ENGINEERING ECONOMY & PLACE

Understanding the engineering economy in places across the UK

Royal Academy of Engineering

Engineering Economy and Place is a collaborative project between the Royal Academy of Engineering and Metro Dynamics, drawing on the Academy's deep understanding of engineering and Metro Dynamics' knowledge of local economies across the UK.

This is the long-read report, the opening sections of which provide introductory information on the context for the project and set the scene with an analysis of the UK's engineering economy. The main body of the report is a presentation of a new typology for local engineering economies. A short-read summary report is available [here]

The report is the product of detailed research and analysis that it is impossible to capture in a single document. As such, the underpinning data, including summaries for each Local Authority, can be found on the connected dashboard on the Academy website.

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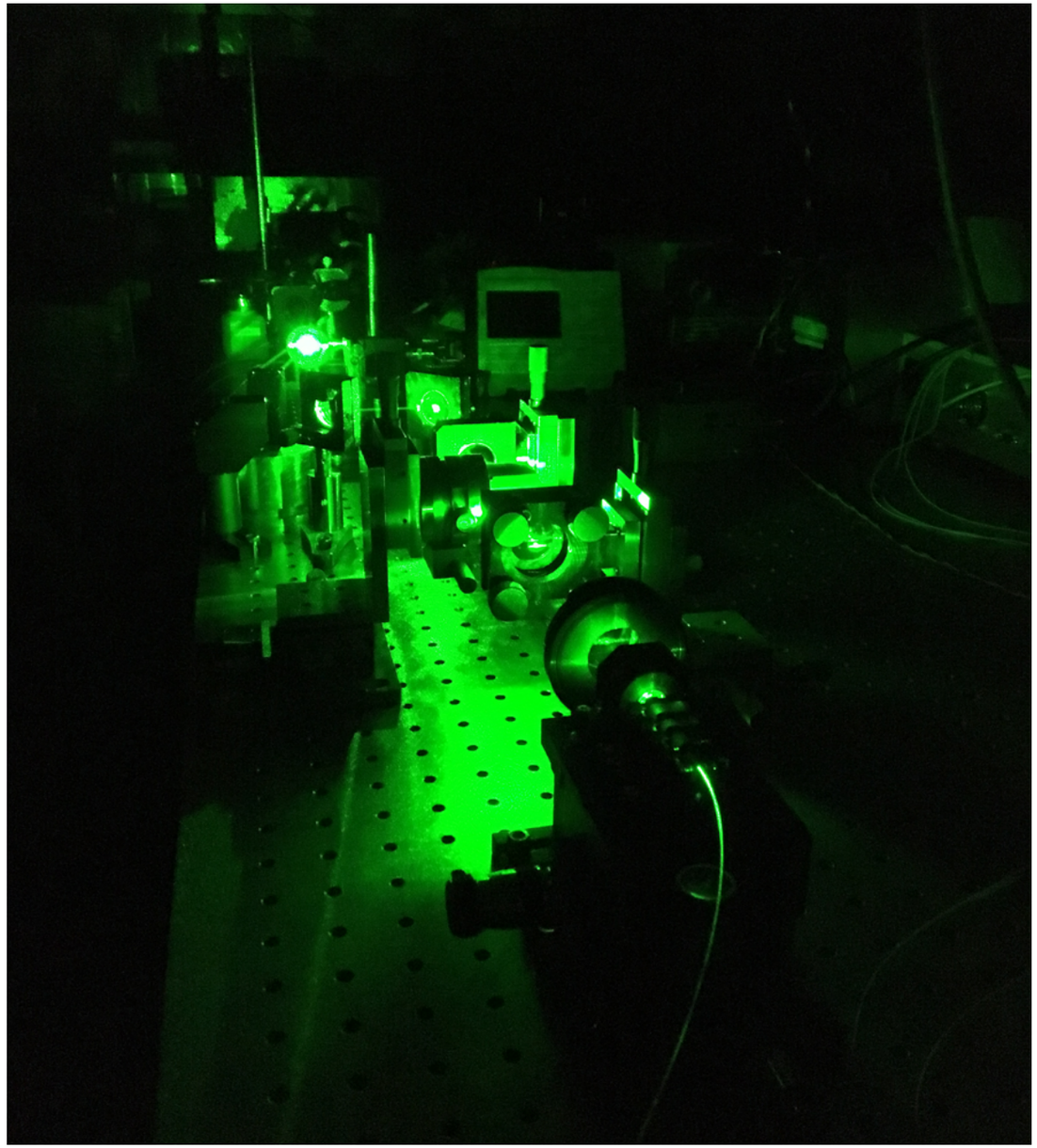
Foreword

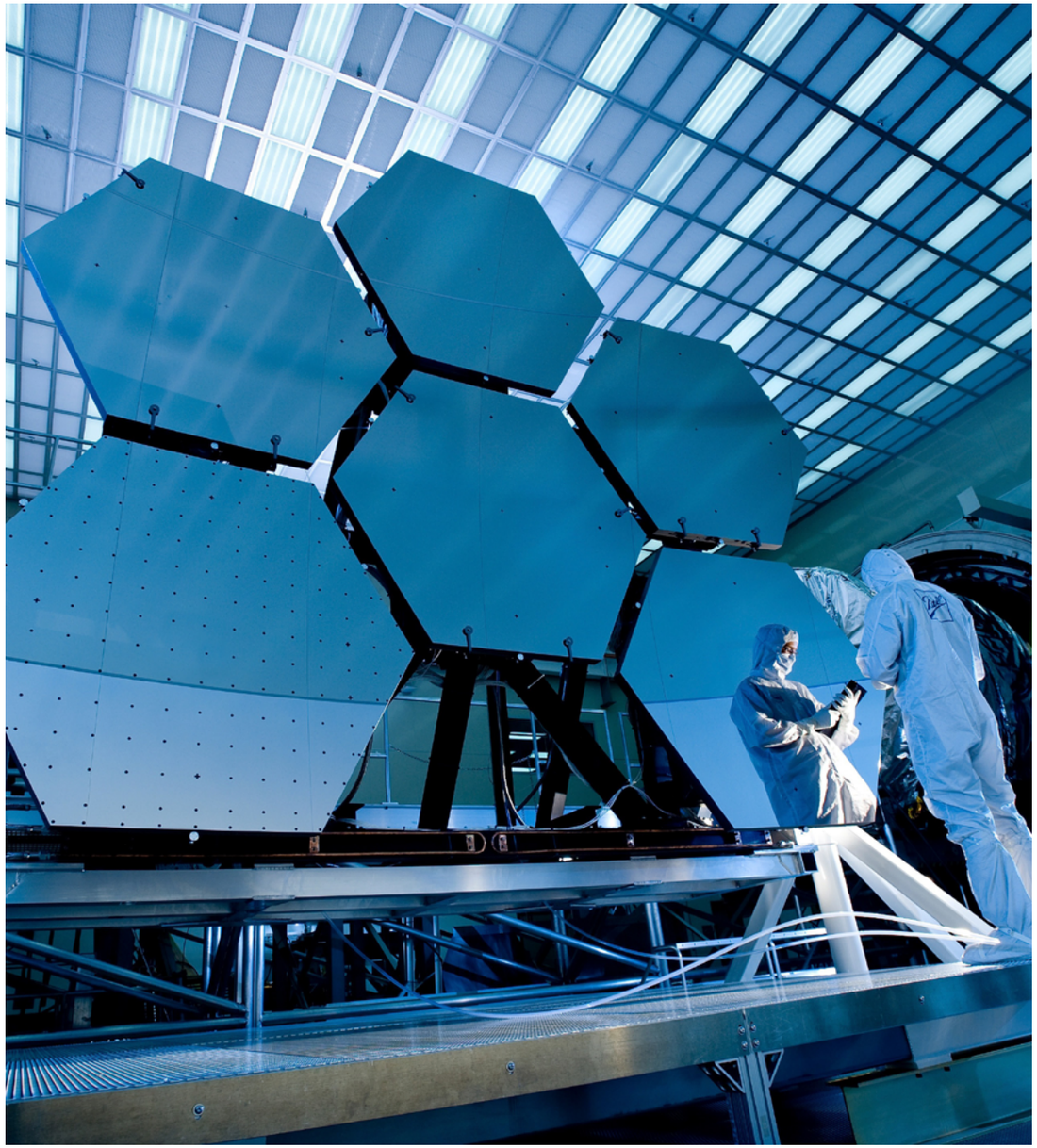
By Professor Sir Jim McDonald FREng FRSE
and Dr Hayaatun Sillem CBE

‘Engineering is everywhere, but nowhere the same’ – we were confident that engineering was indeed everywhere in the UK, but we lacked a way to measure, describe and compare the role engineering plays in different places. Engineering Economy and Place, a collaborative project between the Royal Academy of Engineering and Metro Dynamics, solves this challenge by creating, for the first time, a framework to understand the structure and value of engineering in places across the UK.

Engineers are drivers of economic opportunity, positive social impact and advances in technology innovation. This comes from leveraging advances in research to develop and deliver new products, services and enterprises that generate jobs and benefit society. Engineering jobs tend to be relatively high-wage and high-productivity, and therefore should be of considerable value to the local economies in which they are located. However, given the UK has significant geographical inequality, with successes and opportunities not equally spread across the country, we wanted to understand the role engineering currently plays in local economies across the UK.

As an Academy, it is our goal to harness the power of engineering to build a sustainable society and an inclusive economy that works for everyone. In an inclusive economy, the fruits of prosperity are shared across all regions and groups in society, with engineering serving as an enabler of improvements to people’s lives. We are establishing a UK-wide network of Enterprise Hubs to help grow our devolved administration and regional support offer. The first of these regional Hubs opened in Belfast in 2020, followed by Swansea in 2022 and soon Scotland in 2023, helping places, businesses and entrepreneurs set a new level





of ambition for their engineering economy.

To better support the growth of our regional activities, and to consider the role of engineering across the UK more broadly, we realised that better tools were needed to describe how much, what type, where and in what context engineering is happening. We knew that this would not be a simple task and could be approached in multiple ways.

Engineering traverses the modern economy. Engineers are involved in almost every economic sector, from 'engineering sectors', such as advanced manufacturing and software, to non-engineering industries like financial services and the media. This makes engineering particularly complex and difficult to measure using traditional analyses. Given the pace of technological advances, many of which are underpinned by engineering, we also wanted to capture the role of engineering in emerging technological enterprises. As expected, findings show that engineering is pivotal in the UK's emerging economy. Engineering businesses accounted for the majority of businesses in 80% of the emerging economy sectors identified.

Engineering jobs also encompass a wide spectrum of activities from research and development (R&D) through to delivery and deployment. We were particularly interested to understand more about the spatial distribution of these roles and their contribution to local economies. R&D is widely accepted as an important driver of innovation and productivity gains, and investment in R&D is considered a key lever to addressing 'levelling up'. However, the delivery of economic and social value from R&D is a complex process that depends heavily on the innovation ecosystem, not least at a regional level.

Engineering also plays a pivotal role in manufacturing – another very broad sectoral term! Manufacturing has an important role in creating new green industries like hydrogen power, offshore wind power and electric vehicle development, but it also includes industries that risk falling behind if they don't accelerate the pace at which they adopt digital technologies. Failure to do so could exacerbate inequality dramatically.

For the first time, this report provides insight on the balance of employment in engineering R&D and practice, and on jobs in the engineering economy for non-engineers. Unsurprisingly, simple conclusions cannot be reached! High

concentrations of R&D roles do occur in areas where you might expect them – London, the South East and in many large UK cities, but also in the East Midlands, Cheshire, the South West and South Derbyshire. However, this isn't a pre-requisite for engineering to be a significant contributor to the economy.

By combining indicators that look at the engineering economy, engineering enterprise and place economics, a typology of five categories and seven sub-categories has been developed. They remove a barrier to describing the local and national role of engineering, and highlight that engineering is present across economies and places of all shapes and sizes. It takes a different role and exhibits different features in each, whether it is the volume of engineers, the level of innovation activity, the economic output delivered by businesses or the diverse sectoral activity. We will continue to review and refine the typology as economic conditions and outcomes change.

Now we need to consider what these conditions mean for places and how the findings in this report can help places determine how to best develop their economy and further leverage the potential of engineering to deliver better place outcomes. We hope this report and the associated dashboard will be useful resources to policymakers, local leaders and engineering businesses. We look forward to continuing the conversation and invite you to join us.

Summary Insights

While engineering is everywhere, it is nowhere the same. Having a better understanding engineering's role in different places enables exploration of how places can better leverage engineering to improve prosperity and advance the UK's technology and growth ambitions.

This will mean ensuring that areas of thriving engineering are sustained and extended, and that areas that are underperforming (or are at risk of doing so) are identified and supported to become the success stories of the future.

It is for places to determine how best to develop their economy. In some places engineering is already strong and could be enhanced. In some places the economy is weak and through its engineering economy, could be enhanced. Working in partnership and collaborating strategically at local level, the Academy can support them in how best they can leverage engineering to make a difference.

Places need to tell their own story – and set policy at local levels – but there are three elements which are likely to recur. These are:

Connections between city-centre R&D activity and engineering in surrounding city regions and towns encourage high-value engineering and innovation. The benefits from connection should be further leveraged:

- Areas that have strong connections between city centre-based R&D activity and 'near city' industrial specialisation in surrounding rural/town economies, that can accommodate physically larger businesses have strong engineering performance, and can capitalise on innovation.
    - → London and the South East have a strong gravitational pull on high-value, innovative engineering in the UK, but there is still potential for them to expand their proximal regional connections.

→ Other city centres that have dense R&D-intensive activity should look at how they can strengthen connections with specialised 'near city' engineering in connected surrounding rural/town economies. The West Yorkshire Combined Authority is a good example of this.

- For rural areas outside of a city-region centre of gravity there are very few instances of high-value, high-R&D engineering. For those areas, such as Mid Wales and the Marches, Cornwall, Cumbria, East Anglia and the North West of Scotland, creative solutions must be found to increase connectivity and innovation.

Maximise the potential of highly specialised industry concentrations, for local and national prosperity

- There are several places in the UK with very highly specialised concentrations of engineering businesses, often connected to strong industrial heritage, but structurally weaker economies.
- Frequently, though not exclusively, coastal town communities experience complex, multifaceted socioeconomic challenges and that are less directly connected to R&D infrastructure. These places require targeted support to be able to capitalise on a dense industry foundation that should be an asset.
- This will require enabling the enterprise environment where engineering is strong but the enterprise infrastructure/wider economy is weak. Here the interventions might not need to be engineering-specific to result in beneficial engineering outcomes.

Driving digital transformation and technology adoption across engineering is important for future growth.

- There is a higher automation risk to applied engineering jobs that carry out technical production and application of products and technologies, and standardised operation of existing products, processes, machinery and technologies, compared to engineering R&D jobs. The impact of automation will inevitably be much deeper in places where applied practical engineering jobs dominate the engineering economy. Adoption of new technologies is a case of when, not if. Through a combination of progressive modernisation, pursuit of efficiency improvements and drive to goals such as net zero, change is inevitable. It will bring significant disruption to workforces in these areas.
- Managed well, business transformation to invest in kit and skills development should mean new jobs replace more than old jobs but business owners and leaders will need the vision and support to achieve this. This will require focused interventions for leaders of established businesses, as well as those at the start of their enterprise journeys. One-size-fits-all policy will not work, so any interventions need to be considered in context of place, to both manage the risks posed and to exploit opportunities.

Chapter 01

Introduction

This is a new framework that goes beyond traditional sector analysis. This report highlights the significance of engineering to the UK economy and enables better place-based understanding of the impact and contribution of engineering in local economies.

Engineering innovation and enterprise are crucial for improving productivity, competitiveness, sustainability, public health, safety and security, while delivering economic and social value for people from all parts of the UK.

While the connection between engineering and innovation is implicitly recognised, the complex and expansive nature of this cross-cutting discipline means that its role and economic impact can often be overlooked or misunderstood. This is particularly the case at a local level, where engineering is most frequently paired with manufacturing, recognised only in its most traditional sense (such as structural or mechanical), or absent entirely.

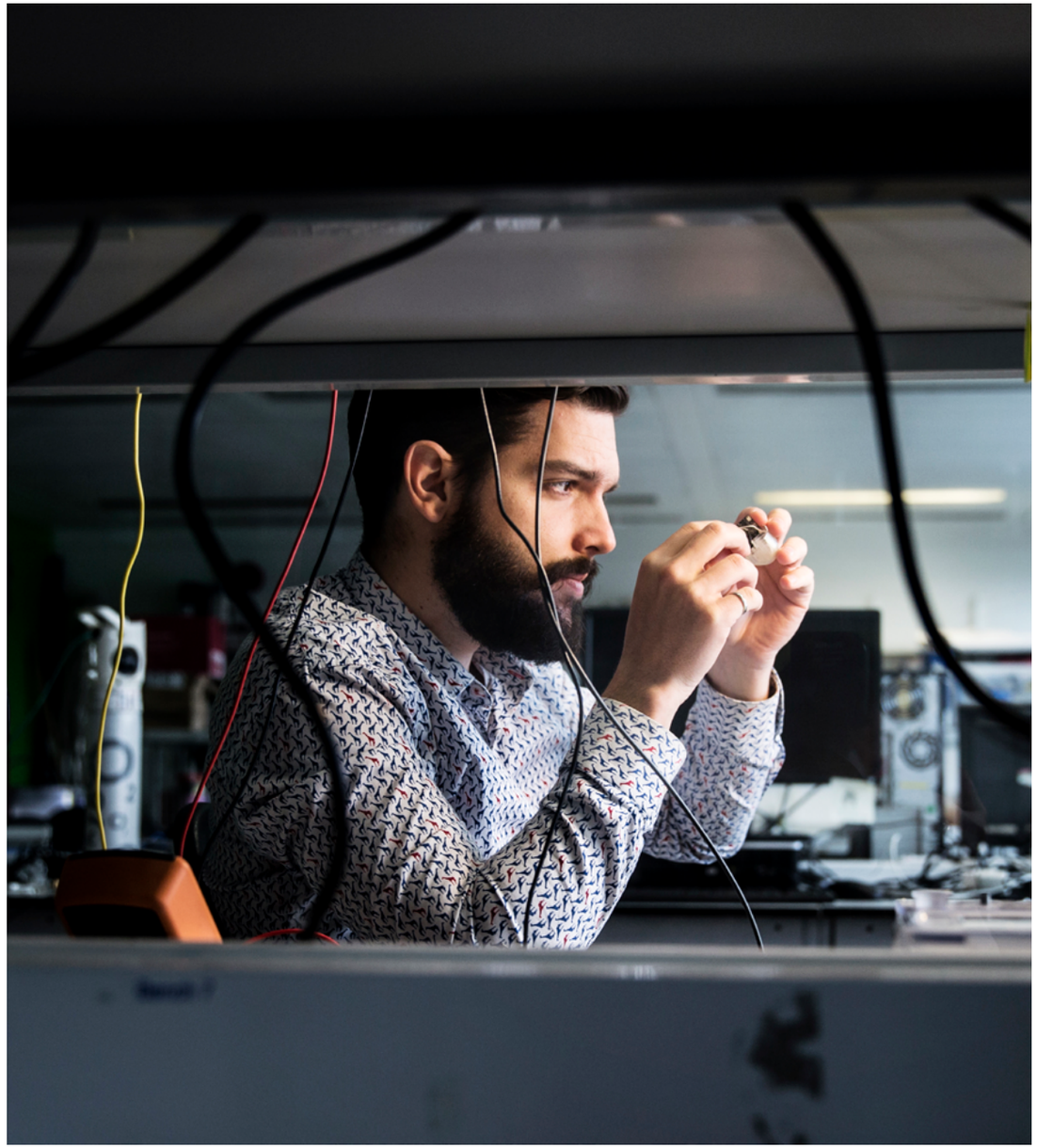
This study, commissioned by the Academy was tasked with delivering a detailed, place-based understanding of engineering across the UK. It goes beyond traditional sectoral analysis to describe how much, what type, where and in what context engineering is happening.

