment risks. This led to the softening of some of our markets which propelled our Centres to work hard to diversify their sector and technology portfolios, which has resulted in greater financial and operational resilience.

This resilience has led to a remarkably good set of financial and operational results for the year. The HVM Catapult has continued on its double-digit growth trajectory which has resulted in us becoming the most significant advanced manufacturing research body in Europe.

We are determined to use this pre-eminent position to help industry to get back on its feet after the COVID-19 crisis and, importantly, keep the torch lit for innovation. This will be crucial to our competitiveness as all nations fight to return to a new normal. We will also use this opportunity to show leadership in driving progress towards achieving net zero by 2050. I know that the manufacturing community can deliver for the planet in a similar way it delivered for the country in its time of need.



Responding to the COVID-19 pandemic

Not since the outbreak of the Spanish Flu in the early 20th century has the UK experienced a pandemic with the impact that we have seen with COVID-19.

In March 2020, the Prime Minister called on manufacturers to help the UK step up production of vital medical equipment the nation would need to respond to the crisis. The HVM Catapult has been at the forefront of efforts to equip the healthcare front line with some of the tools it needs to treat patients suffering from COVID-19 and save lives.



The Ventilator Challenge

On 16th March, the Prime Minister spoke to over sixty of the UK's leading manufacturing businesses and organisations, calling on them to help the UK step up production of vital medical equipment, such as ventilators. He asked manufacturers to rise to this immediate challenge by offering skills and expertise as well as manufacturing components themselves.

His call to arms led to the creation of a number of projects, many focused on the creation of new ventilator designs.

Reaching out to the HVM Catapult's contacts throughout the UK's engineering community, our CEO, Dick Elsy, pulled together an industrial consortium to tackle the challenge. The consortium was made up of those organisations with the capability needed to ramp up production of two ventilator models based on existing technologies and adapted for rapid manufacture. By 19th March the consortium had a plan in place to deliver what the country would need. The HVM Catapult's Centres were closely involved throughout the effort, with the Advanced Manufacturing Research Centre's (AMRC) new Welsh facility at Broughton transformed into a full-scale production line. The consortium is set to produce 10 years' worth of ventilator stock in little more than 10 weeks.



We are proud to play our part in combatting COVID-19.

Producing a vaccine

The world has been plunged into an unprecedented public health and economic crisis. To enable the return to normality and a full recovery, the race is on to find an effective vaccine against COVID-19 and manufacture the millions of doses required to build immunity. Typically, this process would take many years.

Experts from the Centre for Process Innovation (CPI) have joined the national taskforce to develop, trial and manufacture an effective vaccine. They will lead efforts to manufacture and formulate the novel mRNA vaccine candidate from Imperial College London, should it prove successful. CPI will focus its efforts on evaluating the process of scale-up and development of the mRNA vaccine platform technology and on building the capability to manufacture millions of doses of the vaccine as soon as it is found to be safe and effective.

Upskilling during lockdown

COVID-19 may have forced a reduction in UK manufacturing output, but the HVM Catapult wanted to make sure that the UK's manufacturers were able to benefit from this quieter period by using the reduction of activity to improve their future performance. Moving our training and expert seminars to digital platforms, we helped to keep the engineering community's minds stimulated and provided opportunities for upskilling.

In collaboration with Enginuity, and a range of other partners, we also contributed to a new online learning hub that offers a range of courses from those easy, first digital engineering steps through to more sophisticated technologies and innovations. The hub offers training from professional bodies, leading firms and innovation centres, including the HVM Catapult; the Institution of Engineering and Technology (IET); Excellence, Achievement and Learning (EAL); Make UK; and FutureLearn. It will be a resource that continues to grow, helping engineers, technicians and other manufacturing employees to develop the skills needed to use the latest technologies and respond to the pace of global technological innovation. The skills they take back to the workplace will help to underpin a resurgence of UK manufacturing performance.

Personal protective equipment (PPE)

Access to PPE is vital to protecting frontline workers from contracting COVID-19 and limiting its further transmission. The HVM Catapult Centres have been active in ensuring that as much PPE as possible gets to the NHS front line and to social care services. This was done both by donating over 100,000 items of PPE kit and by manufacturing key items, such as face visors, by using 3D-printing and batch cutting techniques to produce them as quickly as possible.

One medical procedure is proving crucial for survival in the most severe cases: intubation, the practice of inserting tubes into a patient's airway for mechanical ventilation. Being in close quarters with potentially aerosolised fluids from a patient carries significant additional risks that ordinary PPE may not protect against effectively thereby increasing the risk to frontline staff. Our team at the Manufacturing Technology Centre (MTC) developed an innovative new Aerosol Generating Procedure (AGP) shield to protect NHS staff whilst carrying out this vital procedure. The shield can be rapidly deployed for the frontline use, providing the extra protection the UK's medical staff need. The MTC distributed the first two hundred shields to NHS trusts across the country free of charge and continues to develop a final lightweight moulded version which could be made available commercially through a third party manufacturer under licence.

Over
100,000
items of PPE donated

2019/20 in numbers

7 centres

across 17 locations

4,646

innovation support projects

2,231

projects with SME clients

4,745

SME engagements

1,389

engagements with UK academic institutions

431

collaborative R&D projects

£791m

asset base

...leads to

£518m

industry R&D linked to HVM
Catapult activity*

Stimulating R&D investment

£128m
2019/20
core grant
investment

...attracts
£113m
commercial
investment
in projects

...wins
£99m
in collaborative
R&D*

...generates
£178m
total related
collaborative R&D
(e.g. match-funding)

* Excluding collaborative R&D in land and buildings.

Success stories

In 2019/20 the HVM Catapult's Centres supported companies across 4,646 projects to harness the power of innovation and strengthen their performance. Those companies ranged from small social enterprises to global giants employing thousands of people both directly and through their UK supply chains. We have seen that our work with companies, no matter their size, helps to improve resilience, drive up productivity, drive down waste and carbon emissions and improve their bottom line.

Here are just a few examples of how working with the HVM Catapult is delivering for UK manufacturing:



4,646 projects



Lightweight wings ready for net zero

To build the next generation of fuel-efficient aircraft for a net zero world, we need lighter wings - making composites essential.

As part of the National Composite Centre's (NCC) £36.7m digital technologies R&D programme, two huge industrial robots that automate the wing production process have the potential to revolutionise aircraft production.

The 'Ultra High Rate Deposition' robots, being pioneered by the NCC as part of the Airbus 'Wing of Tomorrow' programme, measure, cut, lift and place pieces of carbon fibre with millimetric accuracy. They can also lay five metre wide strips of composite material, up to 20 metres long, in one precise movement. This could cut the number of fabric components required from 100,000 to just 150, and reduce wing build-time from one week to one day.

Looking forward, the technology could be used to revolutionise the production of other large structures such as wind turbines, bridges and modular homes.



Cost-effective personalised healthcare

Sometimes the most effective medical treatments demand a bespoke approach. Personalised medicines offer next generation treatments not only for the one in five of us likely to develop cancer, or one in nine living with diabetes, but for the many others at risk of developing common diseases each day.

As personalised medicine becomes a reality, the necessity for small batch sizes makes traditional manufacturing approaches prohibitively expensive. Typically used as a research tool, cell free expression (CFE) has the potential to revolutionise the supply chain, by offering a cost-effective solution for building the specific proteins needed.

Funded by Innovate UK, CPI and partners Ipsen Biopharm and Touchlight Genetics joined forces to examine the use of CFE to produce a novel linear DNA vector, useful for targeted medications. The group then developed a fully scalable CFE platform to allow rapid and flexible manufacture of the next generation of medicines. A key outcome from the project was the development of new manufacturing routes for biopharmaceuticals which eliminate inefficiencies in the supply chain, so that new drugs can reach the market with reduced time and cost. One more step towards the future of healthcare.

Car batteries get a second life

Electric vehicles are not only starting to revolutionise the way we travel. Their powerful Lithium-ion batteries often reach the end of their lifespan with enough capacity for 'second life' applications, such as static energy storage, and can contribute to improving energy distribution. This also means the batteries avoid the need for recycling or disposal. However, grading the batteries for this use is currently labour-intensive.

Partnering with Nissan, AMETEK and Element Energy, WMG's battery technology experts developed a safe, robust and fast grading process, automated by a novel algorithm. This UK Energy Storage Laboratory project, funded by the Department for Business, Energy and Industrial Strategy, reduced grading time from four hours to less than five minutes with extreme accuracy. The processes are now being trialled in Nissan's second-life pilot facility, with the automotive giant aiming for 100% reuse or recycle of its European-assembled battery packs by 2021, with 90% going into second life applications. This could reduce emissions far outside of travel and bring net zero one step closer.

