April 2026

UK Fermentation & Downstream Processing Capacity

Current Capability, Scale-Up Gaps and Investment Needs for Engineering Biology in Non-Human Health Applications

BBIA
CHAMPIONING THE INDUSTRIAL BIOECONOMY

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FOREWORD

The UK Modern Industrial Strategy sets out a vision for the UK to become one of the world's top three hubs for technology-driven innovation by 2035, including the ambition to create the UK's first trillion dollar tech company.

At the heart of this vision is Engineering Biology - a sector focused on designing and manufacturing fuels, chemicals, materials, food, and more, using biological systems. The global bioeconomy is expected to be worth over £30 trillion by 2050, and the UK Government has committed £2 billion over the next decade to support its development.

The UK stands at a pivotal moment in the development of its engineering biology sector. Advances across disciplines are unlocking new possibilities in sustainable chemicals, materials, food production, agriculture, and environmental solutions. Yet, despite this progress, a persistent narrative continues to dominate: that limited access to appropriate scale-up infrastructure is the primary bottleneck preventing bio-based innovations from reaching the market in the UK. This report seeks to examine that assumption more closely.

Drawing on industry insights and survey data, our report *'UK Fermentation & Downstream Processing Capacity: Current Capability, Scale-Up Gaps and Investment Needs for Engineering Biology in Non-Human Health Applications'* explores the reality behind the perceived scale-up challenge. While constraints in fermentation and downstream processing capacity are frequently cited, the full picture is more nuanced. Barriers to commercialisation often extend beyond infrastructure alone, encompassing investment dynamics, coordination across sectors, and the integration of capabilities spanning research through to industrial deployment.

Engineering biology has the potential to transform the UK's industrial landscape, but realising this potential will depend on more than simply expanding facilities. It will require a coherent, system-wide approach - one that connects academia, industry, and policy, and ensures that innovations can move efficiently from laboratory to large-scale production.

This report provides an overview of the UK's current bioprocessing capabilities, identifies critical gaps in scale-up pathways, and highlights priority areas for investment and collaboration. In doing so, it aims to support informed decision-making and contribute to the development of a more robust, competitive, and scalable UK bioeconomy.

Ultimately, the question is not only whether the UK can scale, but whether it can do so in a way that is coordinated, sustainable, and globally competitive.

Dr Jen Vanderhoven
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CONTENTS

01 EXECUTIVE SUMMARY

02 INTRODUCTION

03 FERMENTATION & DSP LANDSCAPE

03.01 FERMENTATION CAPACITY

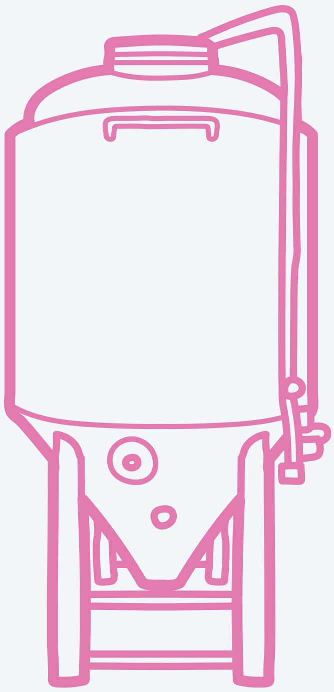
03.02 DOWNSTREAM PROCESSING LANDCSAPE

03.03 FACILITY ACCESS MODELS

03.04 UTILISATION OF FACILITIES AND LEAD TIMES

04 KEY CHALLENGES

05 CLOSING THE GAP



01

EXECUTIVE SUMMARY

01 EXECUTIVE SUMMARY

The UK has a strong foundation in engineering biology, with world-class research, vibrant SME base, and growing momentum behind the bioeconomy. However, this report finds that the primary barrier to commercialisation is not total fermentation capacity, but a lack of accessible, integrated, and appropriately scaled infrastructure to support companies as they grow.

The UK currently has approximately 29.5 million litres of fermentation capacity, yet over 99% is concentrated in just a handful of large commercial sites - while the majority of organisations operate at laboratory scale. This imbalance highlights a structural weakness: strong early-stage innovation, but insufficient pathways to scale.