By better understanding the role of engineering in local economies, an improved understanding of how to leverage engineering to deliver better place outcomes should follow. With geographical inequality a striking feature of the UK, there may be a role for engineering in some places to help reduce inequality.

The astonishing pace and scope of technological change risks exacerbating inequality dramatically. Engineering includes the companies that are accelerating these technological advances, it also includes industries and companies that are at severe risk of being left behind if they do not adapt and embrace technological change. Again, better understanding the role of engineering at a regional level can start to shine a light on both challenges and opportunities different places may face as the technology revolution progresses.

A better understanding of engineering in places can be used both to inform new policy development and deliver against existing priorities to enhance the strengths and address the needs of places.

What follows is a new framework for thinking about the role of engineering in local economies. ■



Approach

In 2018 a study was undertaken by Engineering UK, the Engineering Council and the Royal Academy of Engineering, where a jointly agreed binary definition of engineering was developed using Standard Industrial Classification (SIC) with 2010 Standard Occupational Classification (SOC) codes. This was termed the 'Engineering Footprint'[1].

Whilst there have been several studies on this footprint, none go beyond a regional understanding of engineering. To retain the connection to the footprint measurements and methodology, this study uses the same definition of the engineering footprint. However, the following three-step approach was taken to develop a more nuanced understanding of engineering activity at a local level:

1. Grouping together the SIC and SOC codes in the engineering footprint definition to delineate engineering within and beyond engineering businesses – thereby identifying the 'engineering economy'.
2. Reviewing occupational activities in SOC descriptions to group together different types of jobs in the engineering economy, as well as creating a 'spectrum' of activity distinguishing where R&D is an explicit part of the role.
3. Analysing the characteristics of local engineering economies and blending this wider measures of local economic performance to create a typology of engineering economies across the UK. ■

[1] Engineering UK, Defining the engineering sector: the engineering footprint, 2018

Step 1: Defining engineering and the engineering economy

The 2018 Engineering Footprint defines engineering businesses and engineers using SIC and SOC codes, as laid out in table 1. This study has used SIC and SOC together to understand the occupations in which people are employed across different sectors. This allows us to delineate the engineering economy, as shown in table 2.

TABLE 1.
Engineering businesses and engineers - definition

Engineering businesses	Engineers
Businesses in a set of sectors defined as engineering.	Engineers are those employed in occupations defined as engineering.
This constitutes 295 SIC codes, which can be found here and is unchanged from the 2018 Engineering Footprint definition.	This constitutes 102 SOC codes, which can be found in the appendix of this report. In this list six codes[2] have been added to the Engineering Footprint definition to capture activity aligned to the occupational activities in 'Research & Development' and 'Deliver' categories described in Table 3 below.
All employees in these businesses – regardless of the job they are doing – are included in the total engineering economy employment figures.	All in these engineer-specific occupations, regardless of the activity of the business they work in, are included in the total engineering economy employment figures.

[2] Occupation codes added: Packers, bottlers, canners and fillers; Elementary construction occupations; Elementary process plant occupations n.e.c.; Industrial cleaning process occupations; Textile process operatives; Printing machine assistants. Occupation code omitted: Research and development managers.

TABLE 2.
The structure of the engineering economy

The engineering economy			Everything else
Engineers working in engineering businesses.	Engineers working in non-engineering businesses.	Non-engineers working in engineering businesses.	Non-engineers in non-engineering businesses.

Step 2: Different occupational activities in the engineering economy

Working within the confines of the SOC system, this study has created groups of occupations that reflect different types of activity in the engineering economy by analysing keywords and descriptions of all SOC codes. For the first time, this provides insight on the balance of employment in R&D and 'deploy and deliver'-focused roles, and on jobs in the engineering economy for non-engineers.

Interconnected engineering R&D process

In describing these categories, it is important to emphasise that the activities do not necessarily follow a linear sequence, nor do they generally happen in isolation. Quite often, testing and evaluation leads to further research, or deployment can flow back into development and design. While occupations are mapped to categories, sectors cut across the spectrum. With this in mind, we suggest considering the spectrum in a more interconnected way, to better reflect real-world development processes. ■

TABLE 3.
Occupations in the engineering economy

	Research & Development			Practical Application		Support	Other
	Research	**Develop**	**Evaluate**	**Deploy**	**Deliver**		
Description	Research into new and innovative forms of engineering involving the creation of new technologies or materials.	Development of new forms of engineering and technology including AI, digital design and polymers.	Testing and evaluation of both new and proven products, including quality control, planning and prototyping.	Technical production and application of products and technologies.	Standardised operation of existing products, processes, machinery and technologies.	Underpinning activities of engineering, supporting the running of businesses and the sale and distribution of products.	Refers to any other jobs in which people are employed in engineering businesses that are not represented in the other categories.
Keywords	Researches, conducts experiments, observes, applies, models.	Develops, designs, plans, determines, diagnoses, establishes.	Tests, advises, control, quality control, plans, analyses, calculates.	Repairs, mechanic, electrician, builds, installs, constructs.	Operates machinery, processes, manages.	Sales, finance, human resources.	N/A
Examples of occupations	Research & development managers, chemical scientists, physical scientists.	Civil engineers, mechanical engineers, electrical engineers, software developers.	Quality assurance technicians, engineering technicians, IT and telecommunications professionals.	Electricians and electrical fitters, IT engineers, vehicle technicians, mechanics and electricians.	Process operatives, machine operatives.	Human resources professionals, sales managers, finance professionals.	Caretakers, cleaning services, security guards, storage occupations.

Step 3: Creating a typology of engineering economies

Using the insights from step one and two, step three brings together analysis under three themes for all 374 local authorities in the UK:

1. The Engineering Economy
2. Engineering Enterprise
3. Place Economics.

Tier 1 indicators were used as the primary means of categorisation and tiers 2 and 3 were used as descriptive indicators to enable the development of a blended typology of engineering economy and place.

TABLE 4.
Indicators used to develop the typology

Theme	Tier 1: Engineering Economy	Tier 2: Engineering Enterprise	Tier 3: Place Economics
Purpose	The core indicators used to assess the different types of engineering economies.	Indicators used to describe engineering enterprise associated with the different engineering economies.	Indicators to describe the types of economies and places in which engineering is present.
Indicators	**Volume:** Total number of employees in the engineering economy. **Value:** GVA per engineer. **Industry Specialisation:** Concentration of engineering business. **Local significance:** % of total employment represented by engineering. **% in R&D:** Proportion of engineering jobs in R&D.	**Size of engineering business:** Average number of employees per engineering business. **Engineering businesses growth:** Increase in the number of engineering businesses (2014-19). **Enterprise performance/output:** Increase in the proportion of GVA delivered by engineering businesses (2014-19).	**Wages:** Median wage and % change over time (2014-19). **Productivity:** Productivity and % change over time (2014-19). **Economic output:** Total GVA and % change over time (2014-19). **Size of place:** Population density.

Data limitations

The aim of this study is to work with the existing Engineering Footprint definition and produce the best of what is possible with open data that is widely available and frequently updated. It is acknowledged that SIC codes are limited in describing economic sectors, but they do provide sufficient insight into the UK economy and contain official employment statistics to make them a trusted source.

This study uses ONS data from 2019. At the time of analysis, more recent data was only available for the years affected by the Covid-19 pandemic. Because of this, 2019 was selected to get the best representation of the engineering economy. This methodology has been designed to be replicable for future ONS datasets which are more stable.

The smallest geographical unit in the study is at Local Authority level. Beyond this, it is extremely challenging to validate analysis due to data segmentation and suppression.

To gain an understanding of the presence of R&D activity in engineering, this study looks at the proportion of engineering workers employed in roles in which R&D is an explicit part of the ONS occupational description. This uses a new approach that assesses the descriptions of all occupations and identifies those most relevant and most closely aligned with research and development activity.

It is recognised that this will exclude innovation and refinement by practice, 'buying in' R&D via contracting or consulting, or collaborative partnerships. This also does not involve looking at R&D investment data. While there are some datasets available on this, none are considered to accurately depict business R&D investment at the granular level required for the analysis in this report. It cannot be linked to individual sectors or occupations, nor is it available at local authority level as it is so difficult to measure, and therefore was not sufficient for the purposes of this study.

The study has also used Data City's[3] platform to gather further insights on business activity across the economy, analysing their SIC – code alternatives – ('Real Time Industrial Classifications') to understand the distribution of engineering in the emerging economy[4]. This uses machine learning technology to analyse text on businesses' websites to understand the activity and sectors they are involved in[5]. While this new data does not account for 100% of engineering businesses, the patterns provide an indicative view of the influence of engineering in the development of new technologies. This was used to aid the description of the engineering economy in places, but not used to inform the development of the definition.

The development of the engineering typology and the subsequent categorisation process has been data-driven, influenced by quantitative patterns but also in part by Metro Dynamics' experience working with places across the UK. This work provides a framework for further, deeper exploration of what's going on beneath the data at local level.

[3] www.thedatacity.com

[4] The emerging economy is a term used to describe new and innovative economic sectors that are in early stages of development. These sectors often involve the development or incorporation of new technologies. Examples include artificial intelligence, advanced materials and blockchain technology.

[5] Note: This data only analyses businesses which have a website as it is based around analysing text. This is approximately 1.8 million businesses in the UK, around 30% of all UK businesses.

"The data in this report provides, for the first time, insight to the balance of employment across the full 'R&D to delivery' spectrum, enabling us to dig deeper into the role of engineering in local economies and explore opportunities for growth across the UK."

Chapter 02

Engineering and Economy

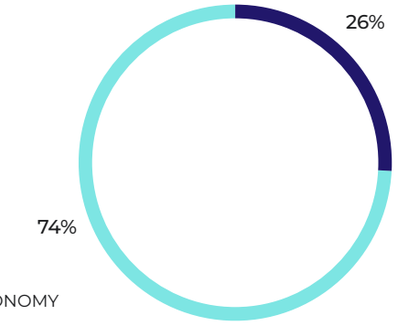
In 2019, the UK engineering economy employed 8.1 million people, more than a quarter of the UK workforce. Around 720,000 engineering businesses (13% of UK business base) contributed more than 30% of the UK's total economic output.

The total engineering economy contributes up to an estimated £646 billion direct GVA annually to the UK economy, which is more than 30% of total economic output. The engineering economy provides high-value, highly productive jobs, where the average value of an individual engineering job, £70,000, is worth almost a quarter more in GVA than the average UK job.

Of the 8.1 million people working in the engineering economy, 5.7 million (70%) are engineers and 2.4 million work in a non-engineering role in an engineering business. These vary across the 'research', 'support' and 'other' roles in engineering, containing jobs that provide integral services that underpin the operation of engineering businesses. Engineering

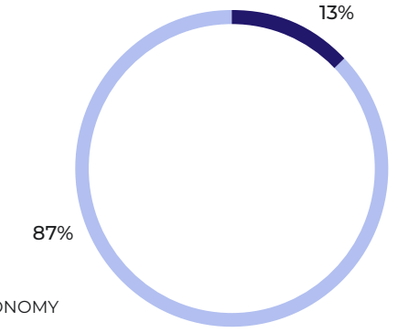
FIGURE 1.
The contribution of engineering to the UK economy, 2019

8.1 M
ENGINEERING EMPLOYMENT



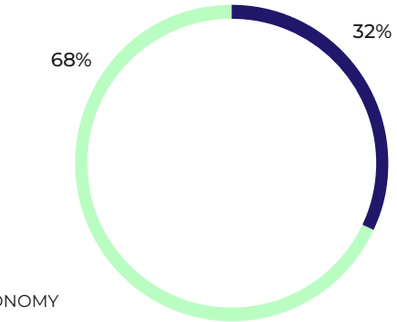
ENGINEERING ECONOMY REST OF THE ECONOMY

720 K
ENGINEERING BUSINESSES



ENGINEERING ECONOMY REST OF THE ECONOMY

£646 BN
GVA OUTPUT



ENGINEERING ECONOMY REST OF THE ECONOMY

FIGURE 2.
Employment in the engineering economy, 2019

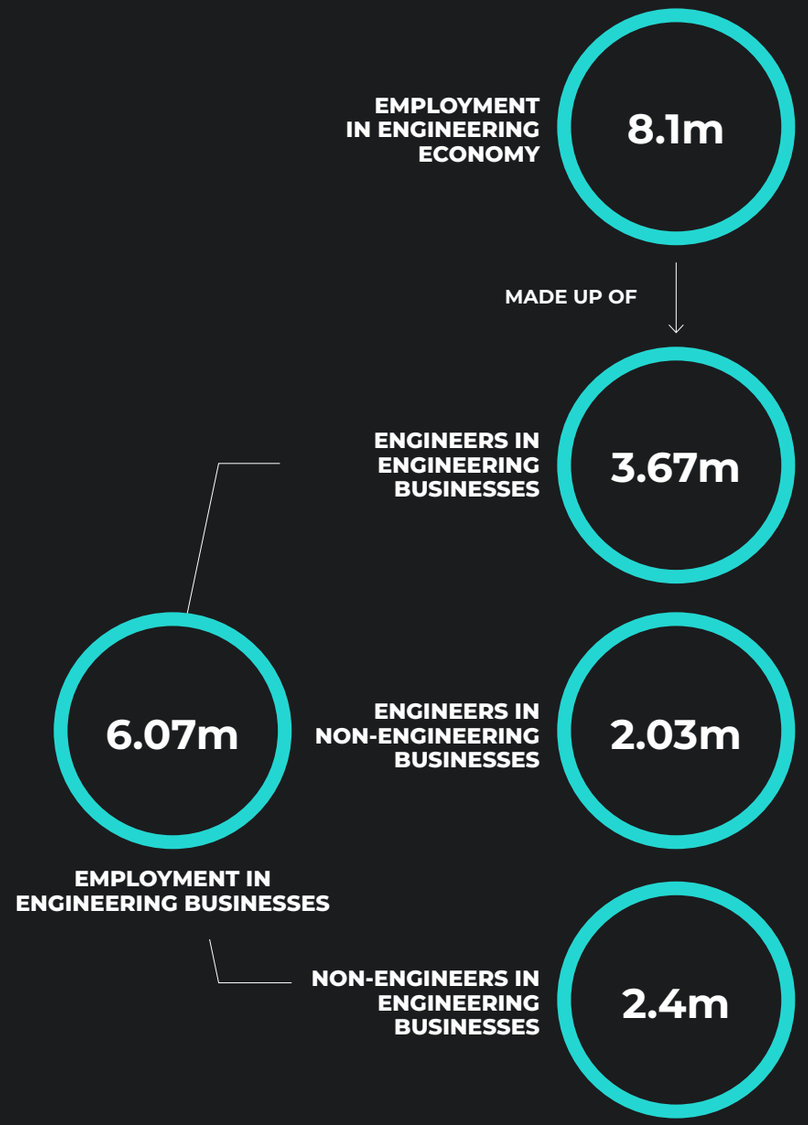
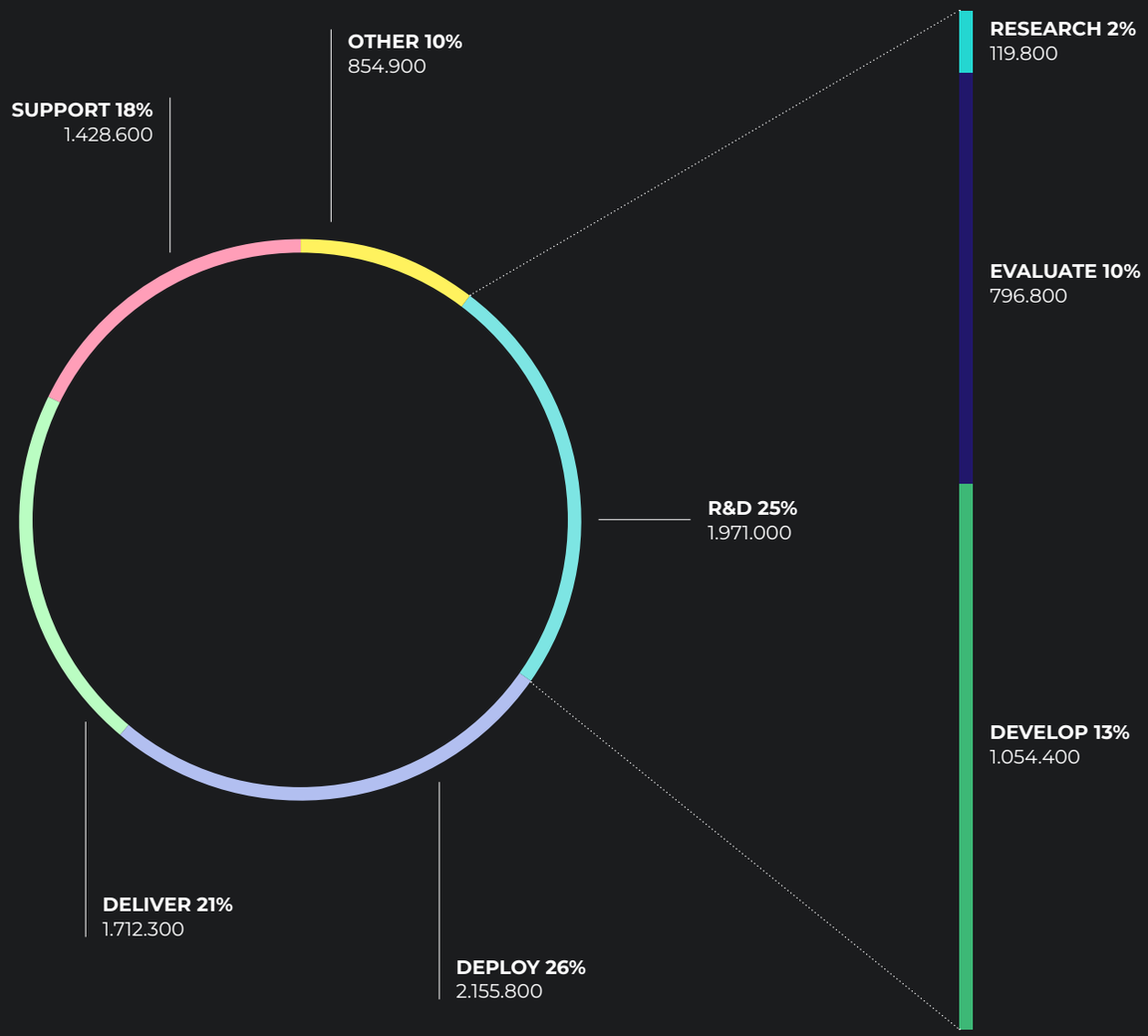


FIGURE 3.
Distribution of engineering economy by employment by occupation



businesses overall employ 6.07m people. Using the analysis of occupational codes and the newly defined occupational categories presented in table 3 (page 13), the overall engineering economy employment figures can be broken down further across these seven groups. As a reminder, R&D is a combination of 'Research', 'Develop' and 'Evaluate', as each of these contain R&D related activity, while 'Deploy' and 'Deliver' represent applied engineering.

The two largest occupational groups are Deploy, with 2.16 million jobs (27%) and R&D with 1.97 million jobs (24%). However, when the two engineering practice categories (Deploy and Deliver) are combined, the ratio of Practice to R&D is 2:1.

These occupations can be analysed further. The ONS provides data which assesses the probability or risk of automation for all UK occupations[6]. When applying this methodology to the occupations used in this study, 77% of roles within R&D are classed as resistant or 'low risk' to automation. This is much higher than the more practical roles within Deploy (10% low risk) and Deliver (30% low risk). Therefore the distribution of the type of engineering role will also have a bearing on the future role of engineering in place.

[6] ONS, Which occupations are at highest risk of being automated? 2019.

Distribution by sector

Using the Engineering Footprint SIC and SOC code definitions, Figure 4 shows how engineering employment is distributed across the UK's broad sectors.