Next-generation bioimaging

Commercialising the UK's world-leading research is key to growing our economy. Enter Stream Bio, a UK-based SME whose Conjugated Polymer Nanoparticles™, invented in the research labs of King's College London, represent a new generation of innovative molecular bioimaging probes. These highly fluorescent, non-toxic nanoparticles are set to transform the bioimaging market with their unique brightness, exceptional stability, magnetic capability and suitability to be combined with a range of molecules.

Collaborating with CPI enabled Stream Bio to develop a commercially viable manufacturing process for this new product in four colours (or wavelengths), moving the product from idea to commercial reality. Now launched in the market, these nanoparticles are set to improve diagnostics and therapeutic targeting, with potential uses in imaging tumours and fluorescence-guided surgery. The increased accuracy this UK-made product can achieve could truly be a life-saver for millions of patients across the world.



Reinforcements to save construction 54 million hours

Reinforced concrete is a crucial part of modern construction. The traditional method for producing this, using reinforcement bars (rebar), is time-consuming and heavily reliant on skilled workers, often in short supply. Because of this, a wide variance is seen in the assemblies and the UK's Health and Safety Executive records thousands of major injuries associated with rebar each year.

Working with MetLase (the exciting joint venture between Rolls-Royce and Unipart), the MTC's Construction Innovation Hub project has the potential to transform rebar for the global stage. With an innovative new concept and patented twist dowel design, the new rebar could slash construction time, saving up to 54 million hours of labour per year and improving the health and safety of workers.



saving up to

54million

hours of labour

Our offer

The HVM Catapult offers manufacturers of all sizes open access to the equipment and expertise they need to develop new and existing products and processes. Our approach allows firms to test and prove their innovative ideas before they commit to significant capital investment, giving them the confidence to move forward. The breadth and depth of our expertise moves innovation in all areas from concept to commercialisation, underpinned by the workforce training required to maintain productive capacity far after our involvement.

There are five key aspects of our offer.



1 Manufacturing expertise

We offer manufacturing businesses access to a unique reservoir of manufacturing insight and expertise.



2 Access to cutting-edge equipment

We provide companies with access to world-class facilities and skills to scale-up and prove-out high value manufacturing technologies.



3 Workforce development

Our Centres offer apprenticeships, training courses and student placements to help build, maintain and continually develop the high-level skills UK manufacturing needs.



4 Research

We are a meeting point for academics and businesses, playing a key role in stimulating demand-led research.



5 Policy insight

Our business insight and technical knowledge make us a valuable partner in the development and delivery of national or more local policy.

Our technology



Advanced Assembly



Automation



Biologics

Case studies on pages 13-14



Biotechnology



Casting



Composites



Design



Digital Manufacturing



Electronics



Flexible Manufacturing



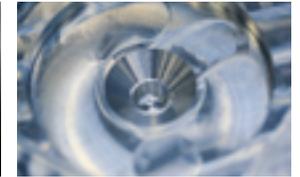
Formulation



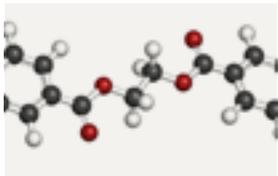
High Temperature Processing



Joining



Machining



Manufacturing with Polymers



Materials Characterisation



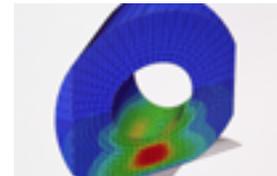
Medicine Manufacturing



Metal Forming and Forging



Metrology



Modelling and Simulation



Net Shape and Additive Manufacturing



Powder technology



Power and energy storage

Case studies on pages 28-29



Printable Electronics



Sustainable and resource efficient manufacturing

Case studies on page 24-27



Surface Engineering



Tooling and Fixtures



Visualisation and Virtual Reality

Achieving net zero

2019 delivered a landmark commitment from the UK Government to achieve net zero greenhouse gas emissions within thirty years. National emissions have been steadily reducing for three decades, but serious effort is required to meet the net zero target. This will require rethinking the way we travel, the way we generate electricity, the way we heat our buildings and the way we use resources. Manufacturing is a key area where that transformation can happen. By innovating the essential products that people use and the processes that create them, the HVM Catapult is in the vanguard of our national (and global) emission reduction journey.



Our world-leading expertise and capabilities are crucial to achieving net zero.





The future of transport

We are designing the future of transport, with projects that redefine road, rail, sea and air travel and solutions that minimise the need for those journeys.

SWARM like automated bees

Connected and Automated Mobility (CAM) will make travel safer, cheaper and more sustainable, as well as increasing access for the elderly and disabled. To realise this potential, vehicles will need to communicate with each other effectively.

For this challenge, WMG found inspiration from the animal kingdom in their SWARM project with Aurrigo and Milton Keynes Council. Using the colony behaviours of bees and ants as a template for revolutionary 'swarm' intelligence, the team designed processes to effectively manage fleets of autonomous pods with minimal supervision costs. Alongside new sensor technology, this allows the pods to self-organise for many uses.

After a successful public demonstration in January 2020, Aurrigo are now advancing this technology into commercial applications. The first of these is planned to be autonomous luggage vehicles in airports, potentially saving the airline industry millions.



The future of transport

The Factory in a Box

The key to reducing emissions from travel lies not just in the way we power our transport, but in the number of journeys we need to take. One way to minimise the need to travel is to reduce the number of people needed on-site. Developed by the MTC and a team of academic and industrial partners, the 'Factory in a Box' could do just that.

Able to be transported independently, with monitoring and control from any location with an internet connection, the 'Factory in a Box' is an industrial-scale production line built into a regular shipping container, customisable to production needs. The project demonstrator, produced through Innovate UK's Energy Research Accelerator programme, has successfully proven the concept for commercial applications, with the technology ready for scaling. This solution can provide a rapid route to market for manufacturing innovation, creating components on-site using local materials, whilst minimising the need to transport people and goods back and forth.

Electrifying travel for road and sky

Electrification is a growing priority with both industry and government recognising not only the commercial opportunities, but the environmental benefits too. A leader in automotive electrification, WMG is helping to transfer their knowledge to other sectors, for cleaner, safer travel.

Electric motorcycles have a vital role to play in future transport across the globe, reducing congestion and improving urban air quality as well as easing parking. WMG is working with Triumph Motorcycles, and other electrification experts, to develop specialist electric motorcycle technology as part of a two-year project (TRIUMPH TE-1) funded by Innovate UK.

WMG has even taken electrification to the skies, supporting Electroflight in the development of the ACCEL battery and powertrain, working on characterisation and validation for a high-performance electric aircraft. This ACCEL project, led by Rolls Royce and part-funded by the Aerospace Technology Institute (ATI) will attempt a world record for the fastest all-electric aircraft later in 2020, looking to hit speeds of over 300mph.



Lightweight materials for tomorrow's vehicles

High performance electric vehicles need to have increased battery capacity while maintaining safety standards and without adding weight. To accommodate and protect these batteries, casings are a critical safety feature that need to withstand extremes of heat without impacting the performance of the vehicle.

As part of the Hyperbat joint venture led by Williams Advanced Engineering, the NCC designed and developed a series of novel battery casings and examined future-proofing processes that could be applied to all electric vehicles. The team delivered up to 50% reduction in battery case costs and worked with ELG Carbon to save 65% of the carbon fibre from a case, to be repurposed in the manufacturing of a new case. This is a significant step in achieving sustainable vehicles.

65%
recycling of materials



Rail innovation on track for success

Very Light Rail (VLR) is a gamechanger for UK rail travel, with lightweight, energy efficient rail vehicles and low-cost infrastructure providing the potential for reopening disused branch lines and establishing new urban tram systems across the country. WMG continues to lead the way in this exciting new technology.

Two of their projects exemplify this. Revolution VLR, led by Transport Design International in partnership with Eversholt Rail, brings the capability of battery technology to the traditional diesel engine, with WMG developing the power pack, high voltage battery and lightweight body materials. This hybrid design will lead to significant savings in fuel and emissions.

In the urban landscape, Coventry City Council, in partnership with WMG and Transport Design International, plan to implement VLR to connect the city centre with strategic locations. Their battery-powered vehicle solution would do away with typical high-cost infrastructure, such as overhead power cables, and the prototype testing and demonstration is set to commence in early 2021. The shuttle will be an important transport mode to connect the city.

Reducing waste

We are rethinking the world's relationship with waste, creating products and processes with the need to reuse, recycle or remanufacture in mind, and reducing the need for resource extraction whilst maximising its use.

