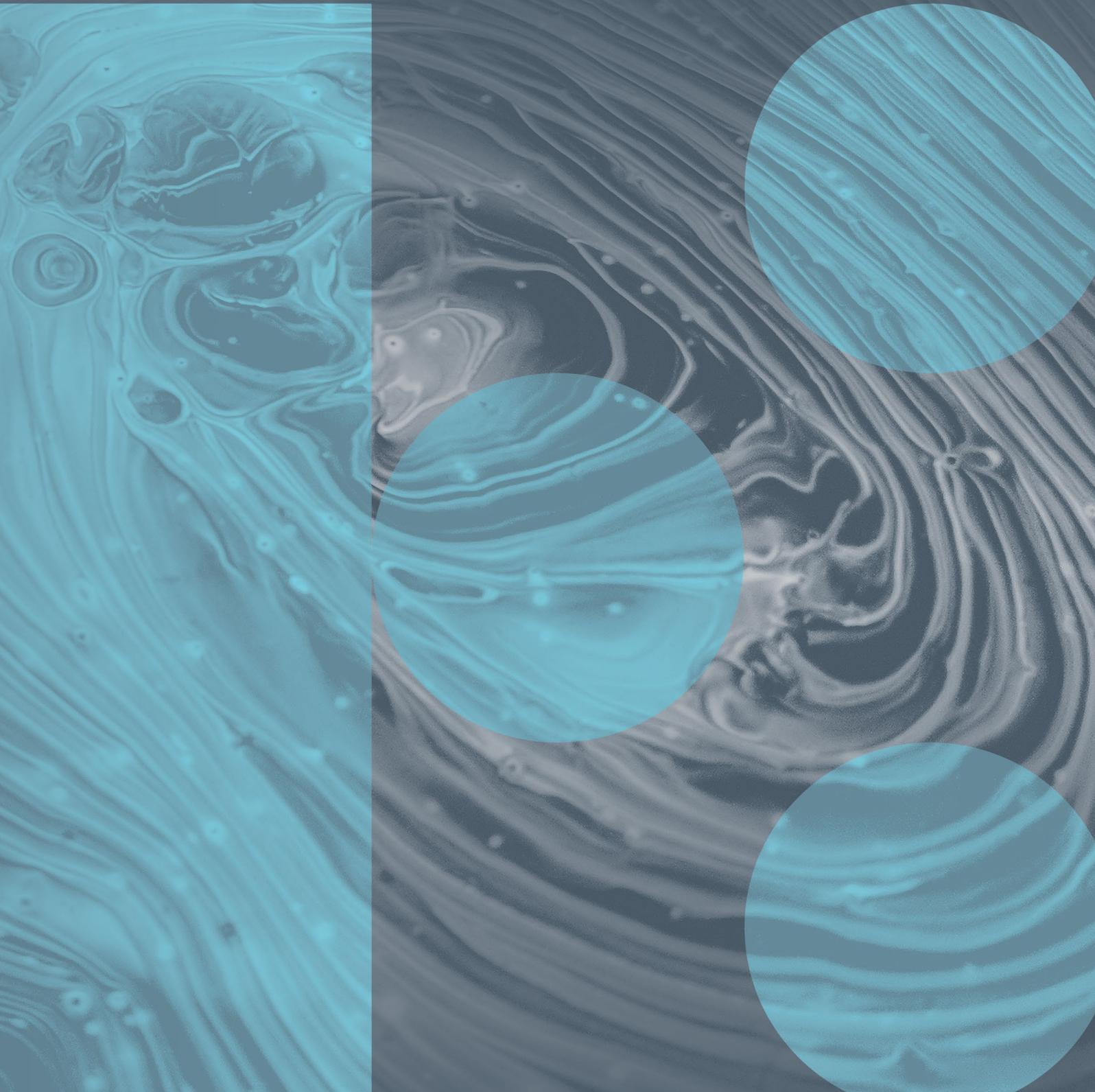


Chemical Innovation Outlook 2020

Kene . Partners



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References

¹ James Clark, University of York (UK), 2nd Green and Sustainable Chemistry Conference, Berlin, 14 – 17 May, 2017.

² EEF, The Manufacturer's Organisation and Santander, Sector Bulletin: Chemicals, 2018.