The size and diversity of engineering means that its employment falls across many different sectors of the UK economy. Engineering plays a pivotal role in construction, manufacturing, metals and mining, and utilities. It also makes up almost 80% of the UK information and communication sector, with roles like software programming and web design, and almost a third of professional, scientific and technical activities, with roles like mechanical and electrical engineers and research and development managers.

This diversity and scale emphasises engineering's national economic importance and influence, underpinning a range of activity from machinery-based to computing and research.

Engineering is pivotal in the UK's emerging economy. Using data provided by the Data City, Figure 5 maps engineering against emerging economy activities. It demonstrates a diverse range of engineering activity, from advanced manufacturing and quantum technologies to genomics.

FIGURE 4.
Distribution of engineering economy employment by broad sector

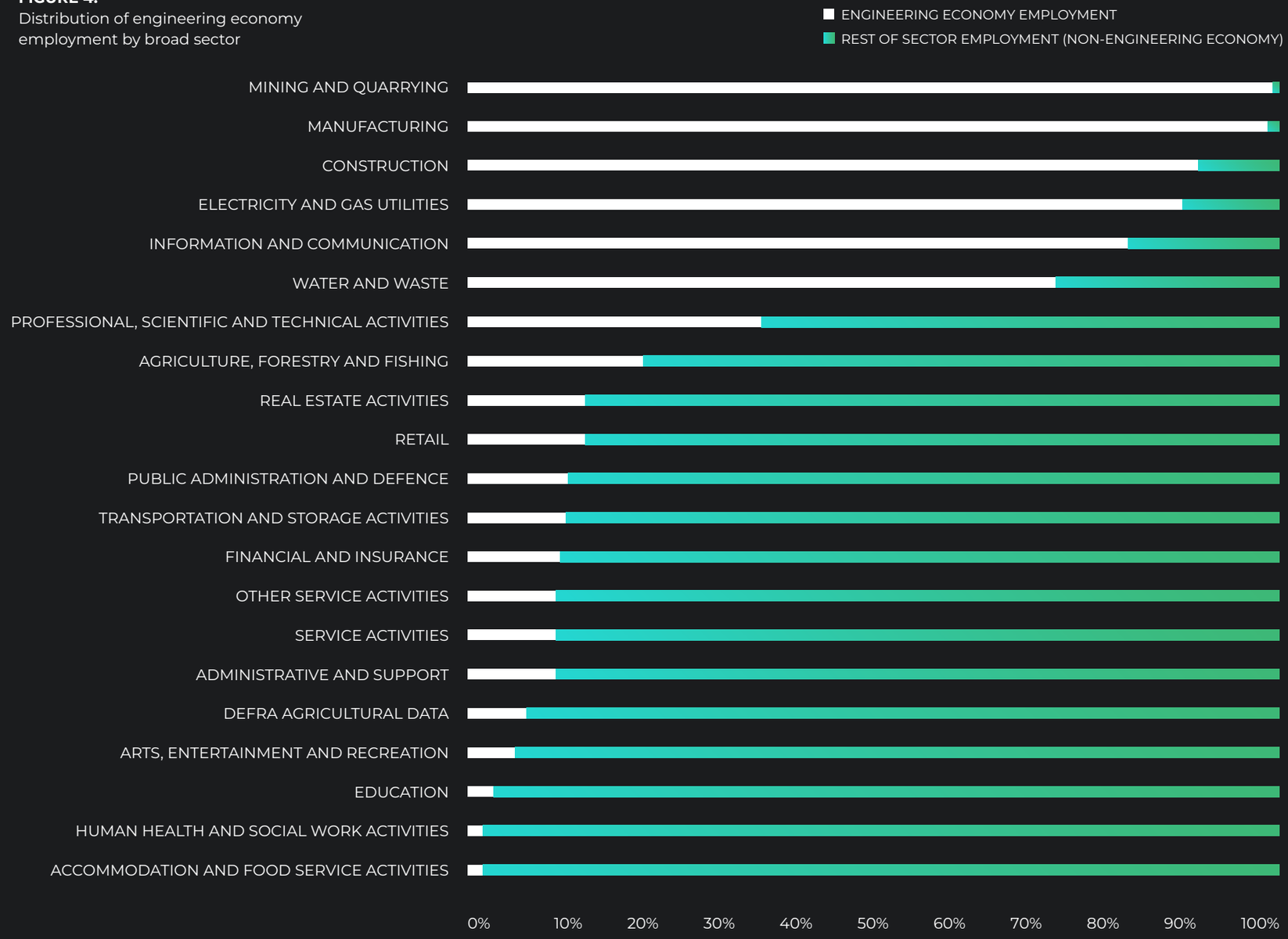
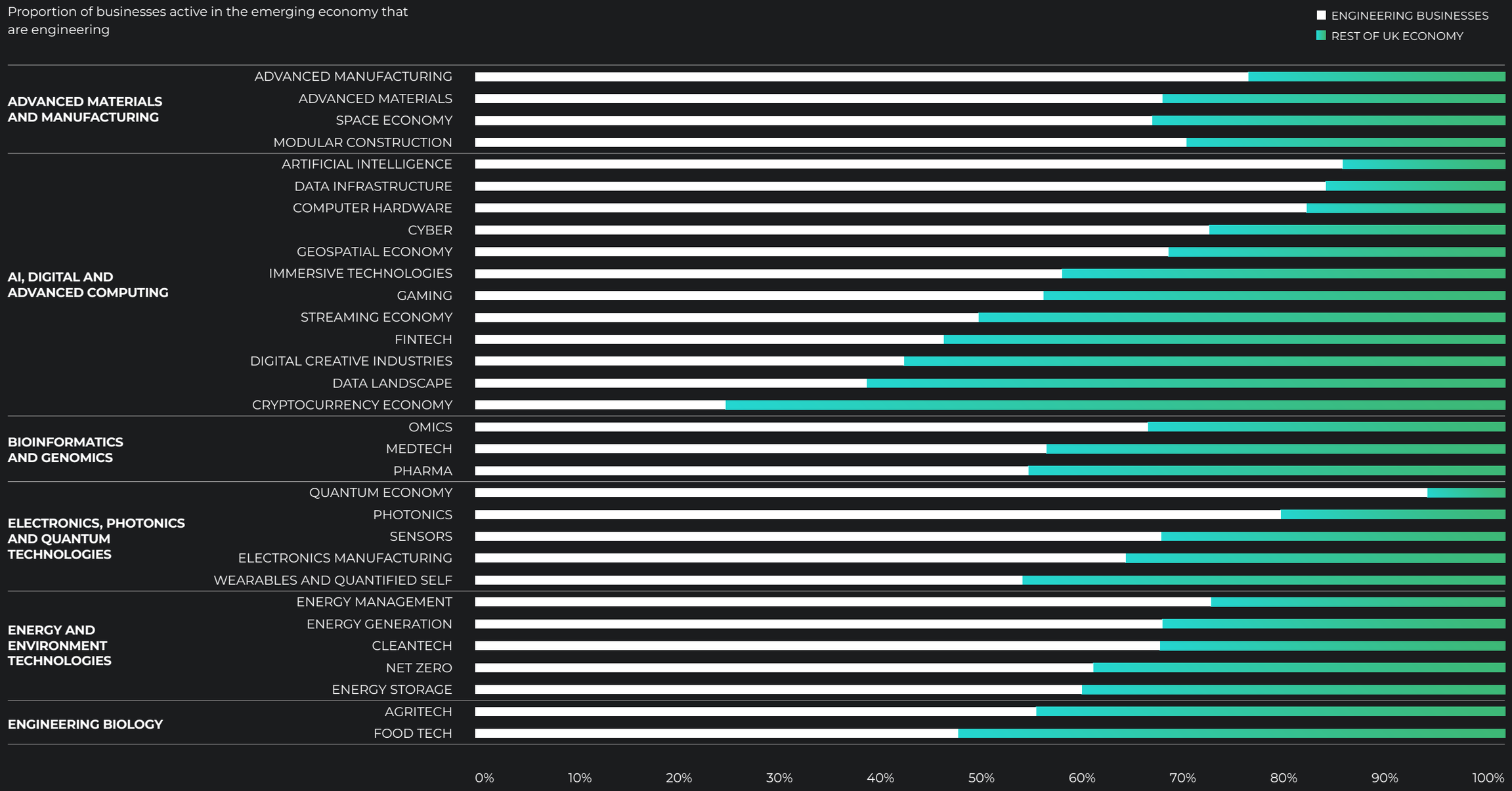


FIGURE 5.
Proportion of businesses active in the emerging economy that are engineering



Distribution across the UK

The following maps show how the 8.1 million jobs, 720,000 businesses and £646 billion GVA are distributed in local authorities across the UK. As described in the introduction, there are four primary 'Tier 1' metrics used to analyse the engineering economy:

- **Volume:** the total number of jobs in the engineering economy.
- **Value(£):** GVA Per engineering job.
- **Local Significance:** the proportion of total local employment that is within the engineering economy.
- **Industry Specialisation:** the concentration of engineering businesses within a place relative to the UK average (using location quotient analysis).

Each of these are presented as maps on the following pages, showing the spatial variation of each indicator across the UK. This is followed by an additional map which presents the proportion of engineering jobs in R&D by local authority. This was intentionally kept separate from tier 1 metrics to see how R&D levels changed depending upon the dominant engineering economy characteristic.

As might be expected, the places with large volumes of engineering employment tend to have a much higher population density. Cities, urban centres and their surrounding areas are more often the places with the highest absolute volume of workers. However, large volumes do not always translate into high local significance in cities as engineering is often 'one of many' rather than a dominant presence. This is most evident in London boroughs.

Industry specialisation, referring to the concentration of engineering businesses, has a similar distribution but differs in that most specialised places tend to be near cities – South Gloucestershire-Bristol, South Cambridgeshire-Cambridge, Fareham-Portsmouth and a clear loop around London all reflect the pull of city regions rather than city centres specifically.

The prominence of cities is diluted somewhat when considering local significance. Representing 26% of jobs nationally, engineering cannot be overlooked anywhere. It makes up at least 11% of employment in any local authority (Isles of Scilly being the smallest) and 50% at its highest (found in Copeland, Cumbria). It is highly significant to the local labour market in more sparsely populated places, providing large numbers of jobs which tend to be concentrated on larger sites and generate above average value per job. However, rurality is not always a consistent indicator for significance.

In terms of value, there is not a North-South divide to the same extent as there is in national GVA proportions. Whilst many of the strongest places for value are in the South East, there are also several places across the Midlands, North West and Scotland which are above average. Outside of London, high-value engineering economies include South Derbyshire, Cheshire East, Wokingham and Stratford-on-Avon. However, values are more variable from place to place outside of the central South East, with a stronger likelihood that the highest performance in a sub-region will be a city centre and its adjacent boroughs.

FIGURE 6.
The engineering economy core metrics

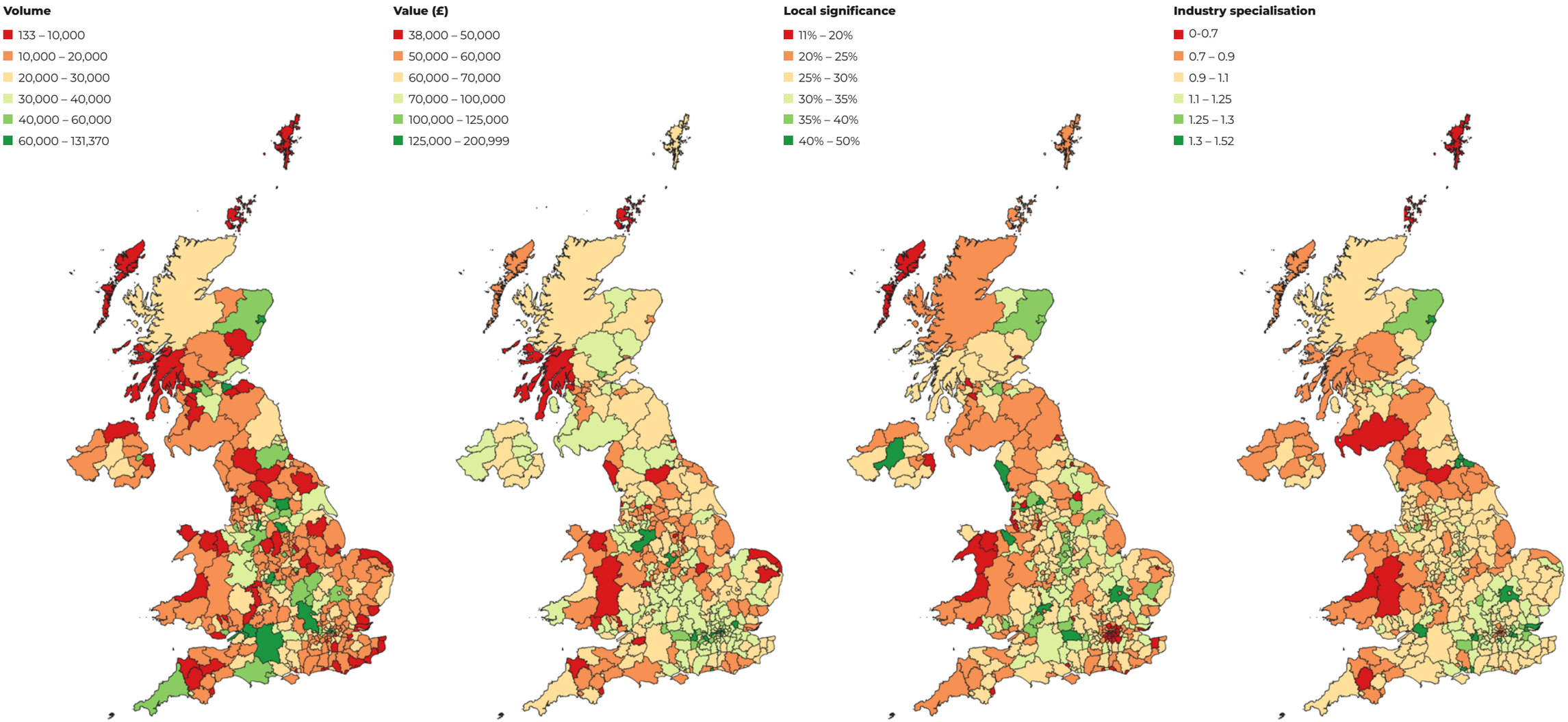
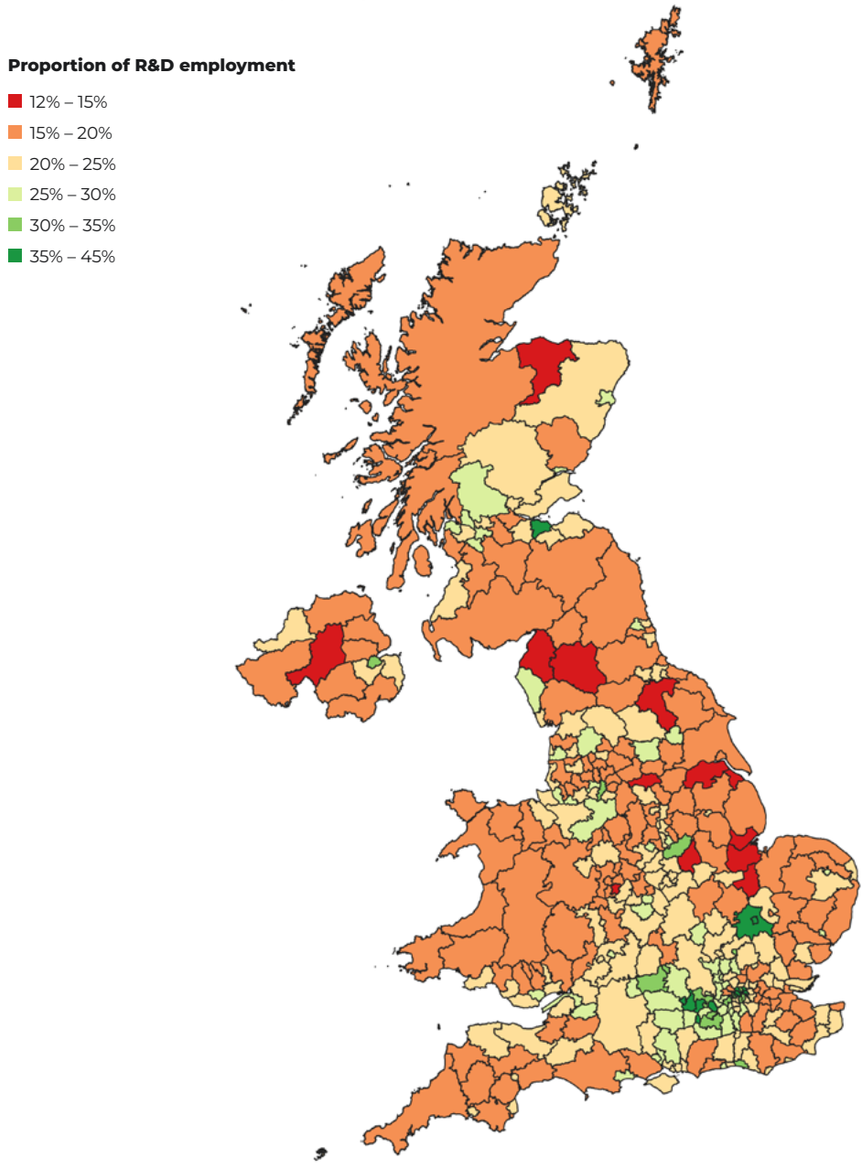


FIGURE 7.
R&D employment In the engineering economy



Generally, there are high concentrations of R&D employment across London, the South East and the Oxford-Cambridge arc, following some high-value patterns. Outside of these geographies, concentrations are found largely in UK cities, including Edinburgh, Belfast, Manchester and Brighton, and some smaller concentrations in the East Midlands, Cheshire and the South West. There are some examples of rural places having high proportions of R&D employment, such as South Derbyshire, but these instances are much less frequent.

Analysis of these metrics independently demonstrates that whilst engineering is everywhere, it is nowhere the same and despite (predictable) concentrations in the South East and in proximity to cities, there are few 'stand-out' patterns.

There is also not necessarily a distinctive relationship between these indicators. For example, local significance does not mean high-industrial specialisation and high-volume does not translate to high-value.

Arriving at a meaningful way of grouping authorities therefore requires an integrated analysis of a wider set of features, combining engineering economy characteristics with local engineering enterprise indicators and general economic metrics. This methodology and grouping results in a blended view of Engineering, Economy and Place.

"Engineering cannot be overlooked anywhere. Representing 26% of jobs nationally, engineering makes up at least 11% of employment in any local authority and up to 50% at its highest."