A critical 'missing middle' exists between lab and commercial production, particularly in the 10 to 10,000 litre range, extending up to pre-commercial scales. Limited access to pilot and demonstration facilities, combined with long lead times for larger fermenters, creates delays that directly impact investment, regulatory timelines, and competitiveness. As a result, many companies are forced to scale overseas, leading to a loss of economic value for the UK.

The challenge is compounded by downstream processing constraints, which are often more acute than fermentation itself. Limited access to scalable purification and separation technologies restricts the ability to produce commercially viable products and increases technical and financial risk.

Crucially, this is not simply an infrastructure gap - it is a system-level challenge. The UK lacks a coordinated, end-to-end bioprocessing ecosystem that connects research, scale-up, and manufacturing. Existing capacity is often fragmented, difficult to access, or unsuitable for specific technical needs, with most facilities operating under restricted access models.

Despite these challenges, there is a significant opportunity. Targeted investment in integrated, flexible, and accessible mid-to-large-scale infrastructure, particularly at demonstration scale, could unlock faster commercialisation, attract inward investment, and position the UK as a global leader in engineering biology.

To realise this opportunity, the report identifies five priority actions:

1. Expand demonstration-scale (1,000–10,000 L) infrastructure
2. Enable access to large-scale commercial capacity (50,000–100,000+ L)
3. Strengthen downstream processing capabilities
4. Improve coordination, transparency, and access to facilities
5. Develop targeted funding mechanisms to bridge the scale-up gap

Without intervention, the UK risks exporting its innovations and missing out on the economic, environmental, and strategic benefits of the bioeconomy. With the right action, it can instead build a globally competitive, resilient, and scalable biomanufacturing ecosystem.

KEY STATISTICS

Total UK capacity

29.5 million litres of fermentation capacity in UK

Highly concentrated infrastructure

99% of capacity is located in just 6 commercial sites

Innovation heavy ecosystem

77% of organisations are SMEs or academia

DSP bottleneck

66% of demonstration scale DSP facilities are fully occupied

Limited immediate availability

Majority of capacity requires 6 month lead time

DOES THE UK HAVE SUFFICIENT FERMENTATION INFRASTRUCTURE?

Is total fermentation capacity enough to meet growing biotech demand?	NO
Are large-scale fermenters readily accessible when needed?	NO
Can processes scale from lab to commercial without delays?	NO
Can SMEs reliably access the right fermenter at the right time?	NO
Do lead times meet investor and regulatory timelines?	NO
Does current infrastructure prevent companies from moving operations abroad?	NO
Are capacities coordinated to reduce bottlenecks?	NO
Does the current system maximise the economic value of UK engineering biology innovation?	NO
Could targeted mid- and large-scale infrastructure strengthen UK competitiveness and attract inward investment?	YES

02
INTRODUCTION

CHAMPIONING THE INDUSTRIAL BIOECONOMY

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INTRODUCTION

As the UK transitions from fossil-based production and advances its engineering biology ambitions, it has never been more important to build a clear, shared understanding of the UKs current fermentation and downstream processing capacity - an effort that has proven challenging in the past.

The UK has a growing and diverse fermentation and biomanufacturing sector serving non-human health applications, chemicals, materials, food and feed, agriculture, materials, chemicals, and other bio-based products. Understanding the current availability, scale, and accessibility of fermentation and downstream processing (DSP) infrastructure is critical to supporting innovation, investment, and scale-up across this ecosystem.

This report from the Bio-based and Biodegradable Industries Association (BBIA), the Biorenewables Development Centre (BDC) and Pioneer Group, draws on industry insights and survey data, on existing fermentation and DSP capabilities within the UK for non-human health uses, including capacity, technical specifications, utilisation, and access models.

We hope these insights will serve as a foundation for strategic decision-making, enabling stakeholders across industry, academia, and government to identify prioritise investments, and accelerate the UK's transition to a thriving, bio-based economy. By providing a clear picture of current capabilities, this survey aims to unlock opportunities for innovation, collaboration, and scale-up, ensuring the UK can fully realise its engineering biology ambitions.