Transforming recycling and reuse of composites

One of the strengths of composites is that they are incredibly robust, but that can make reuse or recycling more challenging.

A revolutionary new technology developed by the NCC and Oxford Brookes University means composite structures can now be disbonded quickly and cheaply using a simple heat source.

By adding low-cost materials to off-the-shelf structural adhesives, composite parts could be separated from each other in as little as six seconds with the directed application of low heat without a significant impact on their normal performance.

This means composite components may be easily repositioned and reused during manufacturing – reducing waste, enabling easier repair in operation, and making them more efficient to recycle. With the NCC proving that the process can work at scale, it could have a transformational impact on the design, use and end-of life recycling of a wide range of products, including cars, aircraft and wind turbines.

60-70%
of all municipal solid waste
in the UK could be recycled

SEISMIC reduction in construction waste

In Britain, around 100 new and replacement primary schools are needed every year. The cost to the Exchequer is some £5bn and the scale of the demand exceeds the available capacity in the UK construction industry. As part of a pioneering consortium, the MTC worked with construction industry leads to transform the way primary school projects are designed and constructed.

By standardising the design of the modular frame, the consortium was able to reduce the quantity of material required and refine the process of manufacturing. This in-turn reduced the weight of the modules by over 25% with no compromise on the structural rigidity. With an average sized primary school made up of 62 modules, this frame design brings significant savings to carbon emissions – estimated to be equivalent to over 155,000 miles of car driving or 17 flights from London to Sydney.





Creating sustainable products from waste

Almost 15 million tonnes of waste are sent to landfill each year in the UK. It is essential to reduce this as far as possible to minimise the environmental impact. CPI supported the technology company Fiberight to improve and scale up their process for separating, cleaning and processing organic and plastic parts of mixed waste. Once separated, the recyclable fraction of the waste can be converted into renewable materials or fuels.

CPI's contribution played a central role in demonstrating the technology's commercial viability to investors and stakeholders. Once commercialised, this technology has the potential to allow 60-70% of all municipal solid waste in the UK to be recycled and converted into useful raw materials, some 9-10 million tonnes per year. Such an achievement would be a significant step in helping the UK become a leading player in sustainable development.

Remanufacturing set to make tool and die sector green

Dies are everyday objects for the modern production line, used as specialised tools in forming metal. With the process to forge new dies both energy intensive and expensive, any increase in the lifespan of a die reduces environmental impact and saves a company money. In collaboration with six other companies, the Advanced Forming Research Centre (AFRC), part of National Manufacturing Institute Scotland (NMIS), created a low-cost remanufacturing solution for the tool and die sector, successfully increasing the lifespan of a die by 120%.

The two-year DigiTool project is helping UK manufacturers of all sizes and across various industries to embrace the circular economy, boost sustainability and realise significant financial savings by offsetting the purchase of new dies. A small change is having a big impact.



The future of energy

We are pushing the limits of energy production and use, with ground-breaking contributions to renewable and nuclear energy and heating, whilst laying the groundwork for nuclear fusion technology.





Small Modular Reactors

Nuclear technologies are a vital part of the global move to low-carbon power generation. Unfortunately, the lengthy lead times and financing hurdles involved in construction of a traditional gigawatt-scale nuclear power station can get in the way of a transition away from more polluting energy options. The Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) is working to develop Small Modular Reactors (SMRs) which dramatically reduce both cost and lead times for nuclear new build.

In SMRs, the entire reactor can be produced in factories as large modules and transported to site by a standard heavy goods vehicle for rapid assembly. As part of the UK SMR consortium, led by Rolls-Royce, the Nuclear AMRC is leading research into the use of technologies such as robotic machining, large-scale metrology and digital twinning which will give the UK supply chain a global lead in the SMR market. This project is set to create £52bn of value for the UK economy, whilst bolstering national supply chains and creating up to 40,000 jobs and delivering a potential route for low carbon electrical base load.

Part of
£220m
investment in fusion design development



Ready to lead in fusion power

Nuclear fusion is coming to the Advanced Manufacturing Park in Rotherham, home of the AMRC and Nuclear AMRC. Drawn by the expertise of our Nuclear AMRC, the UK Atomic Energy Agency's new fusion materials research facility will bring 40 high-skilled jobs to the cluster.

In the meantime, our work in commercialising fusion power continues. The Nuclear AMRC is leading cutting-edge research into modular construction for the Spherical Tokamak for Energy Production, as part of a £220m investment in design development. The AMRC has also developed a 3D woven composite breeder blanket for the new reactor, designed to be an easy to manufacture component capable of withstanding the extreme temperatures inside.

Fusion power is one step closer to bringing a revolution in truly limitless zero carbon energy to the world.

The future of energy

Fair winds for green energy

Offshore wind is a powerful source of renewable energy but the industry is always seeking new ways to make it even more efficient and affordable. In collaboration with a growing Scottish business, a number of our HVM Catapult Centres have been developing a new, lighter composite turbine blade that can generate more energy from a turbine.

The collaboration between ACT Blade, the Lightweight Manufacturing Centre (sister centre to the AFRC within NMIS), the AMRC and the Offshore Renewable Energy Catapult has demonstrated a distinct advantage over traditional glass fibre materials. A lighter composite blade allows for 10% more length, which, in turn, generates over 9% more energy from the same wind turbine.

The new, partly recyclable blades cost 30% less to manufacture than conventional blades and don't require additional finishing. This saves time and energy in manufacture, lowering the average cost of each gigawatt produced whilst increasing recycling potential and avoiding pollutants.

The development could be a major disruptor for the industry, helping to make offshore wind easier and cheaper to include in the energy production mix.





up to **80%** energy efficiency savings



Sustainable heating for all

For the Government's ambitious net zero plans to be possible by 2050, businesses need cost-effective solutions to eliminate their reliance on gas and oil for heating and cooling. WMG supported Arriba Technologies Ltd to develop a solar-powered heat pump product for large buildings including hospitals, factories, schools and supermarkets.

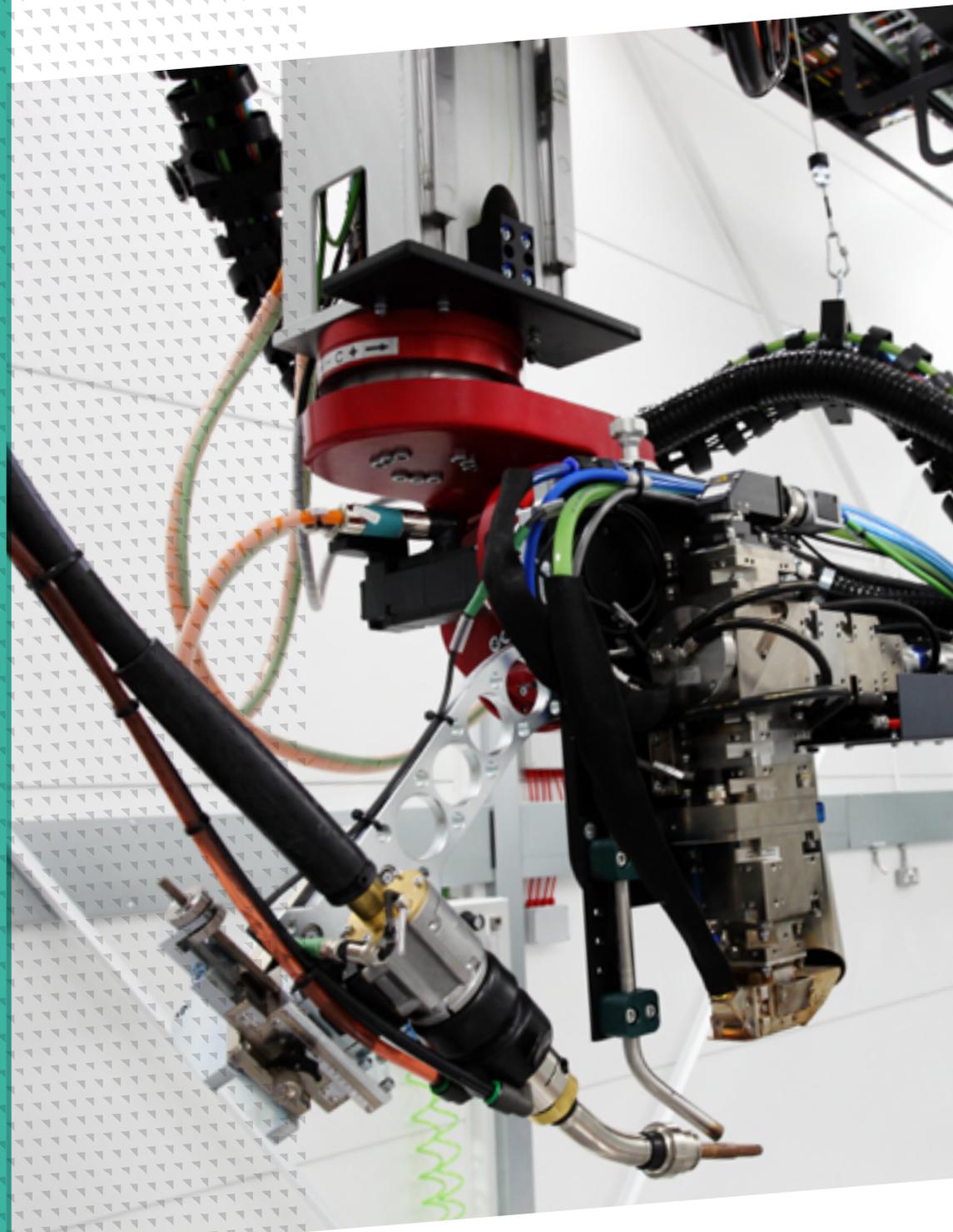
Early readings from the heat-pump's first large-scale installation at Addenbrooke's Hospital in Cambridge suggest energy efficiency savings of up to 80%. By using renewable sources and less energy, the heat-pump cuts costs whilst reducing emissions to zero. With a planned UK facility, commercial scaling is in progress and attracting interest from significant public sector organisations including the Department for Health.