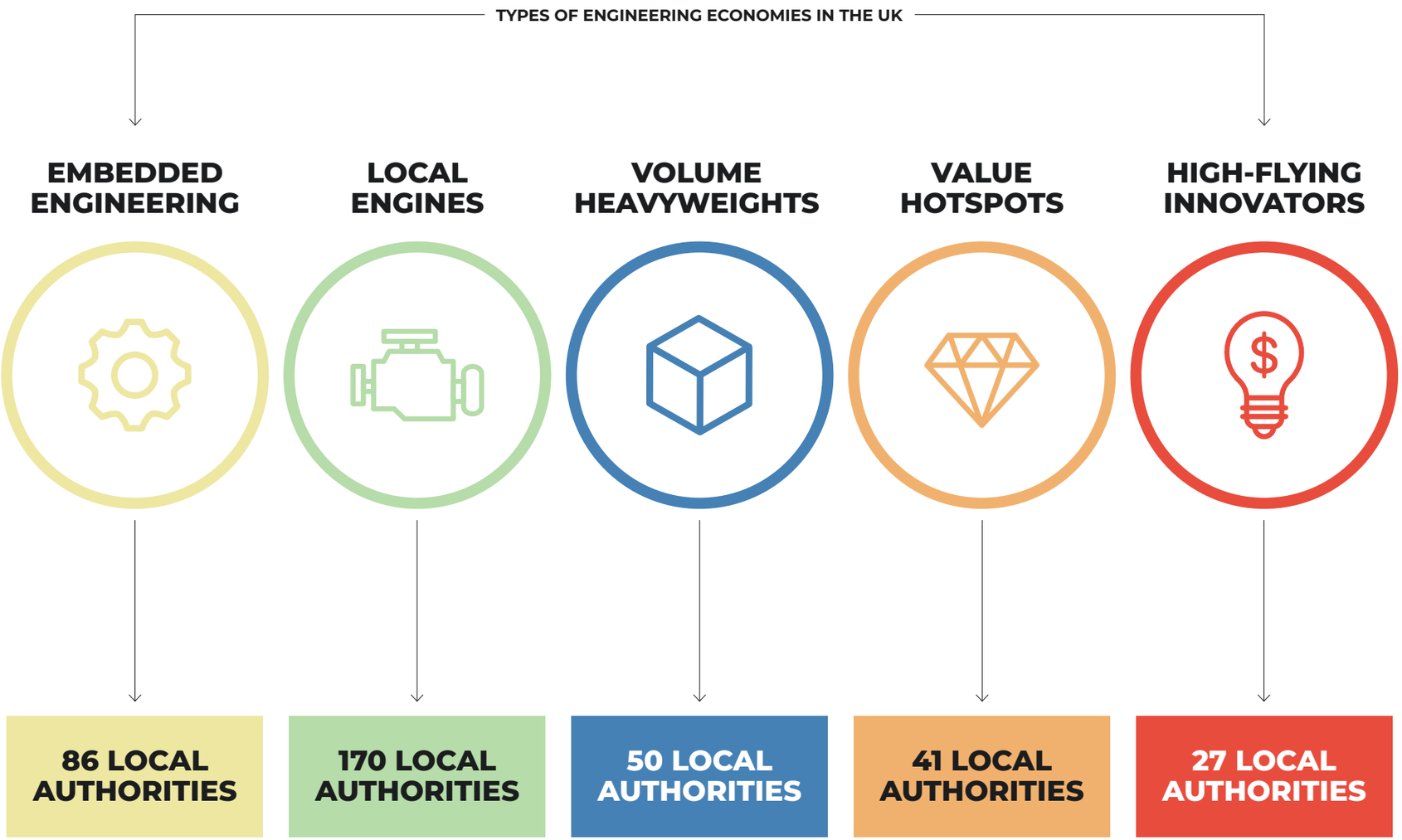
03

Chapter 03

A new typology for Engineering Economy & Place

Engineering is everywhere but nowhere the same – places have different distinctive engineering traits that are further moulded by their place characteristics. This scale and diversity means that developing a typology that is both sophisticated enough to capture nuance but succinct enough to be useful is extremely challenging.

FIGURE 8.
Engineering, Economy and Place typology categories and number of local authorities



The typology presented in this section brings together engineering economy and place features under three themes:
1. the engineering economy.
2. The engineering enterprise.
3. Place economics. These themes, or tiers of indicators, have been used to categorise all 374 local authorities in the UK.

This process has identified five broad typology categories. Individual authorities have been grouped together based on shared characteristics and trends, rather than geographical proximity – although naturally, some within each category share boundaries or regions.

Table 5.
Broad typology categories explained

	EMBEDDED ENGINEERING			LOCAL ENGINES			VOLUME HEAVYWEIGHTS			VALUE HOTSPOTS			HIGH-FLYING INNOVATORS		
ENGINEERING ECONOMY	**1,100,000** Employment	**121,000** Businesses	**£62,000** GVA per engineering economy job	**1,100,000** Employment	**257,000** Businesses	**£63,000** GVA per engineering economy job	**2,200,000** Employment	**163,000** Businesses	**£69,000** GVA per engineering economy job	**640,000** Employment	**83,000** Businesses	**£99,000** GVA per engineering economy job	**1,200,000** Employment	**97,000** Businesses	**£111,000** GVA per engineering economy job
GROUP TRAITS	These are economies where engineering is not necessarily dominant but due to the widespread nature and relative high value of engineering, is likely to still have an important role locally as an employment provider and a driver of growth.			A diverse group where engineering plays a very significant role in the local economy, providing at least 25% of overall employment. Some of these places have large engineering businesses which are major employers and have high GVA output, while others have concentrations of engineering businesses but have not been able to transfer this into more significant economic benefit.			These places contain some of the largest engineering employment footprints in the UK. These combine high-density, High-Volume Engineering Cities with more rural areas where large, high-performing firms are located. Combined, they provide a large volume of jobs, equivalent to 28% of the national engineering economy, but the value per job is relatively lower than in Value Hotspots or High-Flying Innovator places.			The high-value engineering economies, where jobs are on average worth at least £80,000 in GVA per engineer, £10,000 higher than the engineering economy average. These places are lower in volume and despite their high value, are not seeing widespread growth in their engineering business base. This is instead limited to specific concentrations, many of which are located either around or in key and core cities.			The innovation-dominant engineering economies specialising in R&D-related activity. These places are collectively high in value and volume and have a high proportion of their engineering jobs in R&D-related occupations. They are based in highly populated areas, which are generally more prosperous and engineering businesses are growing in number.		
CORE ENGINEERING INDICATORS	LS Vol Val LQ R&D			LS Vol Val LQ R&D			LS Vol Val LQ R&D			LS Vol Val LQ R&D			LS Vol Val LQ R&D		

Key:
Local significance (LS): percentage of total employment represented by the engineering economy.
Volume (Vol): total number of jobs from the engineering economy.
Value (Val): average GVA per engineer.
Industry Specialisation (LQ): the concentration of engineering business.
R&D: the proportion of engineering economy jobs in research and development related roles.

To identify engineering patterns in places using this set of indicators, a national average was calculated for each metric alongside the numerical range. These values were used as a baseline for assessing and categorising places, informing the development of a 'high to low' threshold for each indicator, displayed by colours as follows:
Red: Low performance relative to average.
Amber: Mid performance relative to average.
Green: High performance relative to average.

These broad typology categories act as a useful mechanism for understanding the types of engineering economies present across the UK and a helpful starting point for those looking to understand their own engineering economy.

However, even within these broad categories, the blend of features and indicators means that places are broadly alike, rather than uniformly identical. Each is on a scale, with some places firmly in the middle and others at the periphery and therefore could share characteristics with an alternative group. To aid further understanding, sub-categories have been developed for three of the typology groups, where there are some observable variations based on engineering, enterprise or place indicators.

This reinforces the importance of a place-based approach, in which local leaders can discover and articulate the nuances of their engineering economy. A new understanding of engineering can be used both to inform new policy development and deliver against existing priorities to enhance the strengths and address the needs of places.

Table 6 on the following page presents the overall averages for all places within each category, across all indicators.

FIGURE 9.
Typology sub-categories

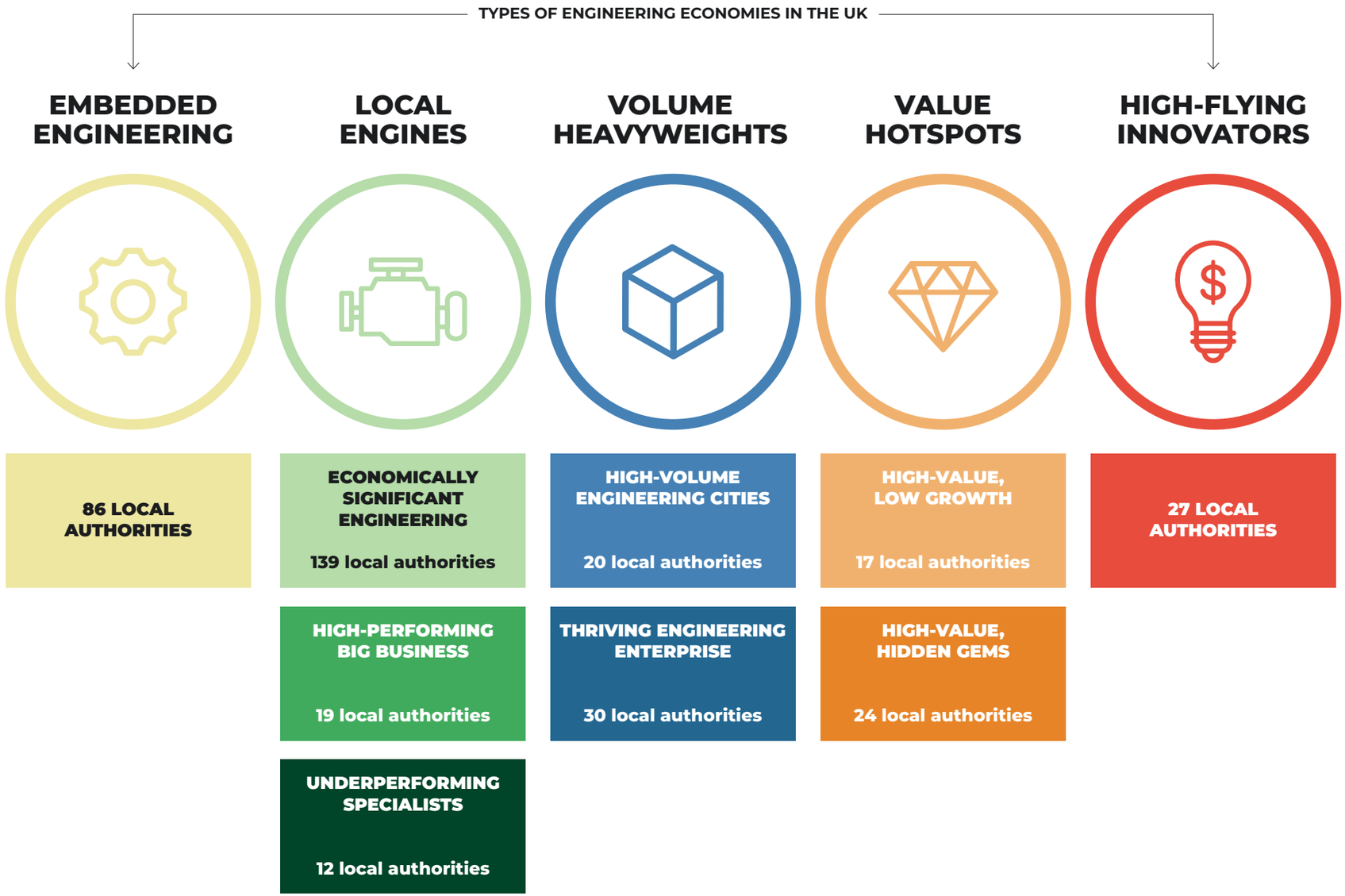


Table 6.
Engineering typology data indicators. Values are averages of all local authorities in each category.

			TIER 1 INDICATORS					TIER 2 INDICATORS			TIER 3 INDICATORS						
Typology category	Typology sub-category	Number of local authorities	Local significance (LS)	Volume (Vol)	Value (Val)	Industry specialisation (LQ)	Average proportion engineering jobs in R&D	Number of employees per engineering business	Engineering business growth	Increasing proportion of GVA delivered by engineering businesses	Median weekly wage 2019	Median wage % change	GVA per job	GVA per job (% change)	GVA (millions)	GVA % Change	Population density
High-Flying Innovators		27	26%	43,000	£111,000	1.09	30%	8.17	12.22	9.09	£700	11%	£82,000	11%	£16,000	9%	52.86
Volume Heavyweights	Thriving Engineering Enterprise	30	33%	38,000	£69,000	1.13	22%	11.49	11.87	12.73	£570	11%	£54,000	9%	£7,000	6%	8.59
	High-Volume Engineering Cities	20	22%	55,000	£69,000	0.91	30%	10.02	12.42	5.66	£580	10%	£54,000	10%	£14,000	7%	40.29
High-value engineering	High-value, low growth	17	20%	15,000	£97,000	1.01	25%	5.17	11.52	6.64	£590	10%	£63,000	12%	£5,000	4%	33.53
	High-Value, Hidden Gems	24	30%	16,000	£100,000	1.08	25%	8.47	10.29	13.32	£610	10%	£69,000	10%	£4,000	6%	6.18
Local Engines	High-performing big business	19	37%	17,000	£66,000	1.06	21%	15.61	10.43	15.42	£580	13%	£53,000	9%	£3,000	5%	8.28
	Economically significant engineering	139	29%	18,000	£63,000	1.02	20%	9.04	11.31	10.16	£530	12%	£49,000	10%	£3,000	4%	6.88
	Underperforming Specialists	12	28%	10,000	£61,000	1.31	21%	6.66	10.19	8.79	£550	13%	£47,000	9%	£2,000	1%	17.12
Embedded Engineering		86	22%	13,000	£62,000	0.92	22%	7.60	11.46	6.11	£530	12%	£47,000	9%	£3,000	3%	14.15

Key:
Local significance (LS): percentage of total employment represented by the engineering economy.
Volume (Vol): total number of jobs from the engineering economy.
Value (Val): average GVA per engineer.
Industry Specialisation (LQ): the concentration of engineering business.
R&D: the proportion of engineering economy jobs in research and development related roles.

To identify engineering patterns in places using this set of indicators, a national average was calculated for each metric alongside the numerical range. These values were used as a baseline for assessing and categorising places, informing the development of a 'high to low' threshold for each indicator, displayed by colours as follows:
Red: Low performance relative to average.
Amber: Mid performance relative to average.
Green: High performance relative to average.

Typology & sector

From analysis of sectors using ONS data, higher value economies show greater concentrations of engineering employment in ICT and Professional, Scientific and Technical (Sci-Tech) activities and lower proportions of Manufacturing compared to other categories. In ICT, these are driven by computer programming activities and data-driven processes. In Sci-Tech, there are much larger concentrations of research and development, technical and experimental sub-sectors. These activities underpin many of the typology groups with higher proportions of R&D, particularly High-Flying Innovators *and* High-Volume Engineering Cities.

Thriving Engineering Enterprise and High-Value, Hidden Gems – the categories that demonstrate strong enterprise environments – are the only two which contain a substantive fusion of 'traditional' practice-centric industry (manufacturing and construction) and the more innovation-centric sectors (ICT and Sci-Tech). The mix of different sector footprints and concentrations in different engineering economies highlights the importance of collaboration across wider geographies and ensuring connectivity between activities that can support each other. Digital adoption and transformation will obviously play a central role in driving this innovation.

Table 7.
Proportion of engineering economy employment by typology group and broad sector.

		High Volume Heavyweights		Value Hotspots		Local Engines			
Broad sector	**High-Flying Innovators**	**Thriving Engineering Enterprise**	**High-Volume Engineering Cities**	**High-value, low growth**	**High-Value, Hidden Gems**	**High-performing big business**	**Economically significant**	**Underperforming Specialists**	**Embedded Engineering**
Information and communication	27.3%	9.1%	20.1%	16.9%	15.2%	5.6%	8.4%	9.0%	9.8%
Professional, scientific and technical activities	18.0%	11.9%	14.4%	13.3%	13.1%	7.3%	9.6%	10.6%	10.8%
Manufacturing	13.9%	36.6%	21.6%	17.2%	27.0%	49.5%	36.6%	31.0%	27.0%
Construction	11.7%	16.0%	12.9%	22.7%	21.7%	16.4%	18.8%	22.5%	20.6%
Retail and other service activities	6.6%	7.7%	7.5%	10.3%	8.5%	6.0%	9.2%	9.2%	10.0%
Financial and insurance activities	4.2%	0.6%	2.6%	1.0%	1.0%	0.4%	0.7%	0.6%	1.1%
Administrative and support service activities	4.1%	3.7%	4.7%	4.5%	2.7%	2.7%	3.1%	3.1%	4.0%
Transportation and storage	3.2%	2.1%	2.4%	2.6%	1.5%	3.2%	2.1%	2.4%	2.5%
Combined other service activities	2.6%	1.6%	2.1%	2.5%	2.4%	1.4%	2.9%	1.6%	3.4%
Public administration and defence	2.2%	2.7%	2.6%	1.5%	1.0%	1.1%	1.9%	1.9%	2.5%
Real estate activities	1.4%	0.7%	1.4%	1.6%	0.8%	0.6%	0.9%	0.9%	1.3%
Electricity and gas utilities	1.3%	1.2%	2.1%	0.5%	1.2%	1.7%	1.6%	2.5%	1.3%
Water and waste	1.2%	1.9%	1.8%	2.4%	1.6%	2.1%	2.1%	1.9%	2.2%
Education	1.1%	0.8%	2.2%	1.4%	0.8%	0.5%	0.8%	1.1%	1.7%
Human health and social work activities	0.9%	0.8%	1.5%	1.5%	0.8%	0.8%	1.0%	1.2%	1.7%
Mining and quarrying	0.2%	2.6%	0.1%	0.1%	0.6%	0.7%	0.4%	0.5%	0.3%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Mapping the engineering typology

Looking across the UK emphasises London and the South East's strong gravitational pull on high-value, innovative engineering, but there is the potential for this to further expand into other regions. The High Volume Engineering Cities and Thriving Engineering Enterprise categories present an opportunity to leverage capacity across a wider city-region and generate greater value into more places.

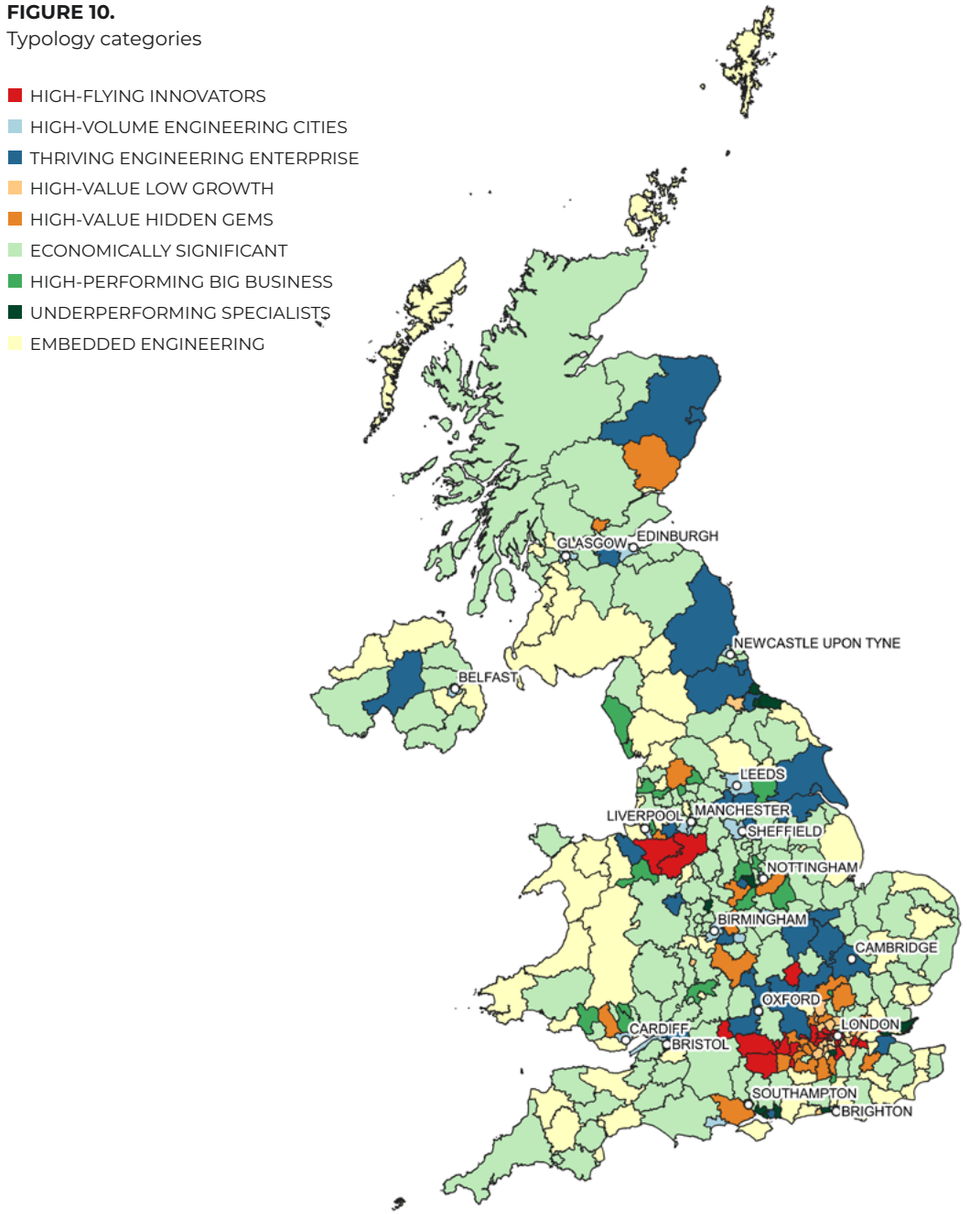
City regions and Combined Authorities are important vehicles for the national engineering economy. These combine dense, R&D-intensive activity in city centres with specialised 'near city' Thriving Engineering Enterprises in the connected surrounding rural/town economies.