Acknowledgements
We would like to thank all individuals and organisations who took the time to participate in this report on fermentation capacity in the UK. Your contributions have been invaluable in helping us build a clearer understanding of the current landscape.

Also, thanks to Chris Hiscocks and Darren Phillips at the Biorenewables Development Centre for their support in analysing and handling the survey data.

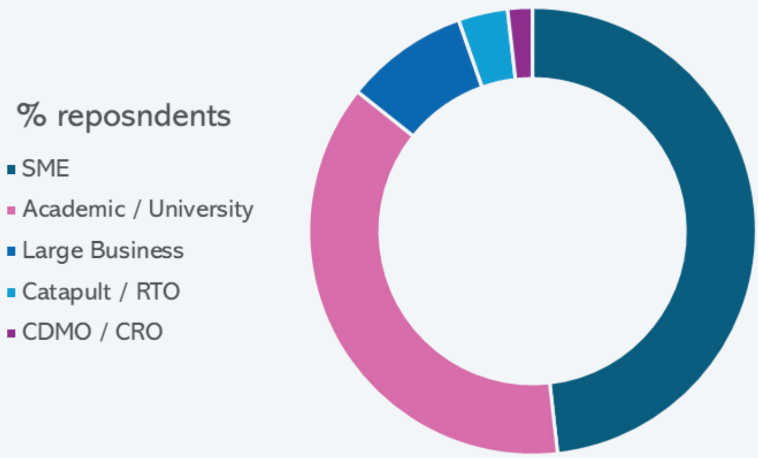
We recognise that there may be stakeholders who were unable to respond, as well as others whom we were not able to reach or capture within the scope of this survey. As a result, this report may not fully reflect all activity or perspectives across the sector. We also acknowledge that some information given potentially represented a snap-shot in time.

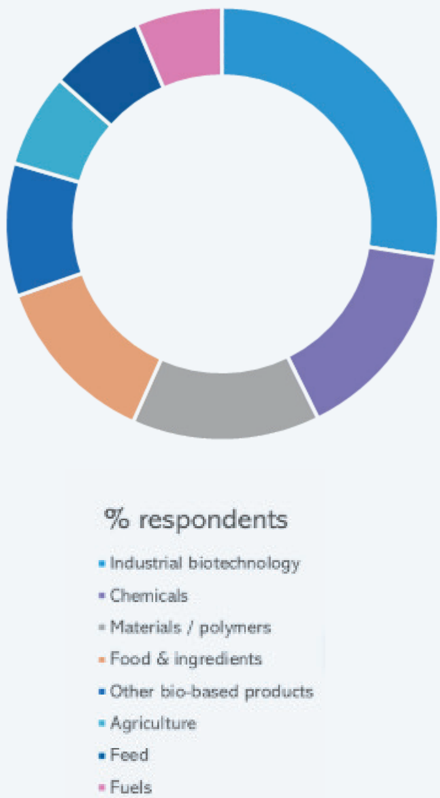
If you feel your organisation or insights have been missed, we warmly encourage you to get in touch so that we can continue to improve the accuracy and completeness of this work, in our next edition.

SURVEY RESPONDENT PROFILE

The respondent profile reveals a system driven primarily by innovation-stage organisations. Of the respondents who identified their organisation type, approximately 48% were SMEs and 38% were academic or university institutions. Large businesses accounted for roughly 9%, while Catapults, Research and Technology Organisations (RTOs), and CDMOs/CROs comprised a small minority.

This composition reflects the UK's structural strengths: a strong research base and a thriving early-stage engineering biology sector. This distribution itself is indicative of where pressure points are likely to emerge, namely at the transition from innovation-led research environments into industrial-scale production settings.





Industrial biotechnology represents the largest share of respondents, accounting for approximately 27.5% of the total. This indicates that the survey sample is strongly oriented toward industrial biotechnology activities.

The next most represented sectors are chemicals (15.2%), materials and polymers (14.0%), and food and ingredients (12.9%), which together make up a significant proportion of respondents and reflect strong participation from industries involved in chemical production, advanced materials, and food-related biotechnology applications.