Delivering economic impact

Manufacturing is a central and important part of our nation's economic mix. With annual output worth some £192bn to our economy, it provides high-skilled jobs, produces some 44% of all UK exports, bringing £273bn into the UK and, as the COVID-19 pandemic has shown, gives us the capability and resilience to tackle global challenges. It is critical to the lifeblood of the nation. The HVM Catapult is playing a key role in making sure that the UK harnesses the power of science and engineering to build on its proud industrial heritage, create the markets of the future and lead those already here.



Our work ensures that the UK remains a world leader in manufacturing.



Bringing work back to the UK

Founded in 1887, Albert Jagger are leading suppliers of hardware and adhesives for industrial, commercial vehicle and marine uses.

With increasing disruption on the global stage, they realised that returning productive capacity to the UK is crucial for supply chain resilience. Approaching our experts at the MTC to help, they sought to secure their supply chain and save their UK facilities from closure by reshoring the manufacture of one of their signature products.

Using SME-friendly visualisation tools and world-leading expertise in manufacturing optimisation, the MTC team showed Albert Jagger what was possible to achieve their aims. Their virtual reality environment enabled the live mapping of the shop floor in a risk-free way, before any significant capital investment.

With the most efficient plan in place, the company was able to save and transform its Bloxwich engineering facility, expanding their workforce. Now in a position to manufacture the products themselves, an estimated £2m of business is expected to return to the UK in the next three years.

£2m

of business is expected to return to the UK in the next three years

Digital cask filling to save whisky industry millions

Few would know just how important a contributor Scotch whisky is to our national prosperity, contributing some £5.5bn to our economy every year. More than 10,000 people are directly employed in the Scotch whisky industry in Scotland and it supports over 40,000 jobs across the UK. The AFRC, with partners including Siemens, Kigtek and Diageo, is bringing digital innovation to an industry steeped in tradition, with a project that could save it millions of pounds each year in inventory costs.

To be called Scotch whisky, the spirit must mature in oak casks in Scotland for at least three years. Current processes used to fill the casks mean that whisky producers face millions of pounds in inventory waste each year. The Innovate UK-funded project tackled this problem by designing a precision filling system, complete with live data shown in a digital twin of the environment. Using this system, operators can achieve extreme accuracy, filling a 200-litre cask in under a minute and minimising waste.



Working with smaller businesses

The HVM Catapult's support is not just for larger firms. In fact, nearly 50% of the projects we work on are geared to helping smaller businesses develop innovative new products, improve their processes, commercialise their ideas and access new markets across the globe.

In 2019/20, 2,231 of our projects were with smaller businesses. All of our Centres have evolved services and approaches geared towards reducing the risks of innovation and helping SMEs to bridge the gap between concept and commercialisation. Here are just a few examples of the excellent work they are doing:



Catapult
Annual Review 2019/20

Medical drone design takes flight

In an emergency, blood, organs or devices like defibrillators often need to reach distant locations as quickly as possible. By road, and even by helicopter, this can be expensive and waste vital seconds that could mean the difference between life and death, especially in rural areas. But what if the journey could be made in a straight line, quickly and cheaply? That question motivated childhood friends Thomas Franchi, Hammad Jeilani and Chris Law to found MEDeus Ltd, a company developing a medical drone system set to revolutionise medical intervention.

The AMRC supported MEDeus by helping them design concepts for their MEDrone and MEDibox system, which won them prestigious UK Space Agency funding. The trio, now appointed as NHS Clinical Entrepreneurs, are working alongside the National Institute for Health Research to uncover the potentially life-saving impacts of drones for patients. One such impact could be in maintaining distance and avoiding contamination in situations of pandemic, alongside everyday uses.



**2,231 of our projects
in 2019/20 were with
smaller businesses.**

Robots secure skilled manufacturing jobs

Robotics and automation offer huge opportunities for firms to improve productivity levels. All too often, smaller firms hold back from investigating their potential fearing that benefits will come with a high price tag. Footprint Tools has shown that need not be the case.

The 150-year-old Sheffield firm has been in the Jewitt family for four generations and had enjoyed huge success during the hey-day of coal and steel. But the low-wage economies in the Far East, the collapse of coal and steel and the 2008 crash brought Footprint Tools to the brink of closure. To fight back they turned to the AMRC.

The result is a robot cell producing their staple product - the humble builder's line pin. Freeing up two skilled workers for other tasks, the company now fulfils orders three times faster than before – a massive impact on an SME like Footprint Tools.

Advanced materials bring protection and success

Moving from concept to commercial reality is a daunting task for many smaller businesses, with development often costly and time-consuming. That's where the HVM Catapult can help.

UK-based SME Graphene Composites (GC) developed a proof of concept for their first product, the GC Shield™ – a strong, lightweight and flexible material for use in body armour. Using graphene and aerogel, the impact-resistant composite provides adaptable protection against knife and firearm attacks, protecting the lives of front-line police officers.

GC worked closely with CPI to move this product from proof of concept to pilot-scale production. CPI's expertise enabled GC to take the most effective route at all stages, from design to the production of working prototypes to a commercial product. This ensured that GC can thrive in global markets and contribute to the UK economy.



Supply chain development

Changes at UK borders and the COVID-19 pandemic mean that we are all more sharply aware of the importance of supply chain security than ever before. The HVM Catapult is helping to develop resilient UK-based supply chains for the products of the future and supporting reshoring of key current supply chains by providing the technological efficiencies that make domestic production globally competitive.

Kickstarting the digital engineering revolution

To deliver a low carbon global economy, everything we make will need to be reimagined and re-engineered. The design technologies and processes of products need to be optimised to make them low cost, quick, and right first time.

Engineers are working out what tools to use, what technologies to invest in and how to exploit the data captured at every stage. This is where Digital Engineering, Technology and Innovation (DETI) comes in.

Based in the West of England and led by the NCC, the DETI test-bed will develop powerful new tools and methods to allow industry to design better products, using artificial intelligence and machine learning, digital twinning, visualisation and cyber security technologies. The two-year R&D initiative aims to support businesses to recover and emerge digitally stronger, something that will become even more important post the COVID-19 pandemic. By fast-tracking innovation, the West of England will be better placed to maintain employment levels, have a more competitive position in global markets, and make business more resilient to similar disruption.

Creating a UK supply chain for 3D-printing

Plastic is not the only thing you can 3D-print. Metal additive manufacturing has the potential for delivering better products, reducing time to market, and simplifying the supply chain for many industries, with aerospace leading the way. The disruption of the traditional supply chain provides an opportunity for developing home-grown talent. We help businesses to exploit this disruption.

The MTC worked with Liberty Steel Specialists (LSS) and seven other partners to develop a range of technologies across the metal powder supply chain. The project, CASCADE, has enabled LSS to establish its first powder production facility and a new supply business, promising to bring up to 50 new jobs to Tees Valley.

With aerospace leading the uptake, it is important to position the UK as the global leader in metal additive manufacturing. Led by the MTC's National Centre for Additive Manufacturing, the DRAMA project does just that, supporting the wider aerospace supply chain in adopting the technology. Drawing on a wide-ranging consortium, the new DRAMA facility in Coventry provides open-access digital infrastructure for supply chain development. UK companies are now better placed to exploit this technology.