³ https://www.santandercb.co.uk/s3fs-factsheets/eef_santander_sector_bulletin_chemicals.pdf

⁴ Sustainable Innovation for a Better World, UK Chemistry Council, 2020.

⁵ Industrial Strategy: Building a Britain fit for future, 2017.

⁶ Developing University Spinouts in the UK Key Trends in Spinout Activity, Investments and Investor Involvement, 2017.

⁷ Mark Stephens, IOP: CE: Manufacture of chemicals and chemical products: CVMSa. Office for National Statistics, 2020.

⁸ Rafaj et al., Outlook for clean air in the context of sustainable development goals, Global Environmental Change, vol. 53, pp.1–11, 2018.

⁹ Single used plastics: A Roadmap to Sustainability, United Nations Environment Programme, 2018.

¹⁰ Future Energy Scenarios, National Grid, 2018.

Executive Summary

Life without industrial products derived from chemical processes is virtually unimaginable.

It impacts our daily and working life, as well as our wellbeing, health and safety. Almost 97% of the products around us derive from chemical production or contain at least one chemical process step in their manufacture. ¹

The global chemical industry is today worth over \$4.3T and is an integral part of the modern world economy, converting raw materials into products encompassing an enormous variety - from plastics to paints, agri-food, consumer goods, textiles and leather products. Many of these items subsequently form part of other value chains, such as automotive, mechanical engineering and construction.

It links critical parts of the supply chain, from energy and feedstocks (raw materials), to advanced materials, fine chemicals, life sciences and consumer products. ²

Kene Partners will be watching with great interest as emerging technologies such as machine learning, data science, AI & blockchain increasingly permeate chemistry, a crucial sector to our daily lives.



Adam Kene, Managing Director of Kene Partners

Industry in Numbers

The chemical sector can be broken down into six smaller groups: ³

	Name	Information	GVA & % of total chemicals
	Inorganic Chemicals & Fertilizers	A broad class of substances encompassing all those that do not include carbon and its derivatives as their principal elements (unlike petrochemicals), including fertilisers	£1.5B 12.6%
	Petrochemicals (& derivatives)	Petrochemicals are chemicals derived primarily from crude oil and natural gases. Once sourced, the petrochemicals can then be converted into their derivatives, namely plastics and rubber in their primary form	£3.5B 29.0%
	Dyestuffs & Agrochemicals	Dyestuffs (also known as pigments) are substances that yield a dye or that can be used as a dye, while agro-chemicals are chemicals used in agriculture, excluding fertilisers (They broadly refer to pesticides)	£1.1B 9.4%
	Paints, Varnishes & similar coatings	These products are derived from dyestuffs, or petrochemicals, depending on whether they are from natural or synthetic sources. They are the commercialised end use products for consumers	£1.5B 12.1%
	Soaps, detergents & cleanings	These are the main consumer facing products of the sector, and are broadly sourced from animal and plant fat chemicals (oleo-chemicals)	£2.8B 23.3%
	Other chemicals	These are the main consumer facing products of the sector, and are broadly sourced from animal and plant fat chemicals (oleo-chemicals)	£1.6B 13.6%

£19.2B

In the year 2018, the Chemical Industry accounted for £19.2B of the UK economy's GVA, with an annual turnover of £55.5B. Chemicals & pharmaceuticals is the UK's second largest manufacturing industry. Only the food, beverages and tobacco processing sector is bigger

500K

The Chemistry Council show that the industry provides direct and indirect employment for 500,000 people in various regions of the UK. Those businesses: (1) Contribute £80M every day to the UK economy (2) Spend £5B each year on research and development (3) Invest £2B a year in capital expenditure (4) Are the UK's number one manufacturing exporter

97%

SMEs make up 97% of the chemical sector

27%

The chemical industry's output has increased by 27% since 1990

63%

63% of companies in the sector export what they make to the world, the highest proportion of any goods manufacturing sector in the UK

60%

60% of the exports from UK go to the EU and 75% of these imports and raw materials come from the EU

6.4%

In 2018, chemicals & chemical products accounted for 6.4% of total manufacturing output

\$4.3T

The chemical industry's total contribution to global GDP in 2017. Equivalent to seven percent of the world's GDP that year

Chemical Industry Investment Landscape

Government Funding

Driving the move to a circular economy, building new facilities for carbon capture, storage and utilisation, facilitating integrated, low-carbon supply chains, industrial symbiosis and infrastructure improvements are all key parts of the strategy to boost the UK's economic sustainability.