West Yorkshire Combined Authority is a good example of this, with Leeds as a high-volume city, surrounded by Thriving Engineering Enterprise, Kirklees and Wakefield, supported by Economically Significant engineering in Bradford and Calderdale.

There are fewer concentrations of high-value engineering in distinctively rural areas, though there are exceptions in places which also have a strong industrial heritage, like Lancashire and Derbyshire.

The very point of there being few instances of high-value, high-R&D engineering in rural areas – for example Mid Wales and the Marches, Cornwall, Cumbria, East Anglia and the North West of Scotland – demonstrates the critical importance of doing more to connect innovation for those outside of a city-region centre of gravity. Rural or out-of-town should not mean disconnected.

FIGURE 10.
Typology categories



"The mix of different sector footprints and concentrations in different engineering economies highlights the importance of collaboration across wider geographies and ensuring connectivity between activities that can support each other."

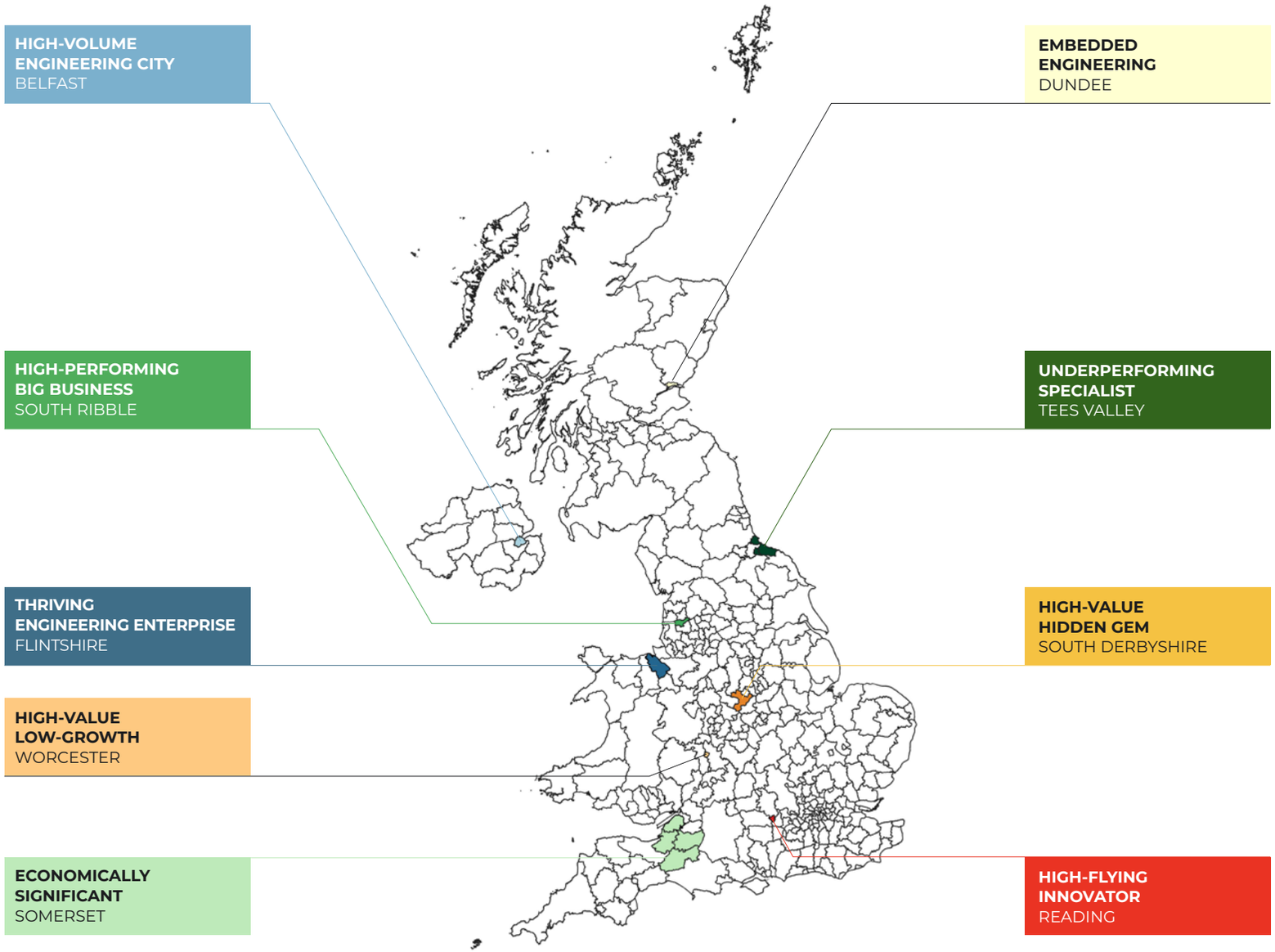
Chapter 04

Engineering Places

04

Place snapshots help illustrate the range and level of nuance across the typology.

Over the following pages each of the nine typology categories is described in more detail, alongside a descriptive profile of a place within the group. As noted previously, within the categories, the blend of features and indicators means that places are broadly alike, rather than uniformly identical. Each category is on a scale, with some places firmly in the middle and others at the periphery and therefore could share characteristics with an alternative group. As such, the aim here has been to select places that are broadly reflective of the centre of each category.



High-Flying Innovators

27 local authorities

All High-Flying Innovators are either in, or in the pull of, London, with the exception of Chesire.

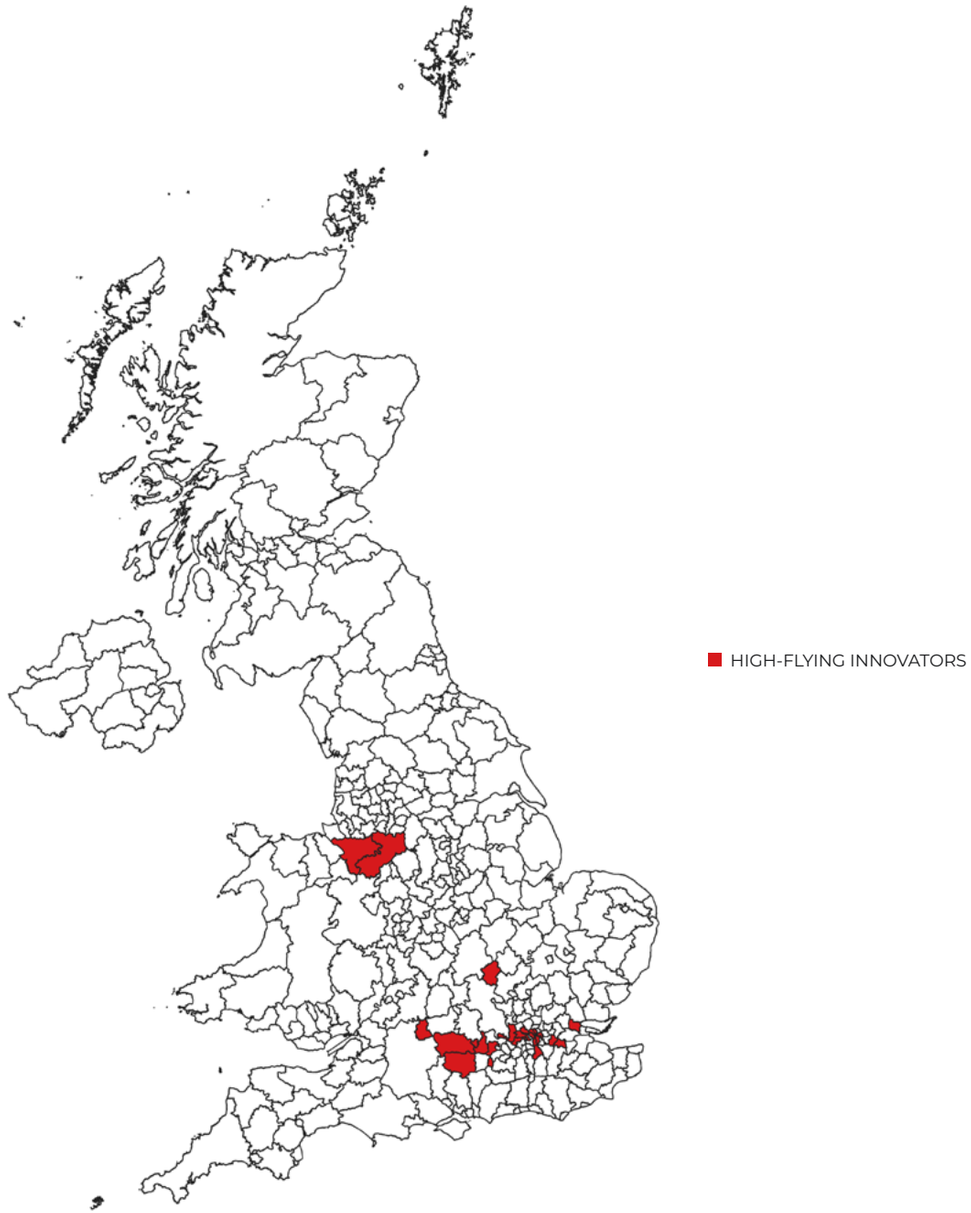
These places are collectively high in value and volume, with a high proportion of their engineering jobs in R&D-related occupations. This is typified by economies which have major businesses, institutions and technological strengths embedded locally, delivering value and generating talent.

The engineering businesses tend to be smaller on average, growing in number, benefitting from a strong enterprise environment and in economies that are generally highly productive. Engineering is often 'one of many' strengths in these diverse economies, but the level of R&D-related activity means it is important nationally and locally.

Almost half, 45%, of engineering employment in these places is in Information and Communication and Professional, Scientific and Technical Services – the highest of all typology groups and by some margin; the next greatest concentration of these activities is in High-Volume Engineering Cities, where they account for 33% of engineering employment. Conversely, the High-Flying Innovators group has the lowest proportion of engineering employment in manufacturing and construction compared to all other groups, 26%.

These are high-knowledge, high- enterprise, high-innovation places, with tech strengths at the forefront of the emerging economy, for example in AI, cleantech, cyber, data processing, space economy and telecoms.

And of course pharmaceuticals in Cheshire, where a rich history in salt mining dating from Roman times has led to a continued chemical industry in the county, now home to Alderley Park, the UK's largest single-site life science campus.



HIGH-FLYING INNOVATOR TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
43,000 Volume	**30%** Average proportion of engineering jobs in R&D	**£700** Weekly median wage
£111,000 Value	**8.17** No. of employees per engineering business	**£82,000** GVA per job
26% Local significance	**12.22** Rate of engineering business growth	**£16,000** GVA output
1.09 Industry specialisation	**9.09** Rate of GVA delivered by engineering business	**52.86** Population density

PLACE PROFILE:
READING

Spotlight on Reading			
Engineering economy:	**34,600** **Employment**	**2,400** **Businesses**	**£80,000** **GVA per engineer**

Located in the South East, Reading was built on a rich industrial heritage nicknamed 'the 3 Bs' – Beer, Biscuits and Bulbs. In 2023, the landscape is very different. Reading sits at the heart of the Thames Valley region, one of the most successful tech hubs in Britain and often referred to as the 'Silicon Valley of the UK'.

Reading's location has been a strong breeding ground for a formidable ICT sector base. It has excellent connections via its major railway hub and the Elizabeth Line to London and to the wider Thames Valley tech corridor, linking to places like Oxford and Wokingham. The connectivity and investment in business infrastructure has attracted several major tech businesses to the area, choosing Reading as their UK base. Microsoft, Cisco, EE and Ericsson, alongside many large international accounting firms, are located here.

With the University of Reading close by, these businesses also have access to a major talent pool, graduating from an institution with major research strengths in computer science, informatics, systems engineering, and food sciences. The university ranks 11th in the world for agriculture and forestry, reflecting the area's rich history of developing new technologies in agriculture. There are several centres of excellence too, including the Henley Business School and the Thames Valley Science Park, providing cutting-edge laboratories for businesses and students alike.

This environment has created a vibrant enterprise scene that has seen the emergence of innovative tech start-ups and spinouts. This success has attracted an influx of investment too. For example, a consortium including BT and EE, but led by Reading-based Altitude Angel, is developing the world's longest network of 'drone superhighways' between the Midlands and the South East. Meanwhile, BP has announced plans to invest up to £50 million in a state-of-the-art electric vehicle battery testing centre at its global headquarters just outside Reading.

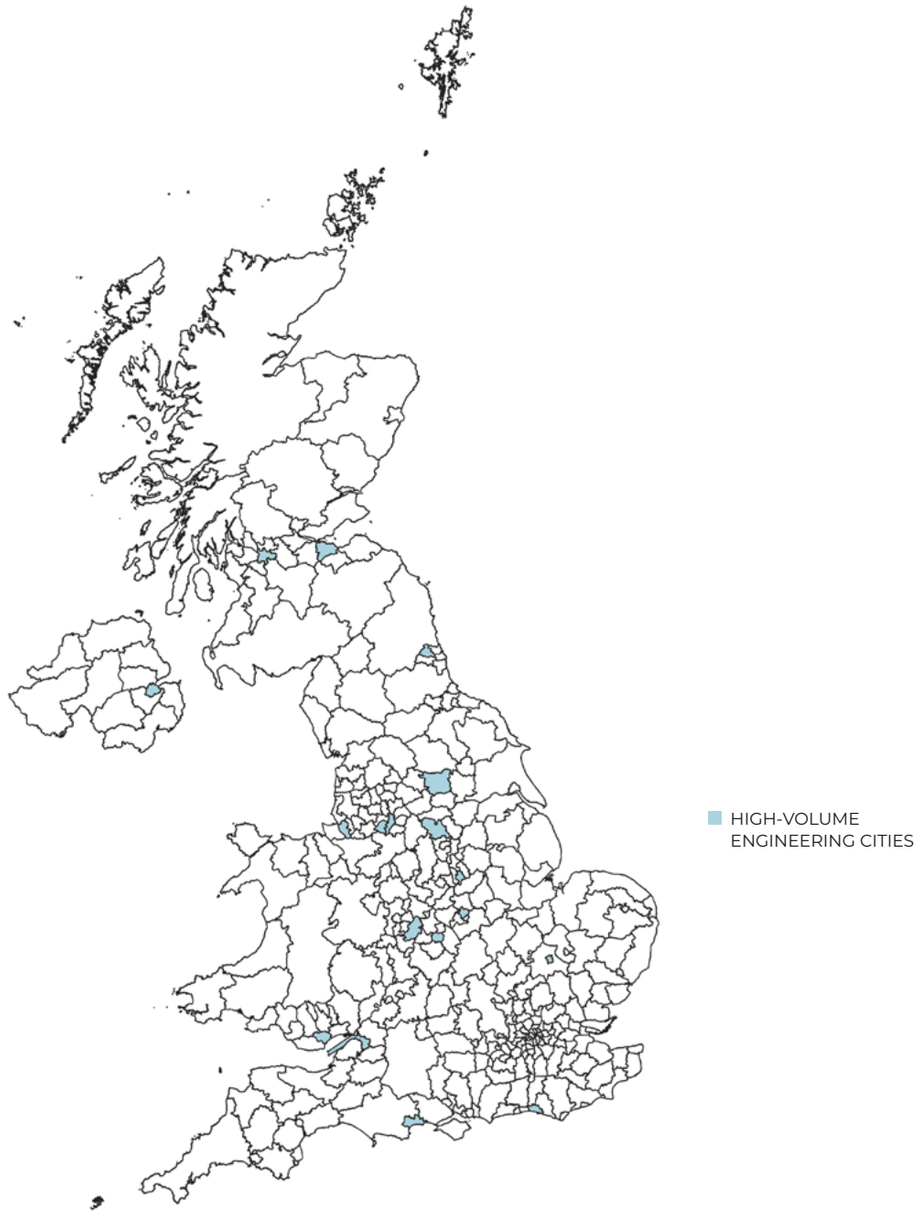
Having also been recently named one of the best places to live in the UK by the Sunday Times, Reading is strong exemplar of what it means to be a High-Flying Innovator.

ENGINEERING ECONOMY KEY INDICATORS FOR READING

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

High-Volume Engineering Cities

20 local authorities



Many places that have high-volume as a primary characteristic are in, or near, the UK's major cities. These tend to have lower value per engineering job and lower wages overall. This is potentially a factor of the size of the labour markets in densely populated areas, which have a more diverse and wider ranging array of occupations.

High-Volume Engineering Cities, however, are a strong source of innovation, containing a similar level of R&D employment to High-Flying Innovators, usually supported by universities, research assets and business networks.

Birmingham, Edinburgh, Belfast, Glasgow, Cambridge, Bristol and several others attract some of the highest volumes of employment and are attractive environments for engineering businesses, which have increased in number over time.

These High-Volume Engineering Cities pair with places found in the Thriving Engineering Enterprise category, displaying similar characteristics and are often neighbouring local authorities.

HIGH-VOLUME ENGINEERING CITIES TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
55,000 Volume	**30%** Average proportion of engineering jobs in R&D	**£580** Weekly median wage
£69,000 Value	**10.02** No. of employees per engineering business	**£54,000** GVA per job
22% Local significance	**12.42** Rate of engineering business growth	**£14,000** GVA output
0.91 Industry specialisation	**5.66** Rate of GVA delivered by engineering business	**40.29** Population density

PLACE PROFILE:
BELFAST

Spotlight on Belfast			
Engineering economy:	**48,332** **Employment**	**2,210** **Businesses**	**£70,500** **GVA per engineer**

Belfast has a long and rich engineering history as one of the largest shipbuilding cities in the world. Long-established employers including Spirit AeroSystems, Harland & Wolff and Thales (with a combined 340-year track record of engineering in the city) continue to constantly innovate and evolve alongside new emerging sectors. Building on that foundation of rich engineering heritage and innovative culture, the city is now also home to companies like Artemis Technologies, lead partner of a Belfast Maritime Consortium awarded £33 million by UK Research and Innovation's Strength in Places Fund to develop a zero-emission high-speed ferry.

Over the last decade, Belfast has seen the emergence of a vibrant enterprise and innovation ecosystem, in which universities are launchpads for commercialising research, entrepreneurship is thriving, and the city has developed a significant R&D base. In this study, in terms of the proportion of R&D employment within the local engineering economy, Belfast is ranked joint 8th of all 374 local authorities in the UK.

The establishment of Invest NI in the 2000s acted as a catalyst for the ecosystem, creating a vehicle which supports local businesses and attracts investment into the region. Following a period of publicly funded regeneration which delivered the Titanic Quarter, a new innovation district, and NI Science Park (now Catalyst NI), private sector leadership has now emerged, focused on creating conditions for business growth and entrepreneurship.