A smaller but still notable share of respondents work in other bio-based products (9.9%), suggesting a diverse range of additional bio-based applications beyond the main sectors. The least represented sectors are agriculture (7.0%), feed (7.0%), and fuels (6.4%).

Overall, the results show that respondents are primarily concentrated in industrial biotechnology and related chemical and materials sectors, while agriculture, feed, and biofuels are comparatively less represented in the sample.

It is important to note, however, that reposndents could select more than one sector in thier answer, which may have skewed data.

SURVEY RESPONDENT PROFILE

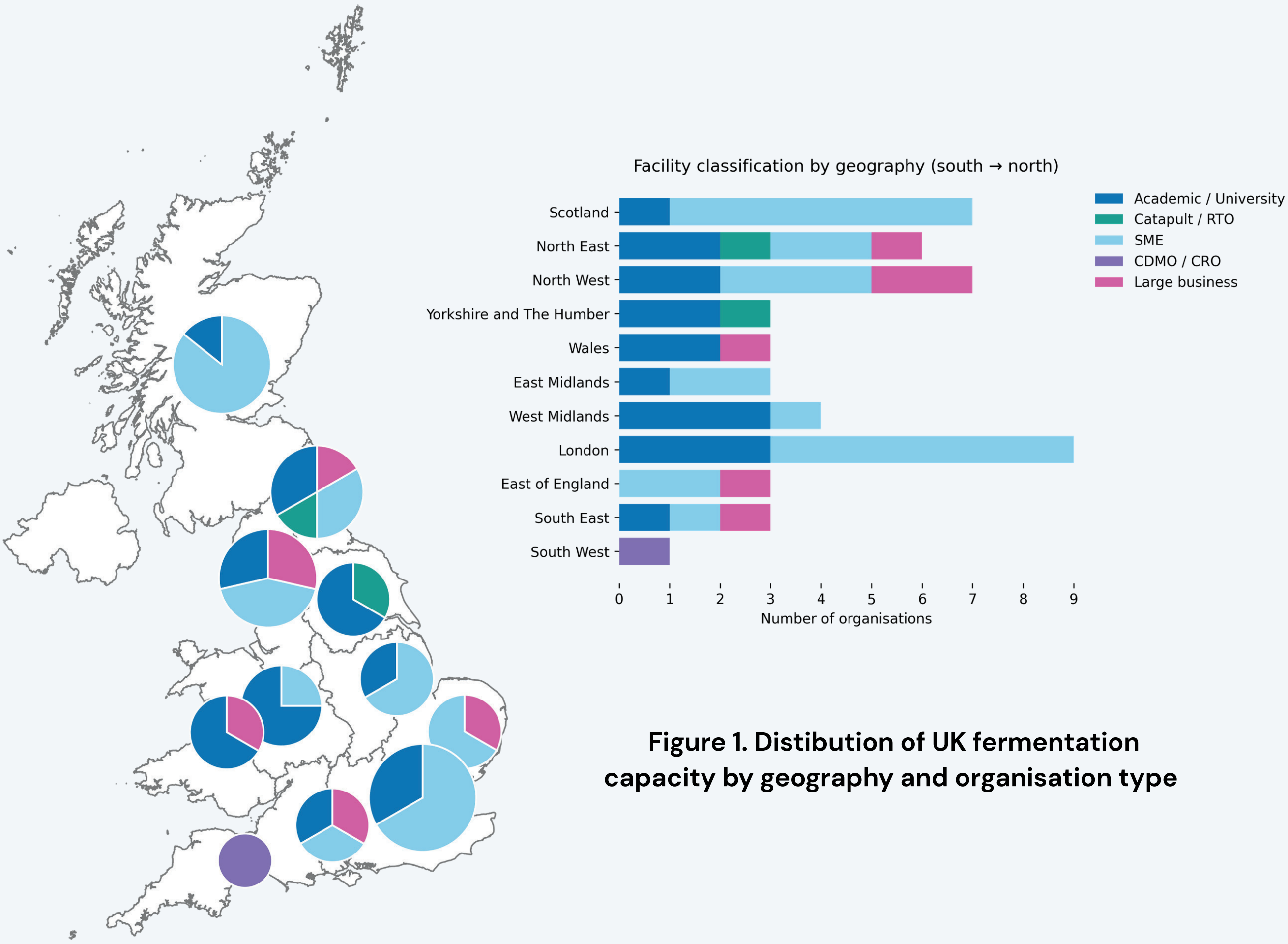


Figure 1. Distibution of UK fermentation capacity by geography and organisation type