£1.9bn
new contracts won

Fit for Nuclear and Offshore Renewables

The Nuclear AMRC's Fit For Nuclear (F4N) programme is now established as the benchmark for manufacturers wanting to win work in the nuclear supply chain.

F4N is a unique service to help manufacturing companies assess and develop their readiness to bid for work in the nuclear supply chain. Developed with the support of the industry's top tier, F4N lets companies measure their operations against the standards required to supply the nuclear industry and take the necessary steps to close any gaps.

Around 120 companies were granted F4N as of April 2020, collectively reporting a total of £75m of new nuclear contracts and £1.1bn non-nuclear contracts won.

Building on this success, the Nuclear AMRC is working with the Offshore Renewable Energy Catapult to bring supply chain development to the wind sector. The Fit 4 Offshore Renewables (F4OR) collaboration was piloted in Scotland in 2019 and is set to deliver the targeted support needed to keep wind sector jobs in the UK.



Anchoring investment in the UK's regions

When the HVM Catapult was created in 2011, its footprint reflected the locations of the seven founding centres which came together to boost UK manufacturing performance.

Today we are drawing in and anchoring investment from around the world to the UK's regions, attracting multinational firms and national institutions with access to our expertise and creating new UK jobs in the process.

Our Centres often contribute to regenerating historically neglected areas, bringing high skilled jobs and prosperity back to deprived communities.

The map shows our current locations across the country, accompanied by some key developments from the past year.



WMG drives future mobility in West Midlands

With a variety of urban and rural environments and a large transport infrastructure, the West Midlands is the perfect place to develop the future of mobility. WMG plays a pivotal role in creating a regional centre for transport innovation.

With a leading position in the Midlands Future Mobility project, WMG is bringing companies from across the country to a 300km road network to trial 'Connected and Automated Mobility' in the real-world. Users are trialling vehicles, systems and infrastructure capturing key data through smart monitoring systems using the latest in wireless connectivity.

WMG's national Energy Innovation Centre also supports the transport industry in the development of efficient, cheaper, and safer batteries. Its work has attracted the UK Battery Industrialisation Centre to the region, allowing companies to move to high-volume (Gigafactory) battery manufacturing. With the recently opened National Automotive Innovation Centre also demonstrating the long-term commitment of Jaguar Land Rover and Tata Motors to the region, the West Midlands has become the best place for developing clean, green, smart transport.

Anchoring printable electronics innovation in the North East

CPI's Formulation, Photonics, Printable and Hybrid Electronics facilities are key anchor tenants for NETPark in Sedgefield, one of the fastest-growing science, engineering and technology parks in the UK. As one of the first companies located at the park, CPI enabled the growth of a globally recognised printable electronics innovation cluster, drawing over 550 highly skilled jobs to the area. Driven by CPI's strategic partnership with both Business Durham and Durham University, the cluster is continuing to grow with CPI working to support and accelerate companies based at the site.

From industrial unrest to industrial innovation

Built close to the site of the historic Orgreave coking plant, the Advanced Manufacturing Park is a beacon of industrial transformation. With the AMRC as anchor tenant from its launch, the cluster of global companies and their supply chains now established on the site is the most concentrated manufacturing base in the UK. The likes of McLaren and Rolls-Royce were drawn to the AMRC's expertise with their factories surrounding the AMRC's facilities. With the Nuclear AMRC joining the park in 2010, it has one of the widest sets of engineering expertise in the UK.

According to the Centre for Cities' 2019 Parks and Innovation report, the site outperforms all similar science parks across the country, with 66% of jobs in the area in high value-added manufacturing. The AMRC and Nuclear AMRC's work is central to this, but the R&D carried out does not just benefit local firms and workers; it is also 'exported' to other parts of the country. With projects like those with Rolls-Royce de-risking their £100m investment in Tyne and Wear and securing 300 highly skilled jobs the AMRC and Nuclear AMRC are regional assets with national impact.

Anchoring investment in the UK's regions



Investment in Merseyside with MTC Liverpool

Continuing a strong partnership with academia in the North West, the MTC has successfully established a base in the heart of Liverpool's Knowledge Quarter, strategically positioned to mobilise partnerships with regional universities and allow local businesses to test their processes in a de-risked environment.

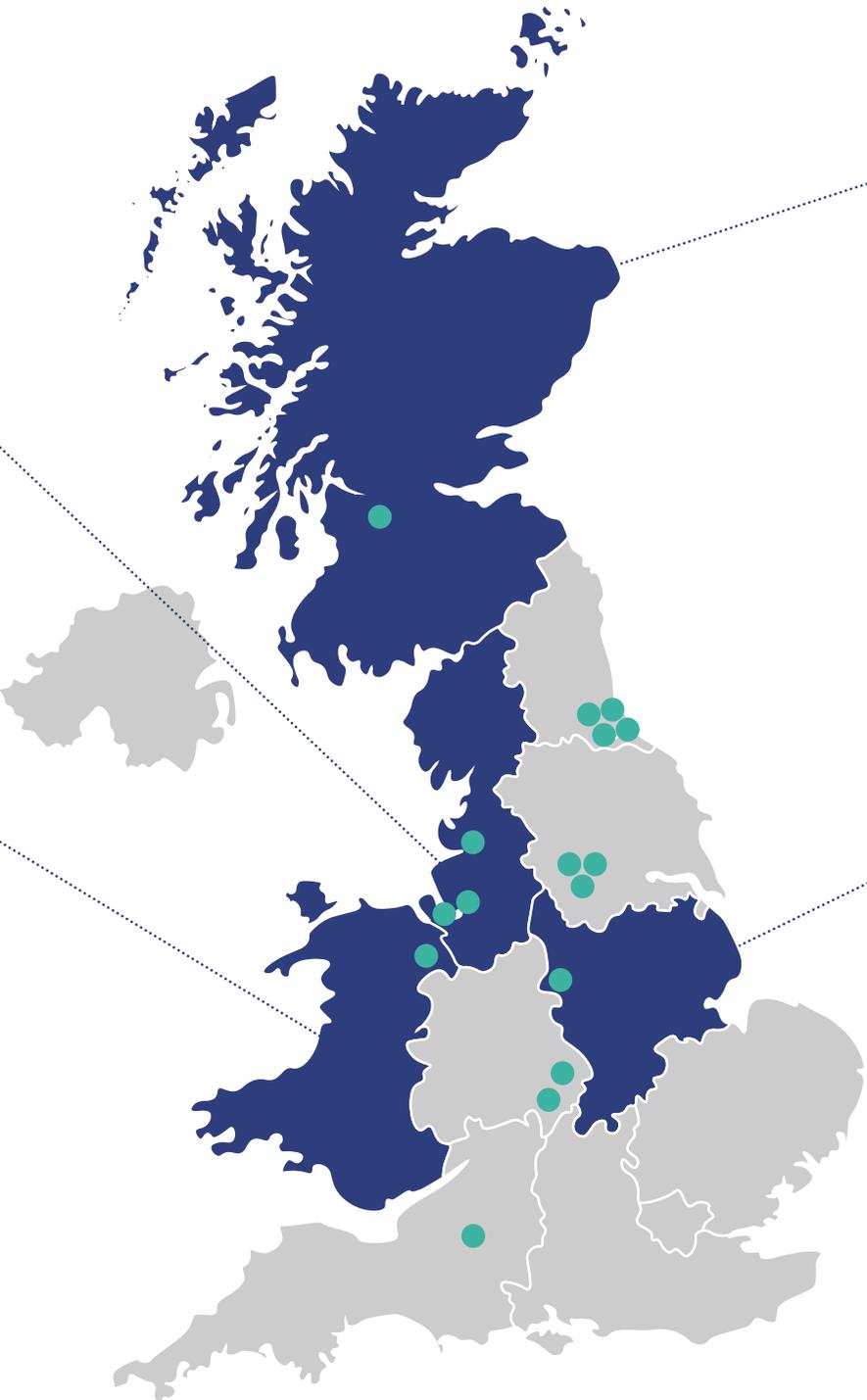
With support from the Liverpool City Region Combined Authority, the MTC is set to expand its impact in the region, boosting productivity, skills, and job creation.

AMRC Cymru opens for business in North Wales

AMRC Cymru, a new £20m state-of-the-art research and development facility in Broughton, has been described by Welsh government ministers as a 'game changer' for the economies of North Wales and the northern powerhouse.