Ormeau Baths embodies this. Set up by four entrepreneurs, it is focused on growing the startup community by providing space to network and access to investment, which is an offer that was previously absent. This subsequently led to the co-location of Barclays Eagle Lab and several organisations that are now pivotal in delivering some of the most successful business support programmes within the region – IgniteNI, Ormeau Labs programme (with TechStart Ventures) and the Royal Academy of Engineering's first regional Enterprise Hub.

The rise of this enterprise ecosystem has coincided with the ongoing evolution and diversification of the city's advanced composites, aerospace and defence and security industries. The city has been recognised nationally for its strengths in advanced manufacturing, cyber and fintech and health and life sciences. This has delivered significant benefits for the city – recent studies have shown Northern Ireland has almost triple the number of engineering start-up and scale up businesses than the UK average. Belfast is now seen as an attractive destination for investment and innovation. Successive programmes have provided a new pathway for early-stage businesses to investor communities and consequently here equity deals at seed stage are higher than the UK average, with over £100 million venture capital raised in 2021. There is now a dynamic set of businesses here, investing in R&D at a faster rate than many other regions across the UK, and Belfast sits at the heart of that. For many in the city, it is an exciting time for entrepreneurship, innovation, and engineering.

ENGINEERING ECONOMY KEY INDICATORS FOR BELFAST

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

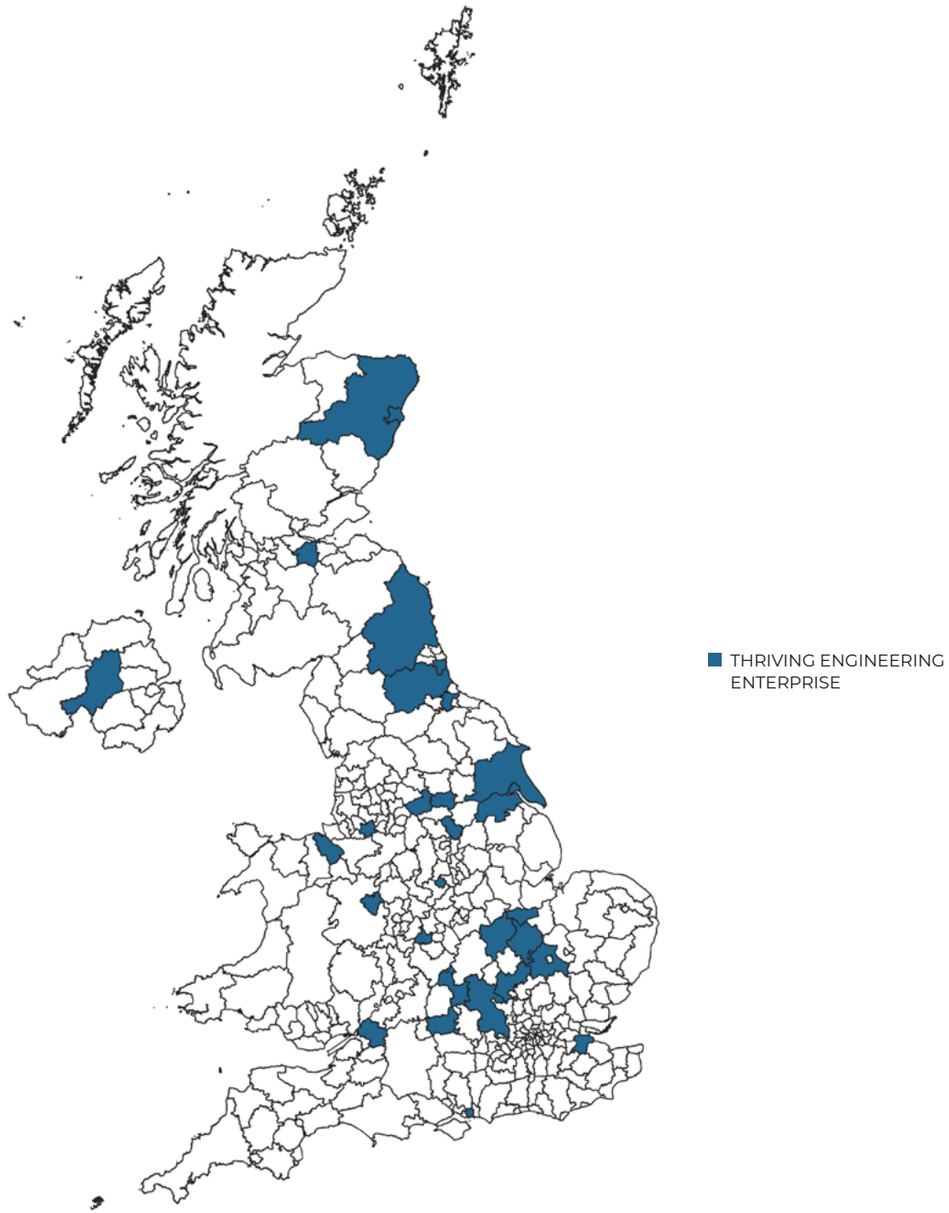
Thriving Engineering Enterprise

30 local authorities

Paired with High-Volume Engineering Cities, these places tend to be located on the outskirts of cities, accommodating larger businesses which value proximity to urban centres but require more physical space.

These patterns are seen particularly in the North East of England, Yorkshire, and across the Oxford-Cambridge Arc.

Thriving Engineering Enterprise places present an opportunity to leverage capacity across a wider city-region, where there is a combination of proximity to city-centre based R&D activity and 'near city' industry, in which several are highly specialised, but currently have lower-value engineering output. Specific examples include South Cambridgeshire, Aberdeenshire and Bedfordshire.



THRIVING ENGINEERING ENTERPRISE TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
38,000 Volume	**22%** Average proportion of engineering jobs in R&D	**£570** Weekly median wage
£69,000 Value	**11.49** No. of employees per engineering business	**£53,000** GVA per job
33% Local significance	**11.87** Rate of engineering business growth	**£7,000** GVA output
1.13 Industry specialisation	**12.73** Rate of GVA delivered by engineering business	**8.59** Population density

PLACE PROFILE:
FLINTSHIRE

Spotlight on Flintshire			
Engineering economy:	**32,295** **Employment**	**1,640** **Businesses**	**£80,000** **GVA per engineer**

Flintshire, located in North East Wales, comprises of several towns and villages, rather than a single large economic centre. While there are pockets of deprivation, it is one of the most productive parts of Wales and shares its borders with Cheshire, Wrexham and Denbighshire, where there is good connectivity to wider regions and cities.

Traditionally, Flintshire was a hub for coal mining and iron and steel production, but has since diversified into more advanced forms of manufacturing, including for the aerospace and automotive industries. Manufacturing makes up a quarter of all jobs in Flintshire, which are seen as equally important for the overall Welsh economy.

These manufacturing strengths have attracted some major businesses, with a strong aerospace specialism thanks to companies like Airbus and Raytheon located in the region. This has brought wider opportunities, with Flintshire having attracted Boccard's first major nuclear manufacturing facility to the UK.

The heritage, a strong defence legacy (the RAF and Marconi), the presence of global businesses and Flintshire's wider connectivity means the area has been an attractive option for business. A primary example of this is Deeside, an extensive industrial area promoted as the "Northern Gateway", a sought-after location for manufacturing and distribution businesses due to its quality of space and connections into England. Companies like Tata Steel and Toyota are located here, while the Welsh Government has recently invested £10 million to unlock further development on the site.

Flintshire offers a range of employment opportunities and is often seen as having high economic growth potential due to its strategic location and skilled workforce. Its sector base aligns with surrounding economies, for example, businesses such as Vauxhall Motors in Liverpool, or JCB and Magellan Aerospace in Wrexham.

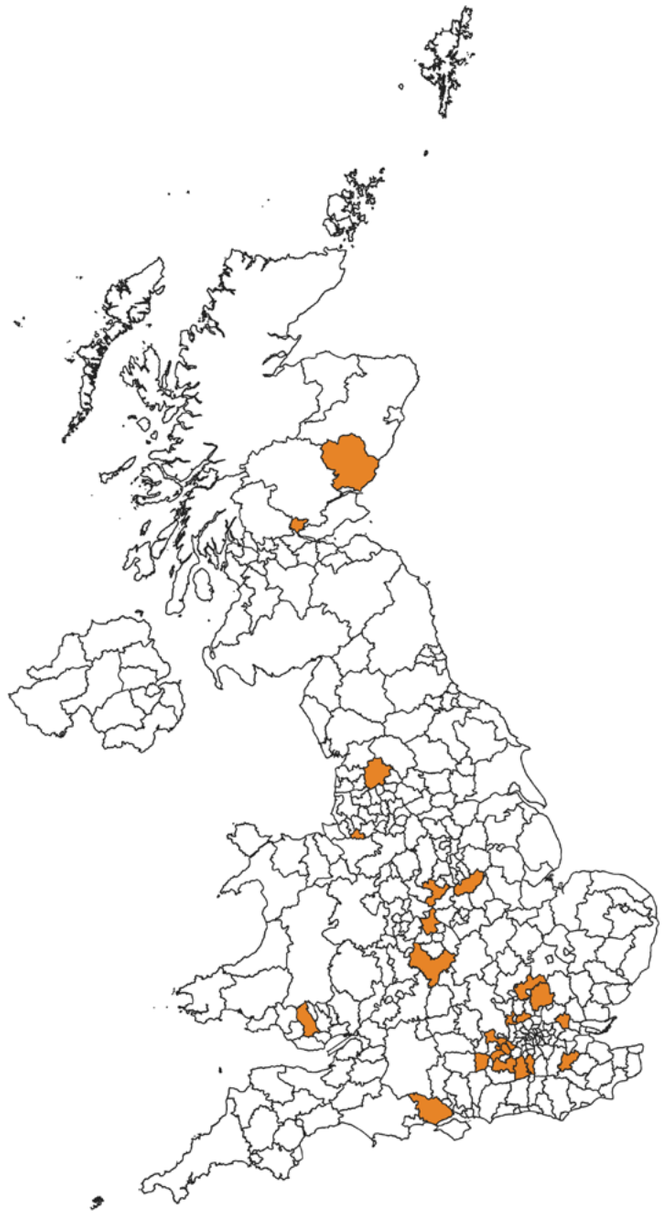
Perhaps most indicative of why businesses thrive in Flintshire is the bigger picture – its neighbours are High-Flying Innovators, High-Volume Engineering Cities, *High-Value, Hidden Gems and High-Performing, Big Business* all of which create a unique, dynamic and accessible ecosystem in this part of the UK.

ENGINEERING ECONOMY KEY INDICATORS FOR FLINTSHIRE

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

High-Value, Hidden Gems

24 local authorities



London and the South East exert a strong gravitational pull on high-value engineering, but it has potential to grow in other city-regions. By some margin, high-value engineering economies show greater concentrations of ICT and scientific and technical activities than traditional manufacturing.

High value is divided between those where engineering has a high local significance and is making a strong contribution to productivity, High-Value, Hidden Gems, and those which have high value engineering jobs which are less locally significant and show less growth, High-Value, Low-Growth.

The High-Value, Hidden Gems, are located outside of London and often in rural locations with a strong industrial heritage. These tend to be less prominent in the mainstream innovation narrative which often focuses on cities.

This category contains places like South Derbyshire, North Warwickshire and Ribble Valley, all which have strong manufacturing bases, paired with high R&D activity and well-paid jobs.

HIGH-VALUE, HIDDEN GEMS TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
16,000 Volume	**25%** Average proportion of engineering jobs in R&D	**£600** Weekly median wage
£100,000 Value	**8.47** No. of employees per engineering business	**£69,000** GVA per job
30% Local significance	**10.29** Rate of engineering business growth	**£4,000** GVA output
1.08 Industry specialisation	**13.32** Rate of GVA delivered by engineering business	**6.18** Population density

PLACE PROFILE:
SOUTH DERBYSHIRE

Spotlight on South Derbyshire			
Engineering economy:	**11,898** **Employment**	**1,055** **Businesses**	**£161,000** **GVA per engineer**

Since the development of the canal network in the 18th century, South Derbyshire has always been a centre of goods, trade and prosperity for the East Midlands, transporting textiles and foodstuffs across the country. It developed a strong hub of manufacturing during the Industrial Revolution, transitioning from textiles towards more factory-based iron, coal and steel production. At the same time, its brewing industry expanded. Burton upon Trent became known as the brewing capital of England, exporting ales across the world.

South Derbyshire has built on this heritage to create the economy it has today, boasting a strong, high-performing manufacturing and logistics -based industry. It has a close relationship with neighbouring Derby, which is a Thriving Engineering Enterprise economy. Several businesses are located here, including the world-leading Rolls-Royce aerospace division, JCB, Toyota and Alstom (incorporating Bombardier Transportation). These companies provide high-value engineering employment, as well as R&D divisions associated with complex production lines creating new engines, cars and commercial and military aircraft.

Given the number of manufacturing bases and final assembly facilities, there is a strong supporting supply chain which provides specialist services to larger businesses, alongside a growing digital and creative sector. With both multinational businesses and their associated supply chains, jobs in South Derbyshire are generally highly skilled in engineering. Businesses offer a variety of employment opportunities, notably in engineering, production and design, many of which are highly paid.

Supporting employment opportunities are several apprenticeship schemes and a range of training programmes available to workers and young people. The University of Derby works with the area's major businesses to deliver these. It is also seen as a centre for innovation, renowned for its engineering and technology, art and design, and business management specialities. With the recent announcement of almost £50 million from the Levelling Up Fund for transport improvements, there is further potential for this engineering economy to grow by building its connections.

ENGINEERING ECONOMY KEY INDICATORS FOR SOUTH DERBYSHIRE

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

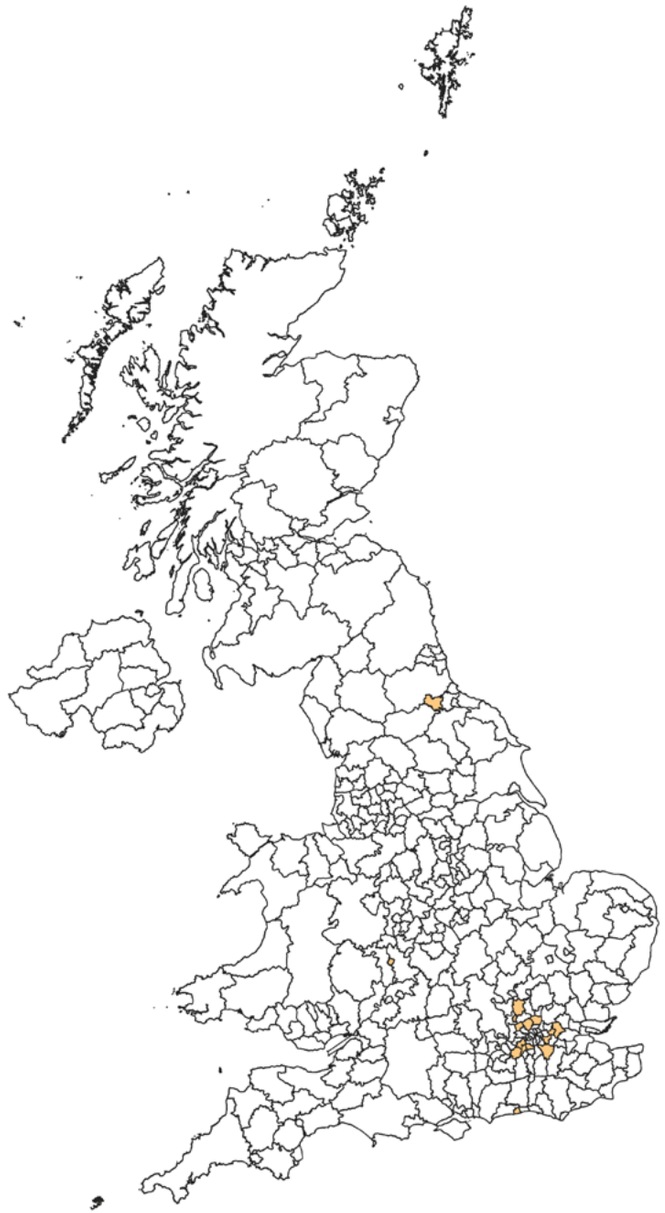
High Value, Low-Growth

17 local authorities

High-Value, Low-Growth is typified by places that have engineering jobs that are high in value but are less locally significant, and where there have not been significant levels of enterprise growth in recent years.

This perhaps suggests that these places may have 'peaked'. However, despite low growth, these places contain a significant number of R&D-related jobs in their engineering economies and still represent high-value engineering.

This group contains predominantly London boroughs, with only three (Darlington, Worcester and the Isle of Scilly) outside of the Greater South East.



HIGH-VALUE, LOW GROWTH

HIGH-VALUE, LOW GROWTH TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
15,000 Volume	**25%** Average proportion of engineering jobs in R&D	**£590** Weekly median wage
£97,000 Value	**5.17** No. of employees per engineering business	**£63,000** GVA per job
20% Local significance	**11.52** Rate of engineering business growth	**£5,000** GVA output
1.01 Industry specialisation	**6.64** Rate of GVA delivered by engineering business	**33.53** Population density

PLACE PROFILE: WORCESTER

Spotlight on Worcester

Engineering economy:	**34,600** **Employment**	**11,230** **Businesses**	**£80,000** **GVA per engineer**

Located in the heart of the West Midlands, Worcester is a small city on the banks of the River Severn and the urban centre of Worcestershire. Worcester is located on the crossroads of two main rail lines, with frequent services to Birmingham and access to further afield cities such as Bristol and Cardiff.

Worcester's economy has developed significantly over time but has long been a centre of diverse industry throughout history. It was the centre of the woollen trade in the medieval period, an economic centre for porcelain and glove making, and is famously the home of Worcestershire Sauce.Darlington and Worcester were also once home to a rich history in railway engineering (coaches and wagons).

Today, it has a strong manufacturing base, strengths in the healthcare sector with Worcestershire Royal Hospital, and a small-but-growing digital sector. This is supported by Worcester Innovation Hub, which provides office space and support services for businesses involved in technology, and the Malvern Hills Science Park, which hosts a cluster of cyber and technology-led businesses.

Worcester University's provision, previously focused on public services, is currently expanding, moving further into the health economy. While it does not offer any engineering-specific courses, it has a strong offer around computing, animation, and design.