A total of 59 responses were recorded, including nil responses, respondents who did not provide detailed capacity data, or those excluded from this analysis due to geographical or sector-related criteria. The analysis incorporated 50 unique respondent organizations, representing all ITL1 regions of the UK, with the exception of Northern Ireland. This almost certainly reflects underreporting, rather than the absence of fermentation facilities in that region (Figure 1).

The types and geographical distribution of these organizations illustrate the strength of early-stage innovation in the UK. Small and Medium Enterprises (SMEs) comprised the largest group of respondents, totaling 23, with the highest concentrations found in the South-East, East Midlands, North-East, North-West of England, and Scotland. Academic institutions followed as the second-largest group, accounting for 18 respondents, with organizations across the UK reporting fermentation capacity, except for the South West of England.

The data also highlights the current state of dedicated scale-up infrastructure in the UK, with three Catapult, RTO, or CRO/CDMO organisations participating in the survey.

Six large businesses provided net or detailed capacity data. Other large companies reported having proprietary fermentation capabilities but could not disclose capacity due to commercial sensitivity and were therefore excluded from the analyses.

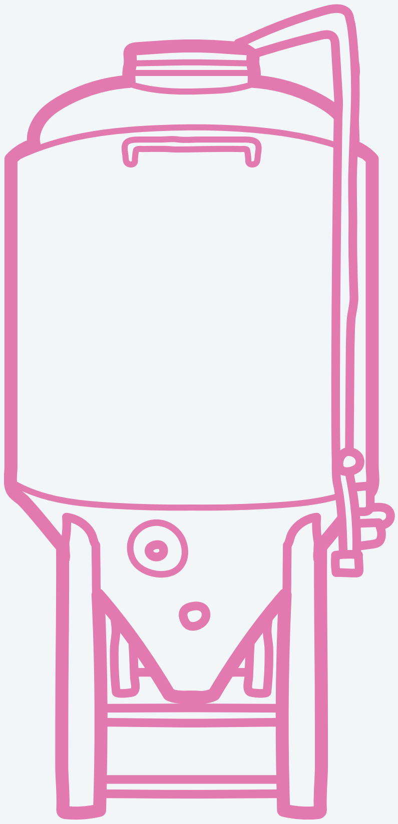
03
UK FERMENTATION & DSP LANDSCAPE

CHAMPIONING THE INDUSTRIAL BIOECONOMY

Biorenewables Development Centre

03.01

FERMENTATION CAPACITY



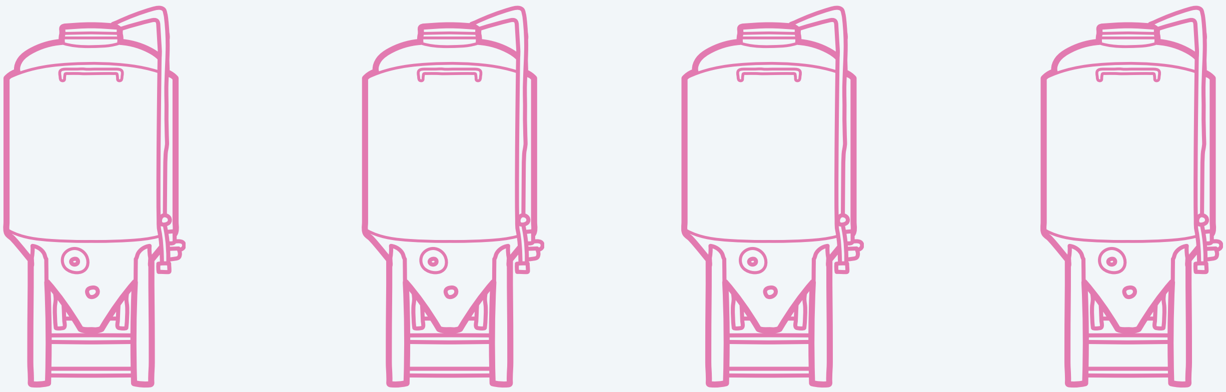
UK FERMENTATION CAPACITY

SUMMARY

A total of 29.5 million litres of fermentation capacity was identified across the UK, although more than 99% of that capacity is found across just 6 commercial sites. Across commodity sectors, more than 88% of that capacity can be attributed to a single manufacturing site. This points to a failure of businesses in those sectors, for example the chemicals sector, to successfully scale or maintain manufacturing in the UK, with consequences for supply chain vulnerability and reliance on imports for key chemicals and materials.