In the UK government's latest Industrial Strategy Report, they set out their plans to make the UK the most innovative economy in the world. Commitments include raising total research and development (R&D) investment to 2.4% of GDP by 2027 from the current 1.7%, increasing the rate of R&D tax credits to 12%, increasing the National Productivity Investment Fund to £31B, and supporting investments in transport, housing and digital infrastructure with over £1B of public investment.⁵

Furthermore, in 2018, the government announced plans to launch a new £40M venture capital fund to support UK clean technology companies in a boost for the sector ahead of a new Green Finance strategy.

UK Research and Innovation (UKRI) is the national funding agency investing in science and research in the UK. Operating across the whole of the UK with a combined budget of more than £6B, UKRI brings together the 7 Research Councils, Innovate UK and Research England. They offer R&D grants and Knowledge Transfer Partnership.

In 2005–2006 the government set up Knowledge Transfer Networks to accelerate successful innovation by improving connections and collaborations between industrial sectors, companies and academic groups. The UK chemistry-using industries were recognised as a group of sectors where knowledge transfer was critical to secure a prosperous future.

Private Investment

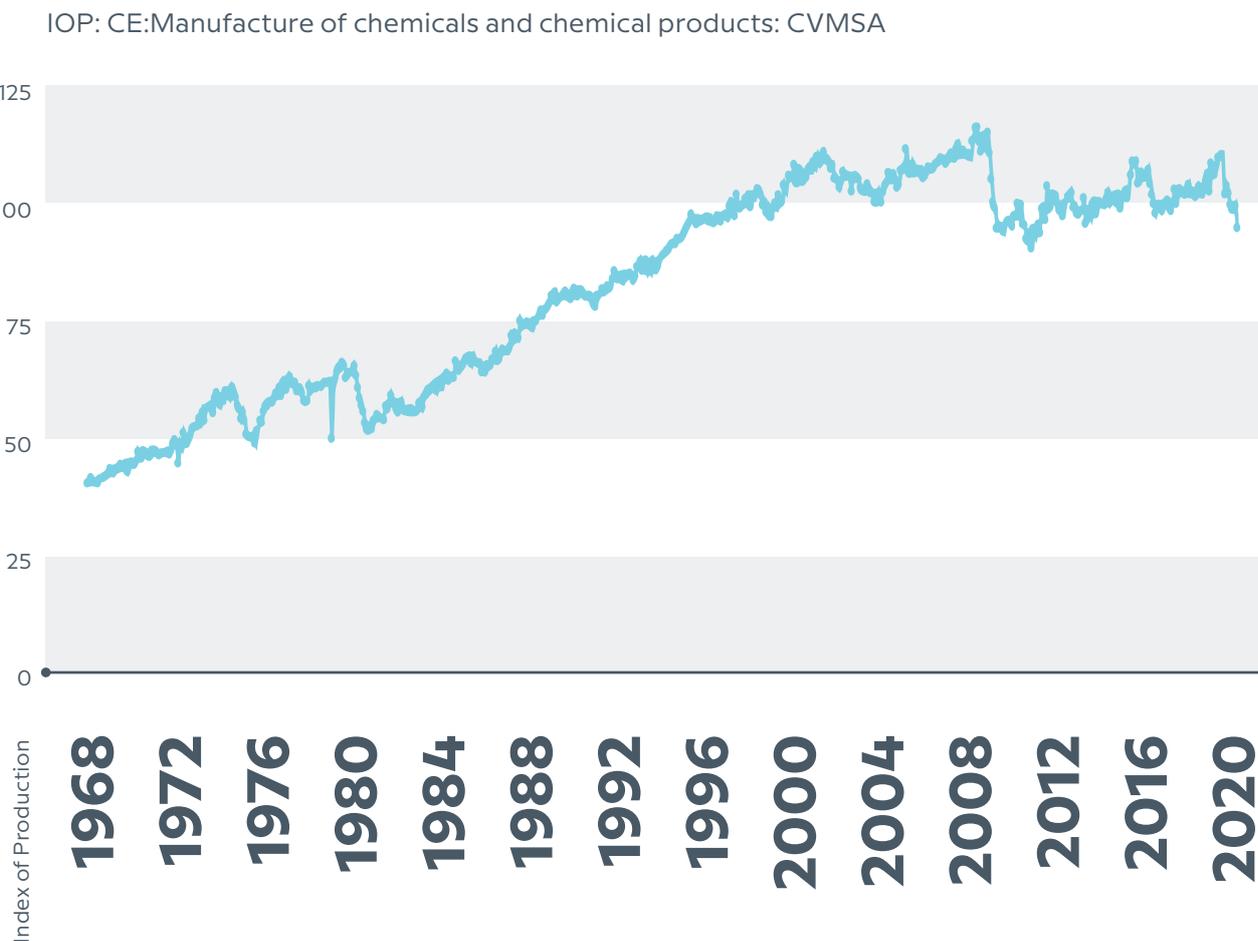
Between 2011–2018, university spin out companies (USOs), received approximately £8.86B in external investments to support their R&D activities, primarily from Private Equity and Venture Capital firms, as well as Universities. Since 2008, the amount of external