Officially opened in November 2019, and situated in the Deeside Enterprise Zone, AMRC Cymru focuses on advanced manufacturing sectors including aerospace, automotive, nuclear and food. With Airbus as the first major tenant and much more planned, it is predicted the new facility could increase GVA to the Welsh economy by as much as £4bn over the next 20 years.

Only months after opening its doors, AMRC Cymru started playing an essential role in an unfamiliar game, helping save lives in the fight against COVID-19 as a production facility for thousands of vital medical ventilators, demonstrating the HVM Catapult's versatility and responsiveness in the face of a global crisis.



Boeing touches down in Scotland

2019/20 was a great year for manufacturing investment in Scotland. Over the year, the AFRC's success has spurred investment in a larger National Manufacturing Institute Scotland (NMIS), of which the AFRC forms a vital part. This development has already seen the opening of the AFRC's sister centre, the Lightweight Manufacturing Centre, nearby to its Renfrewshire facility. Planning permission has also been granted for the new flagship NMIS facility, which will feature a skills academy, fully digitalised factory of the future and collaboration hub.

Drawn by the Centre's expertise and this expansion, Boeing announced a £11.8m R&D collaboration with the AFRC in March 2020. This project is a perfect example of drawing international excellence to the Centre, seeing the aerospace giant establish a Scotland based R&D team as part of its strategic agreement with Scottish Enterprise.

Nuclear AMRC anchors manufacturing in Derby

A year after its launch, Nuclear AMRC Midlands is delivering innovative projects in sensors, control systems and digital manufacturing, and helping the region's young people develop skills for the future workforce.

As the first HVM Catapult location in the East Midlands, Nuclear AMRC Midlands is developing capabilities to serve the key manufacturing sectors of the local economy. Its work with companies across Derbyshire and Nottinghamshire highlights the impact that insights from the nuclear industry can have across sectors. With a full-scale facility in the works, the Centre is expected to anchor investment in the region, bringing innovative companies together to form a collaborative cluster.



MANUFACTURING THE FUTURE WORKFORCE

The workforce crisis in UK manufacturing is well known. There is an acute skills gap that prevents manufacturers from successfully exploiting new technologies. In January 2020, we launched our Manufacturing the Future Workforce report which provides a blueprint for the way forward.

The report is a foundation for industry, government and education providers to work together, creating the workforce development system the country needs.

OUR APPROACH

Built from much greater connectivity between stakeholders, a new approach is needed involving better foresighting and forecasting of future needs with significant improvements to learning delivery. This Skills Value Chain emphasises the unique contribution Centres of Innovation can have.

THE SKILLS OPPORTUNITY

Drawing from good practice across the globe, there is a very real opportunity for the UK to catch up with other nations and then secure a competitive advantage from its research and innovation communities, by leveraging its knowledge and understanding in a Skills Value Chain.

Integration is key here – with government, industry and education providers working together with common purpose to produce a workforce fit for the future. In this landscape, Centres of Innovation (including the HVM Catapult, the National Physical Laboratory (NPL) and TWI) can lead the way.

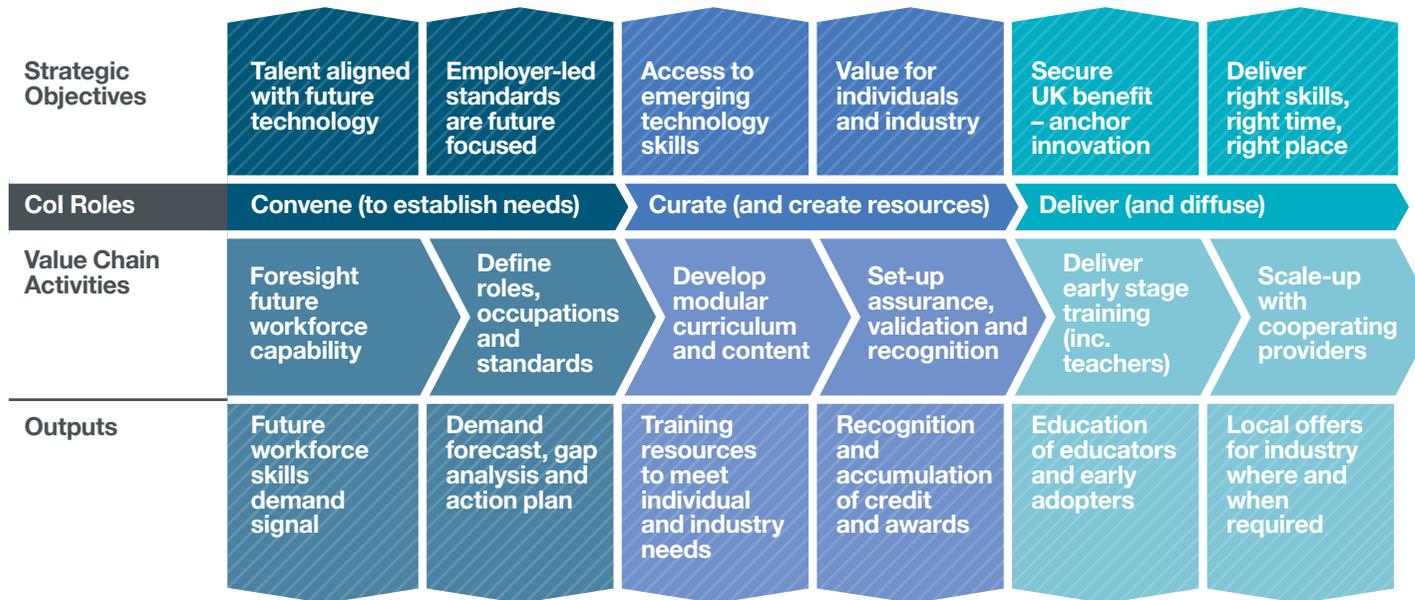
OUR RECOMMENDATIONS

The report makes five recommendations for the UK based on good practice identified around the world:

1. Develop and pilot the application of skills foresighting

Bring together groups of education and technology specialists to analyse and articulate any required changes to current standards and provision based on employer needs.

THE SKILLS VALUE CHAIN



2. Support the development of Higher Technical Qualifications and National Standards

3. Develop modular training and resources to support future workforce skills development

The content should be used and refined during early-stage adoption by geographically distributed and relatively low volumes of learners at specialist locations, including Centres of Innovation. ‘Blueprints’ for wider diffusion and scale-up, responding to local industry demand, can then be rolled out. Training and resources should be suitable both for new workforce entrants and to upskill and reskill those already in work and previously qualified. This will require flexible and modular modes of learning that fit around the working and personal lives of adult learners.

4. Promote ‘Learning Factories’ as an education model to enable industrial digitalisation

A Learning Factory is not simply a replica of an industrial factory but is designed as a simulation to enable experiential learning based on common scenarios.

5. Improve recognition and funding of modular and lifelong learning

Increased take-up of modular courses with formal recognition of continued achievement is an important factor in making reskilling and upskilling programmes effective for individuals and industry alike. Action will be required by Professional Engineering Institutions, academia, government and industry bodies to increase access to courses with related national and local funding.

Research at our core

Research is at the core of the HVM Catapult, whether in the commercialisation of early stage technology or in developing brand new techniques, materials and machines for industry. In our work, we collaborate with a broad range of academic and industry partners to translate research into economic impact. By accelerating research outputs to commercialisation and keeping researchers aware of industry demand, we successfully bridge the gap to bring innovative new products and processes to market.

Here are a few examples of our work with the research community.

UK Manufacturing Forum

Jointly hosted with the Institute for Manufacturing at the University of Cambridge, the UK Manufacturing Forum (UKMF) has become a centrepiece of the annual calendar for a broad swath of the UK's manufacturing community, from both industry and academia. December 2019 saw the third annual event, bringing together over 150 researchers and innovators to collaborate on projects, strengthen networks and build roadmaps for future industry needs. Starting with the aerospace and food and drink sectors, these roadmaps for technological development are identifying sectoral needs and translating these into challenges the research community can conquer.

Providing a focus for collectively exploring opportunities in manufacturing, the UKMF promises to grow year on year. This will draw more of the UK's world-leading manufacturing community together to progress towards collective goals, generate collaborative plans for national challenges, and address the barriers and opportunities in industrial commercialisation. The UKMF is proving key to maximising the return for the UK of its world-class research base.



Our 1,389 engagements with UK academia in 2019/20 show our immense strength in reaching across the research-industry divide.

Researchers in Residence

Every researcher has their own unique knowledge set, bringing with them ideas and approaches that could benefit the UK. That is why collaboration and co-creation remains at the heart of the HVM Catapult's activity. Our Researcher in Residence programme is testament to this, bringing leading academics from across the country into our Centres to undertake research into the technologies that will provide the much needed impact for the UK economy.