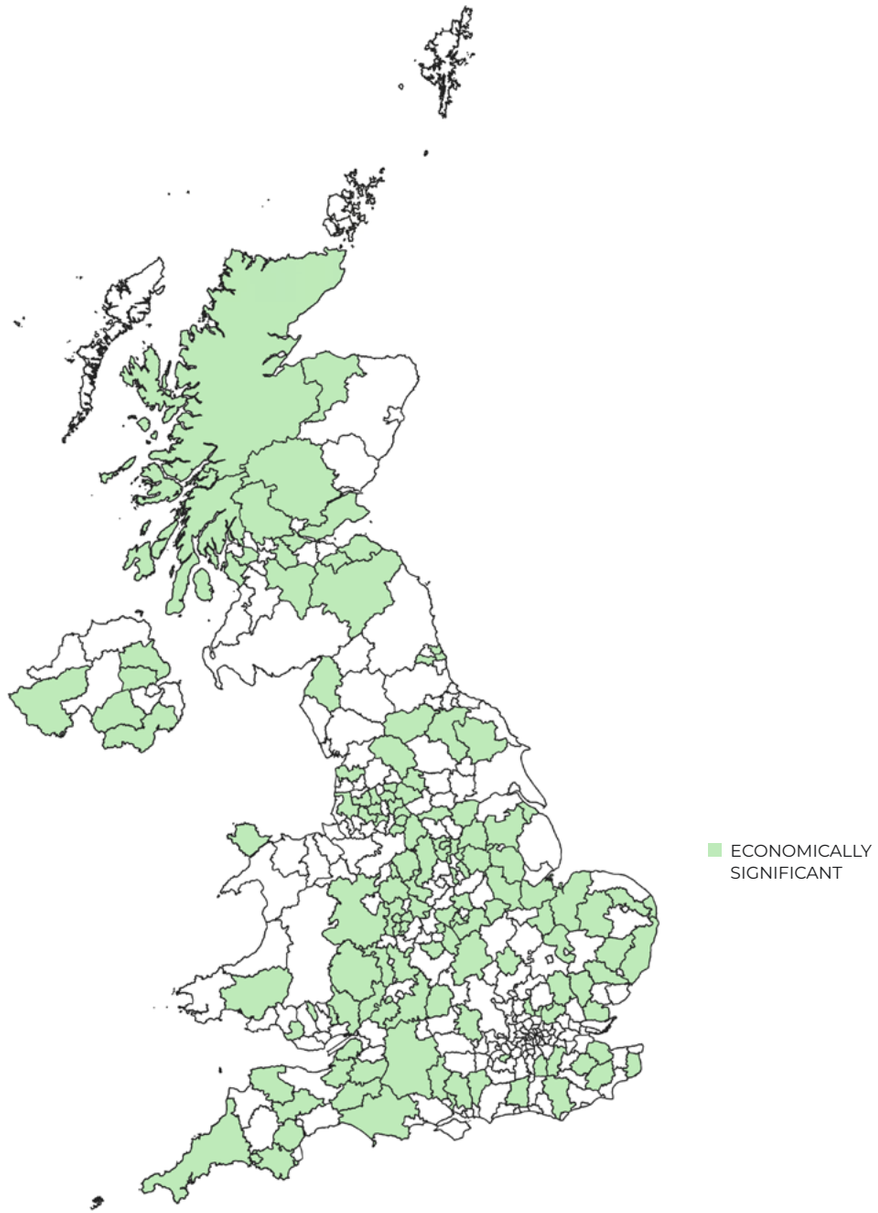
In Worcester, deprivation levels are generally lower than the rest of England, but there remain some challenges around education and skills provision and health inequalities. The City Council has taken important steps in identifying regeneration and investment opportunities to tackle these challenges. One of these is a planned new district called the Shrub Hill Quarter, which will deliver a new station, new homes, and high-quality workspaces for SMEs to deliver a more diverse and more productive economy.

ENGINEERING ECONOMY KEY INDICATORS FOR WORCESTER

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

Economically Significant Engineering

139 local authorities



Local Engines dominate across the UK and represent important providers of employment in the national engineering economy. They are the largest group nationally in terms of total engineering employment, with many more types of places included in this group. On average a Local engine has 17,500 engineering employees, while a volume heavyweight has 45,000.

Local Engines are similar to Volume Heavyweights in terms of average performance but with much lower proportions of R&D employment and lower overall value.

Economically Significant engineering underpins many economies by providing local employment in good-quality jobs. These are locally significant, meaning around a quarter of all employment is based in their engineering economy.

Manufacturing forms a core part of this employment and while activity may not be nationally significant, engineering here is very important to local and regional economies.

HIGH-VALUE, LOW GROWTH TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
18,000 Volume	**20%** Average proportion of engineering jobs in R&D	**£530** Weekly median wage
£63,000 Value	**9.04** No. of employees per engineering business	**£49,000** GVA per job
29% Local significance	**11.31** Rate of engineering business growth	**£3,000** GVA output
1.02 Industry specialisation	**10.61** Rate of GVA delivered by engineering business	**6.88** Population density

PLACE PROFILE: SOMERSET

Spotlight on Somerset

Engineering economy:	**23,500** **Employment**	**2,182** **Businesses**	**£64,500** **GVA per engineer**

A predominantly rural county in the South West, four of Somerset's six local authorities are classed as Economically Significant Engineering. Somerset's rural landscape has helped the county position itself as a centre for agriculture and textiles, particularly in the Somerset Levels, which have benefitted from their rich supply of natural resources. The area has a few primary employment centres, including Taunton, Bridgwater, Bath and Yeovil, which arose as leading ports and major manufacturers of bricks, ceramics, mining, and textiles during the Industrial Revolution.

Today, the county has more refined manufacturing capabilities, notably aerospace and defence equipment and technology. Advanced engineering and manufacturing are key employment providers in Somerset. The county is home to large businesses like Leonardo and GKN Aerospace (aerospace technology and aircrafts), Renishaw (coordinate-measuring machines and machine tool products), AgustaWestland (helicopter manufacturing), and Thales Optics (defence optronics). Agriculture and food and drink production remain as key industries in Somerset, as the area is a major producer of cider, juices, and dairy products, including Thatchers Cider and Yeo Valley Organic.

Somerset boasts a wealth of natural capital, and has good road and rail links to Bristol, the rest of the South West, further afield to Wales, and London. Its proximity to the West of England allows Somerset to align with more concentrated aerospace and advanced engineering innovation in Bristol. However, the county suffers from pockets of relatively high levels of deprivation, particularly around its urban centres, and does not have the same level of infrastructure, investment or talent to compete or replicate innovation seen in nearby cities.

The county does have a range of education and innovation facilities to support its local businesses. Somerset is home to University Centre Somerset, which works in collaboration with major universities to develop skills; several innovation networks, including the Yeovil Innovation Centre and the Somerset Innovation Network; and a planned Taunton Digital Innovation Centre which aims to be the centre of digital innovation in the South West.

Engineering in Somerset is vitally important for the county's people, businesses and communities. It creates important employment provision and provides a gateway to wider regions and opportunities. With several major businesses and assets, there is potential to deliver higher value jobs and develop a more innovative environment for businesses to grow in the future.

ENGINEERING ECONOMY KEY INDICATORS FOR SOMERSET

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

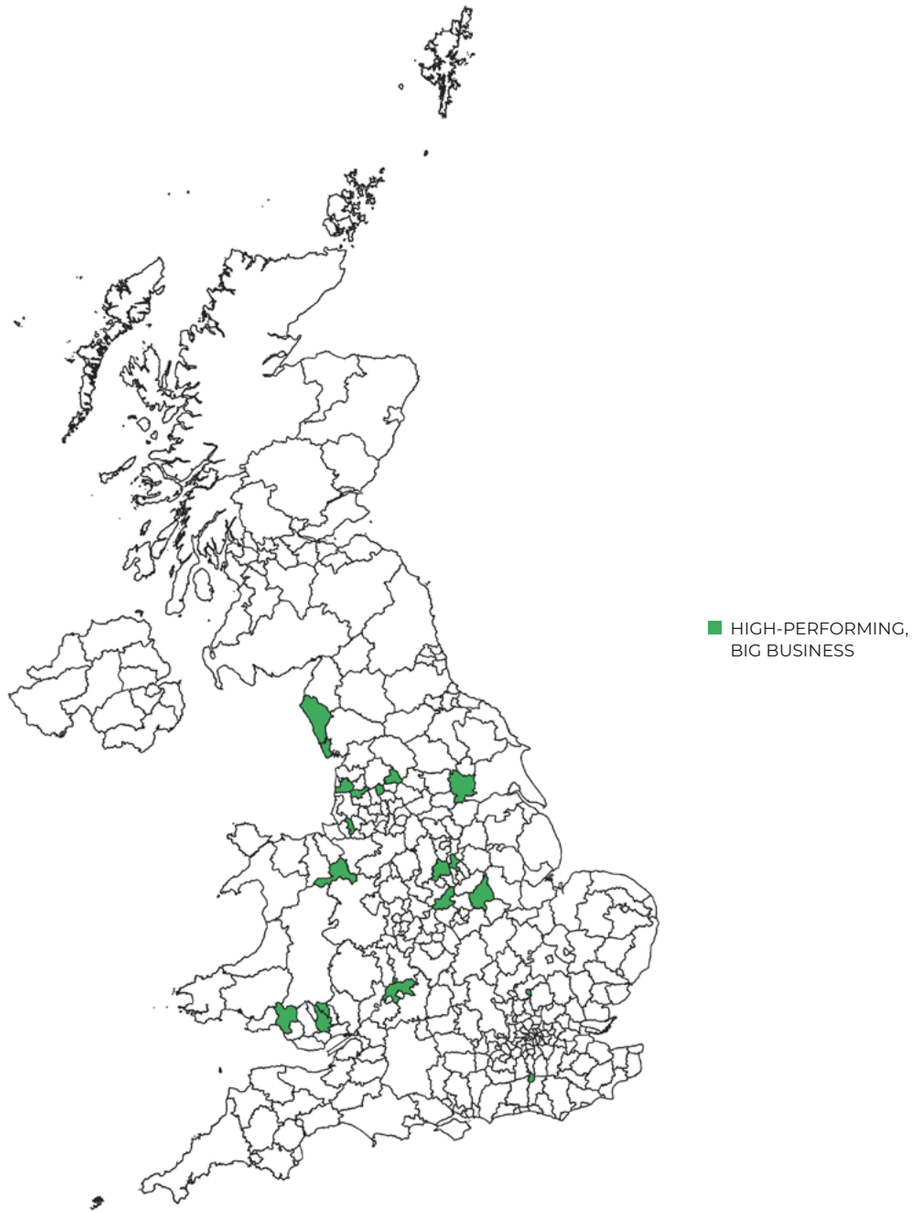
High-Performing, Big Business

19 local authorities

High-Performing, Big Business are places where engineering dominates a large proportion of overall employment, which is provided by a smaller number of bigger businesses.

These businesses are based in much more rural or town-based economies, where there is more space available for companies with typically larger operations. Therefore, while the volume of engineering economy employment is lower, it represents a significant proportion of total employment in the local economy.

The North West dominates this group, with a large manufacturing presence in Fylde, Pendle and South Ribble, but other examples are seen across South Wales and the East Midlands.



HIGH-PERFORMING, BIG BUSINESS TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
17,000 Volume	**21%** Average proportion of engineering jobs in R&D	**£580** Weekly median wage
£66,000 Value	**15.61** No. of employees per engineering business	**£53,000** GVA per job
37% Local significance	**10.43** Rate of engineering business growth	**£3,000** GVA output
1.06 Industry specialisation	**15.42** Rate of GVA delivered by engineering business	**8.28** Population density

PLACE PROFILE:
SOUTH RIBBLE

Spotlight on South Ribble			
Engineering economy:	**24,000** **Employment**	**1,100** **Businesses**	**£75,000** **GVA per engineer**

South Ribble has been shaped by its geography and its industrial past. In Lancashire, a focal point of the industrial revolution and textiles industry, South Ribble had several large cotton mills, which employed thousands of people. Over time, this has transitioned into a much more advanced manufacturing, construction, and logistics economy, with growing digital capabilities, and one of the highest-performing parts of the Lancashire economy.

South Ribble is home to several major employers, which provide crucial employment for the local and regional economy – Leyland Trucks, Conlon Construction, and logistics companies DHL and TNT. However, one of the largest employers is BAE Systems, situated at the Salmesbury Aerospace Enterprise Zone. This is one of BAE's largest UK sites, providing thousands of jobs in high-value manufacturing and engineering roles. It is also home to the BAE Academy for Skills and Knowledge, which trains employees in using modern design and engineering techniques.

Lancashire is well-recognised as being a focal point for BAE Systems in the UK and the value it brings is reflected across its economies. South Ribble has higher productivity levels than many other local authorities in the country, higher wages, and generally lower levels of unemployment.

This advanced manufacturing presence has seen strong innovation and skills infrastructure develop throughout Lancashire. Rolls-Royce has its own centre of excellence, while the Advanced Manufacturing Research Centre North West is a gateway development at Samlesbury. The latter will bring greater technical R&D to manufacturing businesses across Lancashire, from technology provision to SMEs in the supply chain to productivity gains for larger businesses.

Furthermore, the University of Central Lancashire generates a significant number of graduates for these local businesses and operates a large apprenticeship programme to help service Lancashire's manufacturing firms. In addition, it has a high quality Engineering Innovation Centre, which is a major asset in providing flagship research and innovation facilities alongside delivering several successful SME support programmes.

South Ribble is a strong example of how the presence of High-Performing, Big Business can deliver immense economic benefits and how it can also act as an anchor institution, helping to build the supporting infrastructure required for an engineering ecosystem.

ENGINEERING ECONOMY KEY INDICATORS FOR SOUTH RIBBLE

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

Underperforming Specialists

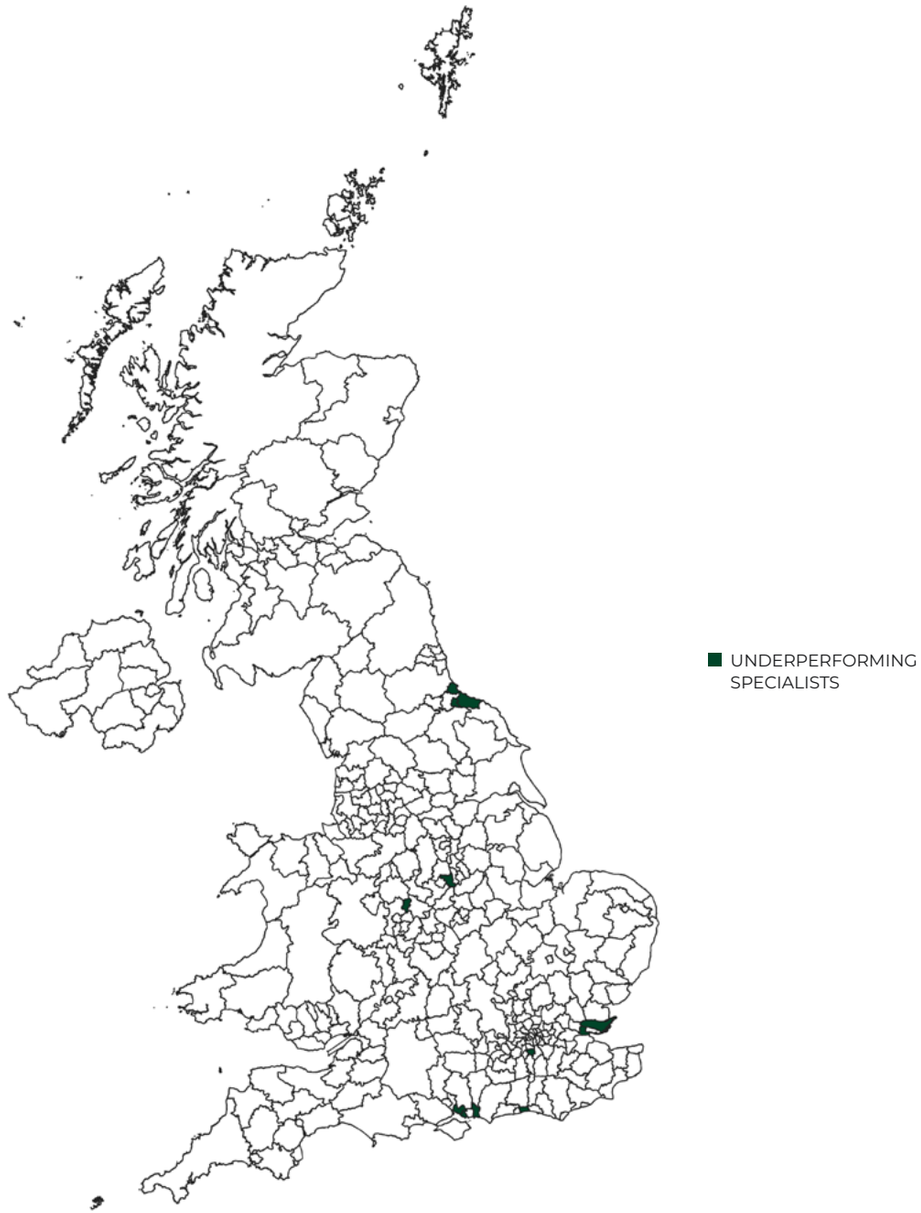
12 local authorities

Local Engines contains some places where engineering is very specialised, but where that specialism has not necessarily transferred into economic benefit.

These Industry Specialists are in industrial coastal towns with higher levels of deprivation, such as Hartlepool, Gosport and Havant.

The concentration of engineering expertise suggests that there are strengths to capitalise on, but wider place performance indicates there are economic and societal challenges impacting the enterprise environment.

Recognising that targeted support may be required, opportunities could be created to further realise the full potential of the industrial strength and specialisms presented by these places.



UNDERPERFORMING SPECIALISTS TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
10,000 Volume	**21%** Average proportion of engineering jobs in R&D	**£550** Weekly median wage
£61,000 Value	**6.66** No. of employees per engineering business	**£47,000** GVA per job
28% Local significance	**10.19** Rate of engineering business growth	**£2,000** GVA output
1.31 Industry specialisation	**8.79** Rate of GVA delivered by engineering business	**17.12** Population density

PLACE PROFILE:
TEES VALLEY COAST

Spotlight on Tees Valley Coast			
Engineering economy:	**9,915** **Employment**	**1,005** **Businesses**	**£58,000** **GVA per engineer**

The Tees Valley Coast is a polycentric, urban and industrialised region in the North East of England, with Hartlepool, and Redcar and Cleveland, connecting to Stockton and Middlesbrough. Traditionally, this area has been home to heavy and energy-intensive industries, such as mining, steelmaking, ship manufacturing and chemicals processing. Many of these were based on the local presence of iron ore deposits that fuelled rapid economic growth in the Victorian era.

Many manufacturing jobs associated with the steel industry were lost from the mid-1970s onwards, with a corresponding growth in the service economy. In the present day, several specialisms still remain, most prominently in chemicals processing and energy. The latter is home to 1,200 businesses producing 30% of the UKs chemical output, although this is primarily associated with the Tees Valley specifically.

Large employers still play a major, although gradually diminishing, role in the local economy. The area's economy is closely linked with that of the wider Tees Valley area, with limited commuting links outside of the region. Levels of deprivation are relatively high, skill levels are lower than the UK average, and the region has the relatively high levels of unemployment and economic inactivity often seen in areas hit by de-industrialisation, although these have declined within the last decade. Despite high levels of specialised industry and concentrations of engineering businesses, these areas have been unable to bring wider societal or economic benefits to the region.

Teesside University, based in Middlesbrough, has a technology focus and hosts several engineering-adjacent research institutes, with a satellite campus for Durham University also nearby. The region attracts relatively high funding from Innovate UK and hosts the Centre for Process Innovation Catapult. It also benefits from strong connectivity, including road and rail links and a deep-water port in the Port of Tees, which is the UK's largest for exports. However, major anchor employers have recently been lost, including the Redcar Steelworks in 2015.

The Tees Valley Coast is also home to Teesworks Freeport, which will occupy the 4,500 acres of land previously taken up by the Redcar steelworks, and generate up to 20,000 jobs. Teesworks will focus on carbon capture, manufacturing and logistics uses. The broader Tees Valley has also benefited from relatively high levels of UK government investment, including the £310 million City-Region Transport Settlement and the Treasury campus at Darlington, suggesting there is a growing capability to maximise industry potential and stimulate greater growth across the Tees Valley Coast.