investment raised has increased substantially in real terms (from approximately £991M in 2008 to £1.5B in 2018). The largest six research universities secured almost half of total USO investments during 2011-2018, compared to generating 16% of USOs. ⁶

The public investment in R&D is expected to bring greater private investment in cleaner and more energy efficient fuels, materials and processes. For example, projects aimed at delivering more sustainable materials for consumer products; waste to feedstock opportunities and advanced materials for batteries are helping build strong links between chemical businesses, academia, waste companies and the consumer product and automotive industries. Chemical industry links with UK academic centres remain strong.

Industry spotlight: Manufacture of chemicals & chemical products in the UK

Over the past 50 years or so, the chemical industry has built an impressive and relatively consistent track record of growth (Figure 1). ⁷



2020 Innovation Trends

The Chemistry Council have identified four key themes to accelerate innovation and commercialisation of sustainable, chemistry-led solutions for the betterment of the world and the society: ⁴

- Advanced Materials and Molecules
- Green Supply Chains
- Energy Storage and Distribution
- Digitisation and Big Data

Advanced Materials and Molecules

New and advanced materials are required to meet the mid to future term needs of society. Developing a healthy pipeline of new, innovative materials that are renewable and sustainable is at the heart of the R&D strategy of the UK. The global market for advanced materials accounted for approximately US \$42.8B in 2015 and is expected to grow at a rapid rate of 10.4% compound annual growth rate (CAGR), increasing to \$102.5B by 2024. This presents a significant opportunity that relies on innovative new materials and molecules being defined, designed, manufactured and formulated into end products.

Trend: Advanced Materials for Health & Well-being

Advancements in chemistry continue to be crucial to medicine, such as the UK's increasing capability in biotechnology and biocatalysts. The UK currently has around 225 biotechnology companies, generating around £2.9B of revenue, with new energy and cost-efficient methods top of the agenda.

Trend: Advanced Materials for Composites

A composite is a material made from two or more different materials that, when combined, are stronger than those individual materials by themselves. Utilising new materials, such as graphene, and designing new multifunctional materials and additives for composites will support other key sectors of the UK economy including aerospace, automotive, and construction.

Green Supply Chains

Due to rising environmental concerns such as air and water pollution, governments adopted the 2015 Sustainable Development Goals, known officially as the 2030 Agenda for Sustainable Development. It aims to substantially reduce the health impacts from hazardous chemicals in air, water and soil pollution⁸. Furthermore, to limit global warming to 1.5 °C, global carbon emissions need to fall to 55% of 2010 levels by 2030 and continue a steep decline to zero net emissions by 2050.

To achieve this, technologies enabling

the cradle-to-cradle recycling and re-use of waste streams will need to be delivered. Three waste streams offer the biggest potential for value added recycle and re-use: plastics, steel, and precious metals.

Trend: Sustainable Materials for Consumer Products

Materials with recyclable and/or biodegradable properties, or that are produced using raw materials green-sources will facilitate this circular economy. Sustainable materials are required for a wide range of end markets, from fuels, coatings, agriculture and home and personal care.

Case Study

Developing green, low carbon adhesive technology

Cambond, a start-up based in Cambridge developed sustainable adhesives from green resources (algae), as an alternative to current toxic and non-sustainable formaldehyde-based aldehydes commonly used in plywood and carpeting. The Company used this novel technology to develop products, such as recyclable and water-resistant wood panels, paper packaging, food and medical packaging, medical devices.