In 2019/20, we hosted 24 Researchers in Residence, accelerating our impact-focused projects and exchanging knowledge across institutional boundaries. One such researcher is Professor Jim Scrivens, of Teesside University, who brought his specialist expertise in mass spectrometry to biotherapeutics and viral vectors at CPI. With future work focusing on establishing a regional mass spectrometry network, these opportunities provide enormous gains for the UK and its regions.



Other highlights

- The AMRC is taking a leading role in a number of Future Manufacturing Research Hubs - collaborative research projects for addressing the major long-term challenges facing manufacturing industries. In association with the Engineering and Physical Sciences Research Council (EPSRC) and other organisations, they are active in Hubs for advanced metrology, electrical machines manufacturing and advanced powder processes.
- Our centres are also key partners in the EPSRC Centres of Doctoral Training, providing a pipeline of research capable of solving future industrial challenges and helping to build a resilient manufacturing industry for the future in the UK.
- Following a successful joint bid for the 'Driving the Electric Revolution' (DER) Industrial Strategy Challenge Fund, all seven of our Centres are part of a national consortium bent on allowing the UK to seize the economic opportunities from the global transition to clean technologies and electrification. Working alongside 23 universities and two other Catapults, the HVM Catapult's DER team has been able to identify and leverage existing UK capability to support the development of a national programme to address future industrial need.

Making the factory of tomorrow

Commercialising research often drives new innovation not just on the factory floor, but also in the tools we are able to use. Through these innovations, we are not only building the UK's manufacturing sector into an economic powerhouse. We are also developing technology that can spur the economic revolution of the future. It is the machines and processes in our Centres today that will be seen across the sector in the factory of tomorrow.

Here are just a few examples of this work.



Redefining 'state of the art' composites manufacturing

Demand for composites is growing as manufacturers seek to make products lighter, stronger and more durable. In the UK alone, the value of composites is expected to reach around £12.5bn by 2030. The NCC ensures that Britain is at the forefront of this fast-growing sector.

As part of a £36.7m R&D programme, the NCC explored how digital technologies can make composites easier to design, and quicker and cheaper to make.

Ten ground-breaking new machines were developed, including a giant Braider, which automatically weaves up to 288 individual strands of high strength carbon fibre to create hollow 3D shapes; the Overmoulder, which demonstrates how composite components can be mass-produced at a high rate; and two robots that work in unison to beam ultrasound through high-pressure water jets for quality control.

By showing that composites can be a viable, mass-producible alternative to traditional metallic parts, the NCC continues to make truly global contributions to manufacturing.

World-first facility brings digital to advanced forging

There is something primal about the naked heat of metal forging, evoking images of early industrialisation. Forging remains a vital part of the global metal processing industry. The AFRC's FutureForge facility will transform the forging sector, helping it to embrace the gains of digitalisation.

With construction completed in early 2020, FutureForge is a world-first, helping companies of all sizes explore less energy-intensive methods of forging and minimising the costly trial and error traditionally associated with the forging process. Planned to be in full operation by early 2021, the facility is predicted to generate around £40m of new collaborative R&D projects over 10 years, revolutionising forging for the 21st century.

Single-platform manufacturing made Simple

Very large assemblies, such as reactor pressure vessels in the nuclear industry, are often time consuming to produce. One of the biggest sources of unproductive time comes from moving these parts between different machines for welding, machining, inspection and other operations. Doing everything on a single platform would allow significant time and cost savings for large complex fabrications in a host of industries.

The Nuclear AMRC's Simple project, part of the government-funded Nuclear Innovation Programme, is designing such a single-platform process. Developing innovative welding and monitoring tools and the digital technologies that underpin single-platform manufacturing, the Simple approach could achieve cost and time savings of at least 50% for a range of large complex fabrications, a step change for the nuclear sector.

A digital future for healthcare

Many pharmaceutical companies have complicated supply chains that are becoming inefficient against increasing and varied demands. Working with partners including GSK and AstraZeneca, the Grand Challenge 2 project at CPI's Medicines Manufacturing Innovation Centre aims to deliver a more agile and responsive clinical supply chain and reduce waste. The project has delivered a ground-breaking design that brings Just in Time manufacturing to medicine production: the Pharmacy Automation for Clinical Efficiency (PACE) platform.

The PACE platform is an automated production and packaging line that can complete single patient orders with custom formulations (capsules) and amounts of drug compounds. Using secure data links to transfer information to Qualified Persons for digital certification, we will be able to produce and release medicines direct to patients in real time. This revolutionary approach to medicine production will enable the pharmaceutical and healthcare sectors to better serve patients with quick, tailored medicine delivery, cutting waste and lead times whilst ensuring medicines are in the right place at the right time for effective treatment.

Our resources

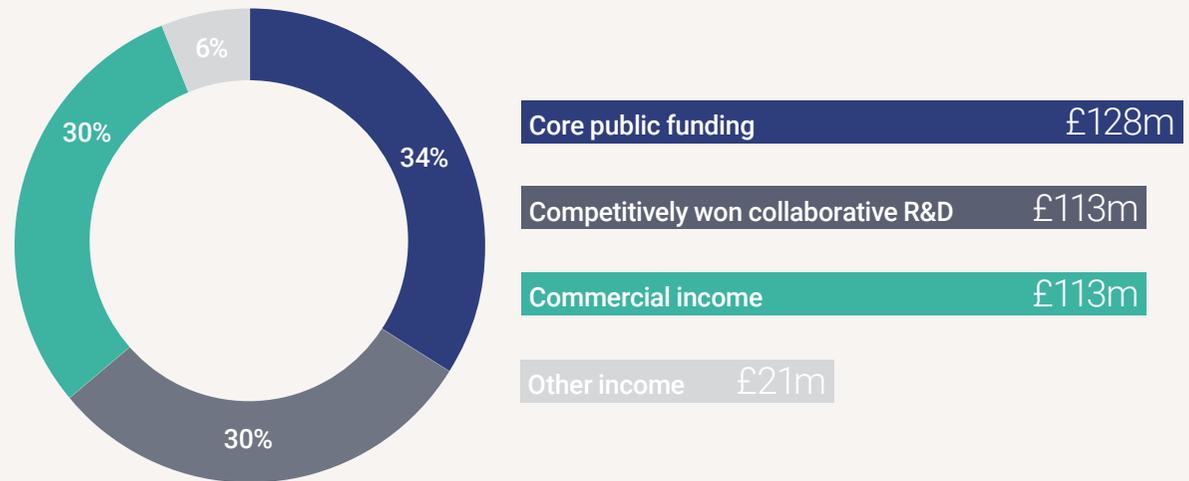
Based on best practice established by the German Fraunhofer approach, the HVM Catapult strives to secure broadly equal amounts of income from:

- Core public funding from the Innovate UK grant for long term investment in infrastructure, expertise and capability development.
- Collaborative R&D projects funded jointly by the public and private sectors and awarded on a competitive basis.
- Commercially funded R&D contracts.

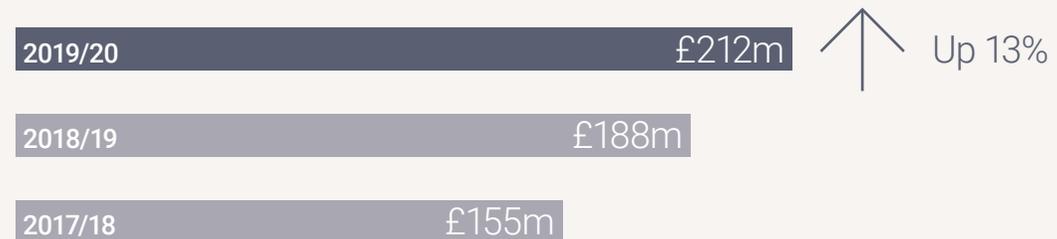
Maintaining the funding model in proportion ensures that an innovation 'sweet spot' is maintained - encouraging risk taking, collaboration and stimulating innovation in areas that are relevant and of benefit to industry.

These charts show the HVM Catapult income sources in 2019/20.

HVM Catapult Income Sources 2019/20



HVM Catapult Collaborative R&D and Commercial Income*



*Excluding collaborative R&D in land and build

Our sales order book

£267m

Investment in capital projects
and capability during 2019/20

£68m

Engagement with UK
academic institutions

1,389

Total value of our assets

£791m

Our people

3,130 full-time
equivalents



Advanced manufacturing can lead the way back to economic prosperity post-pandemic.