ENGINEERING ECONOMY KEY INDICATORS FOR TEES VALLEY COAST

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

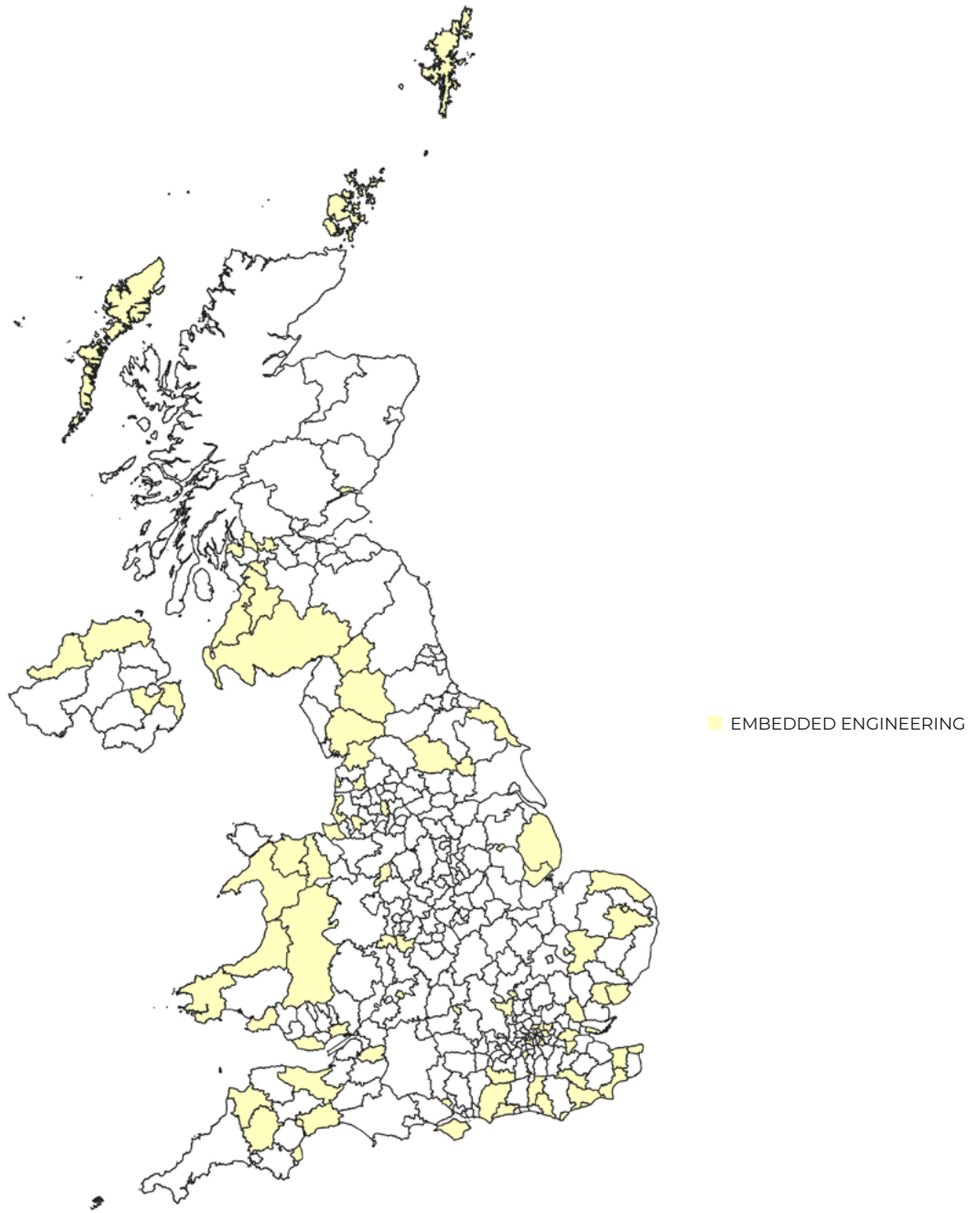
Embedded Engineering

86 local authorities

Embedded Engineering places are those where engineering is least distinctive in the local economic mix.

Many of these economies are rural in nature, however engineering does still play an important supporting role in these places in terms of employment, particularly Wales, East Anglia, Devon and the west coast of Scotland.

Whilst predominantly construction and manufacturing-related engineering, these places do show a slightly higher rate of activity in ICT-related engineering than Local Engines and there are examples of many places which display promising signs of innovative activity.



EMBEDDED ENGINEERING TYPOLOGY DATA INDICATORS:

ENGINEERING	ENTERPRISE	PLACE
13,000 Volume	**22%** Average proportion of engineering jobs in R&D	**£530** Weekly median wage
£62,000 Value	**7.60** No. of employees per engineering business	**£47,000** GVA per job
22% Local significance	**11.46** Rate of engineering business growth	**£3,000** GVA output
0.92 Industry specialisation	**6.11** Rate of GVA delivered by engineering business	**14.15** Population density

PLACE PROFILE: DUNDEE CITY

Spotlight on Dundee City

Engineering economy:	**14,677** **Employment**	**815** **Businesses**	**£60,000** **GVA per engineer**

Dundee City is Scotland's fourth largest city, located on its east coast. The city has gone through several phases of evolution throughout its history, facing some real economic turbulence. In the 19th century, Dundee was known as "Juteopolis" as the Dundee Mills were central to the global manufacturing and distribution of jute fibres, used for making ropes, sacks, and other textiles.

By the 20th century, the jute industry, which employed tens of thousands of people and was a major driver of the economy, had moved to India and many factories were forced to close. This caused a period of severe economic downturn for the city, leading to high levels of unemployment and poverty.

It wasn't until the 1970s that Dundee began to bounce back through a new electronics industry. This began with the National Cash Register (NCR) establishing a manufacturing plant to produce mechanical cash registers and other electronic products. This led to companies like Timex (digital watches and consumer electronics) and Sun Microsystems (computers and components) locating to Dundee and a new industry beginning to prosper.

This laid the foundation for the Dundee of today, transforming its traditional industries into a growing software, electronics and digital media industry. NCR, now known as Teradata, continues to operate, while new businesses are spinning out from the city's universities and businesses. Dundee is now recognised as a UK hub for video game development, with major companies like Rockstar North, 4J Studios and Outplay Entertainment all located in the city.

Through the University of Dundee specialisms in medicine, science, and engineering, alongside the Medical Research Council, the city has diversified further by growing its life sciences sector. Companies like Tayview Medical, Axis-Shield and XenoGesis have established operations, leveraging academic expertise to drive innovation and growth. Meanwhile Abertay University was the UK's first university to be recognised as a Centre for Excellence in Computer Games Education, and ranked as Europe's top university for games courses by the Princeton Review, 2021.

In recent years, the city has attracted funding from both public and private sources, most notably the £700 million Tays Cities Deal, funding regeneration of the city's waterfront, a new innovation hub and job creation.

Despite this significant progress and growth, there are still longstanding economic challenges around poverty, inequality and high unemployment. However, Dundee's economic diversification, blending traditional industry with modern, continues to transform the city into a vibrant and creative economy with great potential.

ENGINEERING ECONOMY KEY INDICATORS FOR DUNDEE CITY

Engineering Economy Indicators	Local significance	Volume	Value	Industry specialisation	R&D

"These local snapshots set the scene for a 'next step', where the focus will shift to deeper exploration of what's going on behind the data. By understanding both the historical and current dynamic of local engineering economies, in partnership with place leaders, we can work together to chart a path towards future growth and prosperity."

05

Chapter 05

Conclusion

This report and its supporting data remove a barrier to describing the local and national role of engineering. Engineering is central to economies and places of all shapes and sizes. It takes a different role and exhibits different features in each, whether it is the number of engineers, the level of innovation activity, diverse sectoral activity or the vibrancy of the enterprise ecosystem. The UK's engineering economy matters.

Key insights

- **London and the Greater South East of England exert a strong gravitational pull on high-value engineering.**

Except for Cheshire, all High-Flying Innovators (those with a combination of high avalue, high R&D, high GVA and strong engineering business growth) are either in, or in the pull of, London. There are also some significant specialisations in the South East and East, where more than half of the High-Value, Hidden Gems are located.

- **High proportions of engineering R&D employment tends to also be in places where engineering is high in value *and* volume, but are comparatively less significant to overall employment provision.**

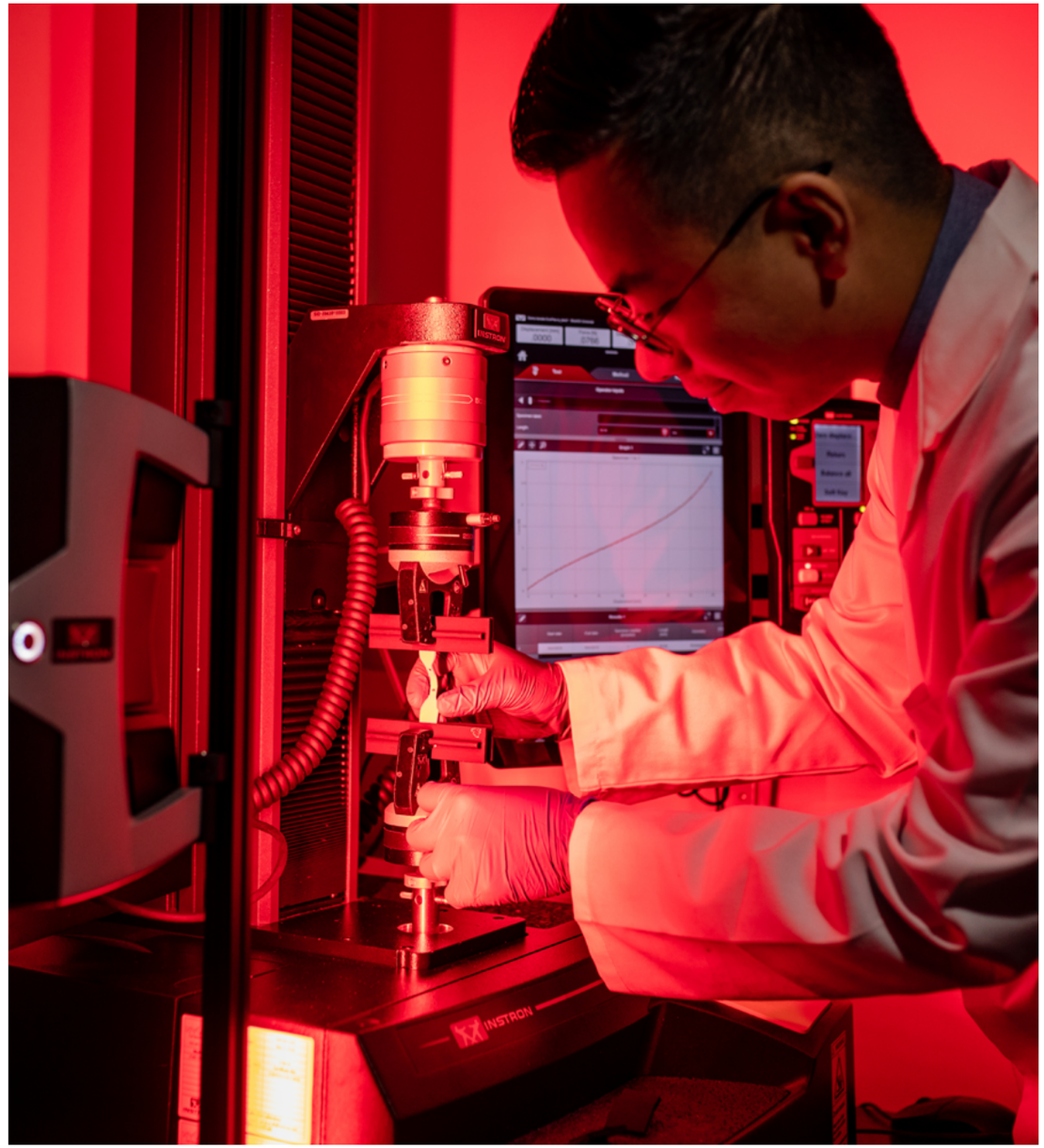
R&D employment is more likely to be present in high-density city locations locations like Cambridge, Edinburgh, Belfast, Manchester, or Bristol, where engineering is no more specialised than other places, but the related R&D activity (pertaining to any sector) is.

- **City regions provide strong functional economies for engineering and enterprise.**

All of the UK's major cities – Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Nottingham, Sheffield – are High-Volume Engineering Cities. These combine R&D in city centres with high-performing enterprise located in peripheral places with proximity to urban centres but with the physical space to accommodate larger businesses. Opportunities to leverage capacity across wider city-regions exist where there is a combination of city centre-based R&D activity and 'near city' industrial specialisation, but currently lower value per engineering outputs. This R&D capacity and specialist industry can reach further into the wider region.

- **More sparsely populated areas are less likely to have high proportions of R&D employment.**

For example East Anglia, Cumbria, Devon



and Cornwall, and the Welsh Marches, all of which are distinctly distant from a high-value engineering centre. Except for a few places on the edge of city regions, it is rare for rural places to high-value R&D or high-value engineering.

- **Around a third of all engineering employment is in places where engineering makes up a large proportion of the workforce, but on average, far fewer are in R&D-based roles.**

Engineering is important in different ways in these Local Engines. At the top end of the scale are places with small or medium-sized businesses, mainly in affluent urban or semi-rural locations with relatively high wages, which are on an upward trend and where engineering demonstrates a degree of specialisation (for example in Stirling, Surrey and Warwickshire). At the bottom end are places which are still urban or semi-rural, but with far fewer R&D jobs, lower volumes overall, less engineering specialisation and across the whole local economy, wages are low and declining (for example Redcar and Cleveland, Somerset and the Fens).

- **By some margin, high-value engineering economies show much greater concentrations of ICT and scientific and technical activities than traditional manufacturing.**

There are interesting concentrations of manufacturing and quarrying in more sparsely populated Thriving Engineering Enterprise places, where high volumes of workers mean engineering is locally significant. However, this tends to be heavily practice-based and likely to be deeply rooted in heritage industries. The opposing balance of high:low value and digital:manufacturing highlights the importance of driving digital transformation and technology adoption across engineering. Through a combination of progressive modernisation, pursuit of efficiency improvements and drive to goals such as net zero, change is inevitable, bringing significant disruption to the workforces in the manufacturing heavy Local Engines areas. Managed well, business transformation to invest in equipment *and* skills development *should* mean new knowledge economy jobs (at low risk to automation) replace old, but business owners and leaders (both of established businesses and those at the start of their enterprise journeys) need focused support to achieve this.

- **For many places, their engineering economy will not have unique concentrations of businesses or a high number of jobs in R&D, but the engineering that is present provides a sufficient number of jobs for it to be an important consideration locally**.

In a number of these places (like Oxford, Cheltenham, Epsom and Bath – all Embedded Engineering) a high proportion of the engineering that is present is in R&D, indicating that it is the R&D that is specialised, rather than the engineering industry.

- **A small number of places have nationally significant engineering specialisms but are struggling to translate these into high value outputs.**

The concentration of industry in these places (like Hartlepool, Redcar and Gosport – all Industrial Specialists) suggests that it should be a strength to capitalise on locally, but the wider economic performance indicates challenges in the wider enterprise environment. These places are likely to need support to realise greater potential of their industrial strengths. Doing this will be important for both local and national prosperity.

- **Connectivity to enterprise and R&D infrastructure will be important.**

Opportunities to leverage R&D capacity across wider city-regions and support the engineering economy in places outside of the pull of a city will require the challenges associated with connecting innovation to be addressed. These include both tangible challenges (such as transport and digital infrastructure) and the intangible (such as policy, culture and heritage.)

The Royal Academy of Engineering's perspective

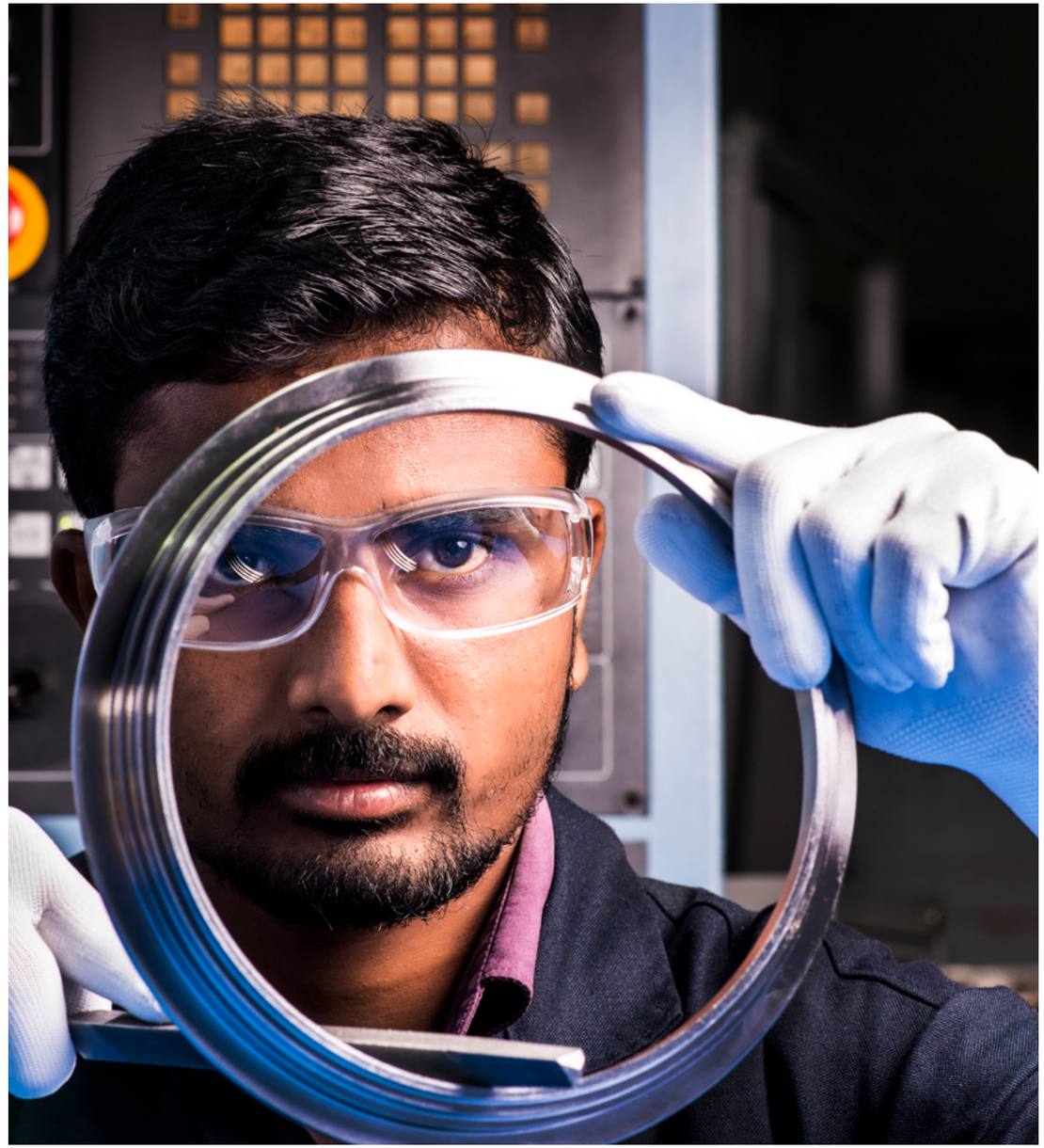
Having a better understanding of the role of engineering across the UK will enable us to explore how places can best leverage engineering to improve prosperity and advance the UK's technology and growth ambitions.

The expansion of our already geographically diverse Enterprise Hub network is an early example of our focus on creating the climate and appetite for enhanced engineering-led growth and opportunity in communities across the country, retaining talent and increasing the number of engineering startups in those areas. As a national academy we can work across borders and boundaries to help strengthen existing or potential engineering and technology hotspots.

This will require partnership and strategic collaboration at local level. By engaging our Fellows, local industry leaders, entrepreneurs, innovators and policymakers, we can work together through the Academy's unique lens of the engineering economy to secure a deeper understanding of engineering and technology capabilities to unlock opportunities in the North, South, East and West.

Demonstrating leadership and building on our existing regional commitment, we will endeavour to work with central government, the devolved administrations and regional leaders across the UK to shape the support we can provide or leverage, as through our Enterprise Hub, partnerships, policy, and support for research and innovation, we strive to **"harness the power of engineering to deliver a sustainable society and inclusive economy that works for everyone".**

We invite you to join us on what promises to be an exciting and rewarding journey, for all.



"It is our sincere wish that place leaders everywhere join us in celebrating the quite remarkable role that the engineering economy plays across the whole of the UK, as we continue to work together to build a sustainable society and inclusive economy that works for everyone."

Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

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Published by Royal Academy of Engineering, 2023

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