Trend: Sustainable Packaging

The desire to move to sustainable packaging and the elimination of single-use plastics to avoid plastic waste, particularly for consumer products, is a huge global trend. Ensuring robust but sustainable packaging requires new product innovations without compromising the qualities of the conventional products.⁹

Trend: Energy Efficient Buildings

Buildings are responsible of around 40% of total global energy consumption, so improvements in their energy efficiency is crucial. From start-ups to large companies, there are several approaches to develop energy efficient building components, including energy efficient windows through optically modulating coatings, and improved insulation.

Energy Storage and Distribution

Energy storage and, in particular, battery storage is expected to play a significant role for electricity storage in delivering the flexibility required for future energy systems, particularly given the need for the integration of higher volumes of electric vehicles and intermittent

renewables into the energy mix. The result is a diversification of the types of storage projects and business models we are seeing coming to the British market. With the Future Energy Scenarios (FES) report, launched in July 2018, projecting storage to grow from 2.9GW in 2017 to between 5.9GW and 9GW by 2030, it is clear that storage will continue to play an ever more important role in the energy market in the UK.¹⁰

Case Study

Low cost, non-combustible, high performance insulation materials

After the Grenfell Tragedy, the most common insulation material, carbon/phenol, was no longer permitted to be used. Therefore, there was a need of novel, high performance insulation materials with unbeatable thermal properties compliant with all fire regulations and to be used in tall buildings. Thermulon, a start-up based in Durham developed innovative aerogels from used glass waste.

Trend: The Hydrogen Economy

Using hydrogen as an energy carrier would provide a new source of low carbon energy. However, for a hydrogen economy to be developed effectively, innovative new technologies which can efficiently and inexpensively derive and process the hydrogen will be required. This is expected to be used for transportation currently relying on finite fossil fuels.

Trend: Car Batteries

Today's car battery performance is limited, impacting the take up of

electric vehicles. Once the current issues such as charging speed, safety, and lifetime hampering the performance of the batteries are addressed, it will be a dramatic step to ensure that a future with electric cars becomes a reality. Demand for lithium is rising rapidly and new sources will be required to meet accelerating demand. The UK has natural lithium resources both in the ground and in the sea. However, currently, technology capable of extracting lithium from seawater is not yet at commercial scale, and significant innovations are required to improve the efficiency of extraction techniques before the UK can tap into this market.

Digitisation & Big Data

The adoption of digitisation and big data will drive a significant wave of innovation, as it is expected to alter the overall productivity, as well as creating new business models. Recent advancements in digital technology such as machine learning, data science, AI, blockchain, cloud and in-memory computing offer unprecedented levels of connectivity, granularity, and speed in accessing, processing, and analysing huge amounts of data. The intersection between deep science and deep technology is expected to be a game-changer in the chemical industry. Digital technology is expected to help chemical companies in many ways such as capturing critical data and drawing insights from it to achieve improved output at lower costs, scheduling preventative maintenance

to minimize downtime, and facilitating accurate inventory planning to prevent stock outs. Innovations in this area are being taken up by the industry, with 80% of 360 chemical companies reporting an increase in investment in digital technologies for plants, in particular, on plant management and product quality.

Trend: Digitisation of Supply Chains

Incorporating digital technology throughout the supply chain would allow industry to manage products throughout its supply chain, creating more visible supply stream across each touch point of the value chain, as well as providing efficient cash-flow management. Therefore, those who move quickly to digitize their supply chain will gain efficiencies, develop new business models and revenue streams, and create competitive advantage.

Case Study

Creating affordable freshness indicators for perishable products

Founded in 2017, Mimica is a start-up, creating the next generation of food expiry labelling that reduces food waste and improves food safety. Their first product Mimica Touch is a patented bio-responsive food expiry label that reacts to the environment around it and gives tactile information. It is a temperature-sensitive indicator cap or label, helping you store the food at the right temperature and reduces the food waste by displaying when the food spoils.

Trend: New Process Technologies

The adoption of new process technologies such as continuous flow technology will provide a step-change in capital cost, materials management

and throughput, whilst new process technologies such as 3D printing create the opportunity to create new business models such as personalised products and localised manufacture at a faster speed and low-cost point.

About Kene Partners

We are a team of specialist R&D Incentive Advisors. We help innovative companies access millions of pounds of government money set aside to encourage innovation.

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