Emerging from the pandemic

The final part of the 2019/20 year was a challenging one for businesses as the COVID-19 pandemic delivered an intense economic shock across all sectors. As the UK rebuilds, a vibrant, innovation-led manufacturing sector will be a critical ingredient of the clean growth that will position the UK to lead the challenges of a net zero future economy. It will also be key to our long-term national resilience giving us the ability to respond when difficult challenges emerge without the dependence on other nations.

A deliberate approach, building on existing national and regional strengths and enabling new industries of the future, has the potential to level up manufacturing and construction activity across the UK. The High Value Manufacturing Catapult can use its unique position at the intersection of industry, academia, and government, and its role as the custodian of our national capability in advanced manufacturing technology to spur clean growth right across the nation. We can bring our insight and expertise, our world-leading facilities and the trusting relationships we have established to help forge a refreshed and more resilient UK economy that works better for more of its citizens.

In the coming year, our Centres across the country will work with local, regional and national Governments to lead the way forward. We will reach into the UK's manufacturing communities and help firms of all sizes to harness the new knowledge flowing from our world-leading research base and the power of new technology. We will continue our work with the key partners who are shaping the future UK landscape, like HS2 and EDF Energy, to deliver the best environment for all UK citizens

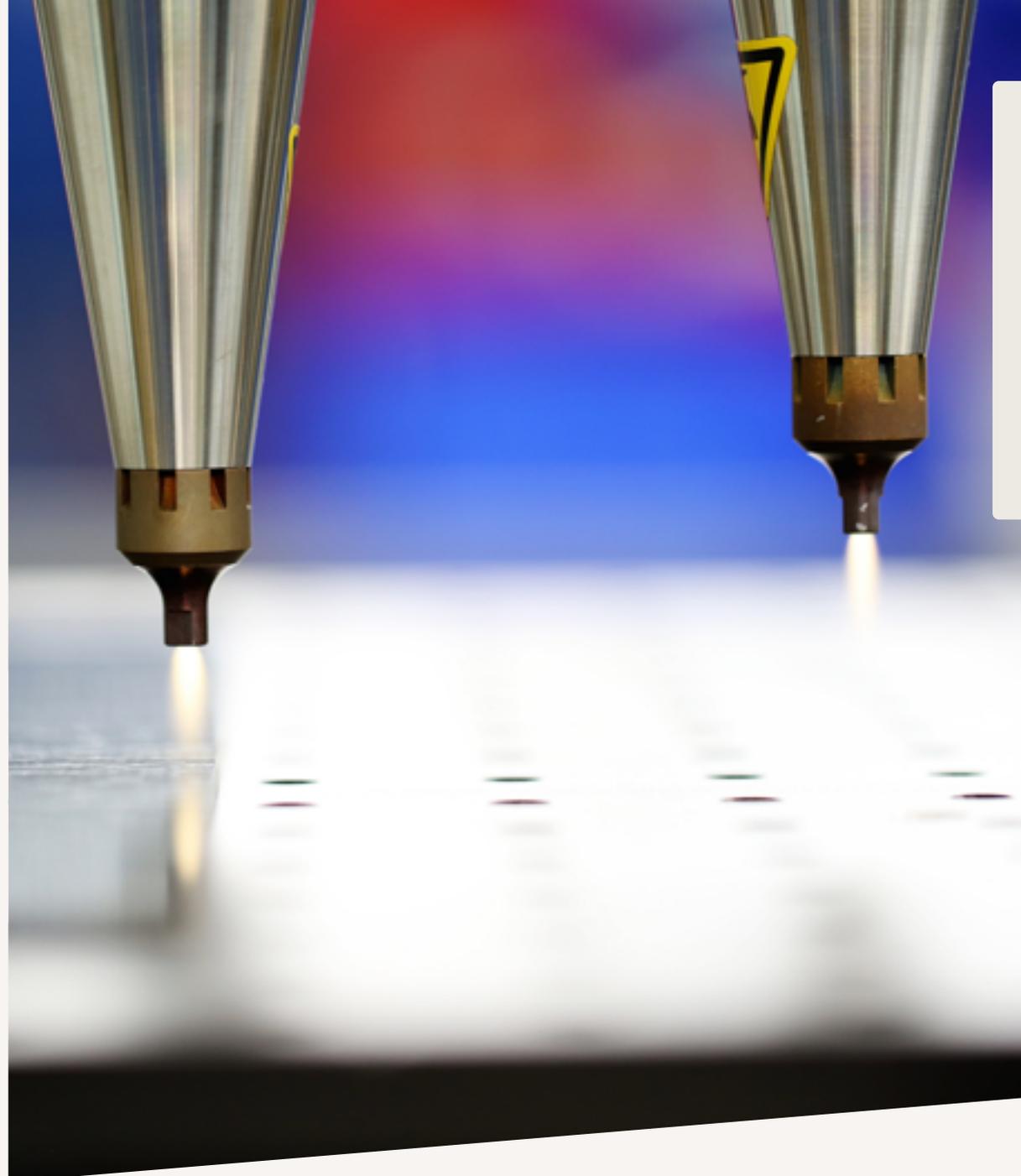
We will work to make sure that UK businesses are ready to rise to the challenges and seize the opportunities our changed world presents. As we do so we will use our resources to spur the investment in R&D that will keep the UK ahead of competitive markets and re-establish its position as a leader on the global stage, particularly in the international imperative of reducing carbon emissions.

The outcome will not only be the improved productivity and performance of those firms we work with, but increased and safeguarded employment in manufacturing, increased manufacturing GVA and a surge in the high value inward investment projects that boost their host communities.

The pandemic has hit all of us hard. We know that the coming year will present many new challenges for the UK but the nation will return to better times.

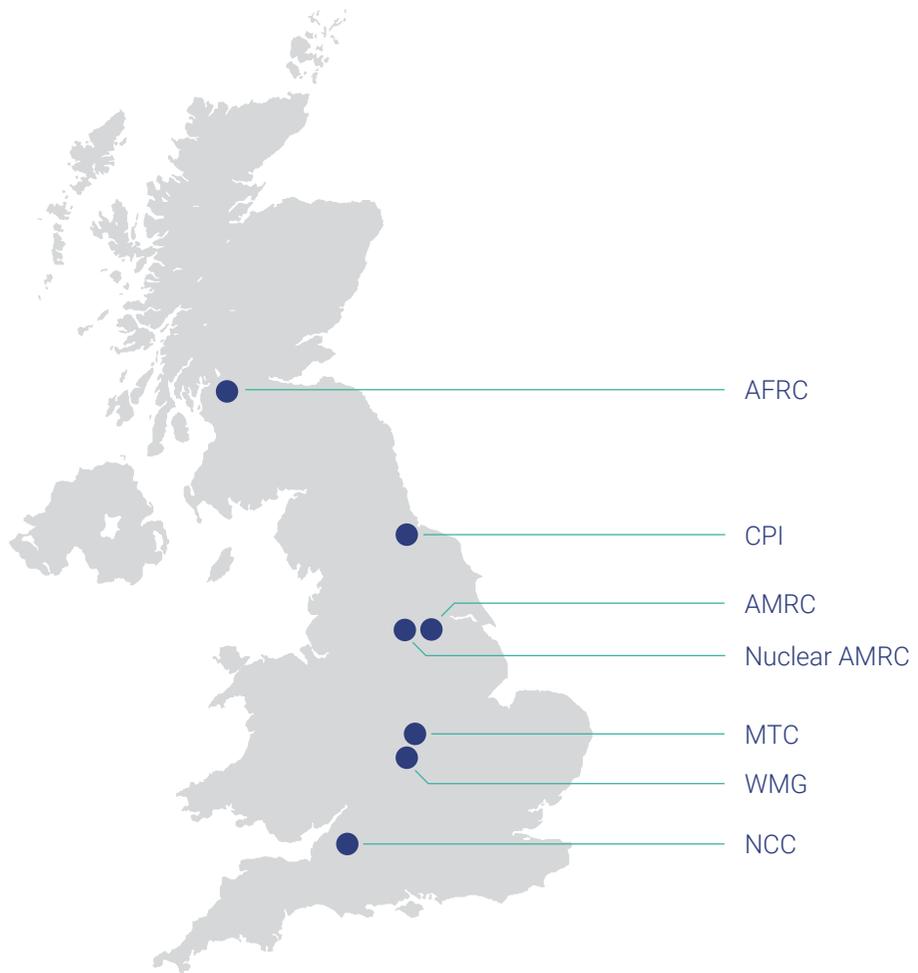


**The High Value
Manufacturing Catapult
will step forward to
play a full part in our
economic resurgence.**



CATAPULT

High Value Manufacturing



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