The strength of UK innovation is also evident in these capacities, with large numbers of academic institutions and SMEs providing capacity across diverse sectors. This clearly points towards opportunities for the UK, if those businesses can successfully scale here.

Limited capacity in open access infrastructure, and a lack of demonstration capacity, is a potential limitation on the ability of businesses to reach commercial maturity in the UK.



KEY MESSAGE

UK fermentation capacity is dominated by a small number of commercial manufacturers, but organisations using fermentation are overwhelmingly working at lower TRL.

UK FERMENTATION CAPACITY

The UK boasts 29.5 million litres of fermentation capacity, possessing strong early-stage R&D capacity at the bench and lab levels, but suffering a severe shortage of the pilot and demonstration-scale facilities necessary to bridge the gap to commercial manufacturing.

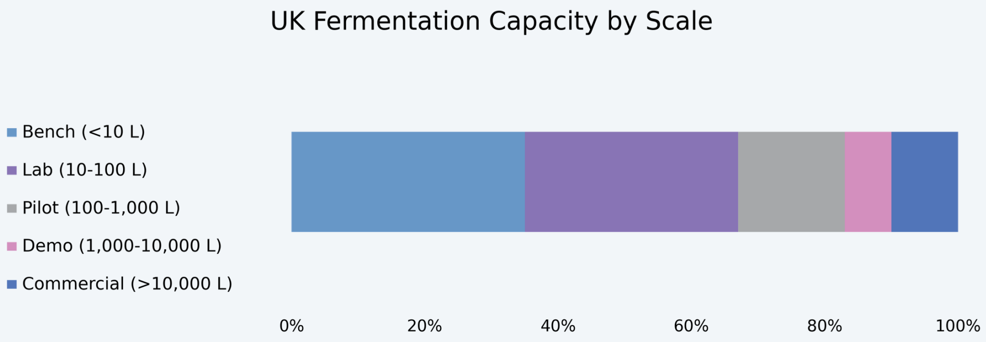
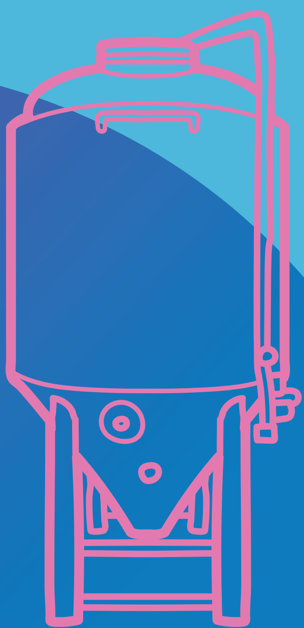


Figure 2. Distribution of UK fermentation capacity by scale

The results indicate that most respondents operate at early-stage development scales (Figure 2). The largest share of respondents work at the bench scale (<10 L), accounting for 40%, followed closely by the laboratory scale (10–100 L) at 37%. This shows that the majority of activities are concentrated in small-scale research and development environments.

A smaller proportion of respondents report working at the pilot scale (100–1,000 L), representing 19%, suggesting that fewer organisations have progressed to intermediate scale-up stages. Even fewer operate at larger scales, with 8% at the demonstration scale (1,000–10,000 L) and 11% at the commercial scale (>10,000 L).

Overall, the distribution highlights that most respondents are engaged in early research and laboratory-scale operations, while a relatively smaller share has advanced to pilot, demonstration, or full commercial production scales.



29,502,224

litres of fermentation capacity in the UK

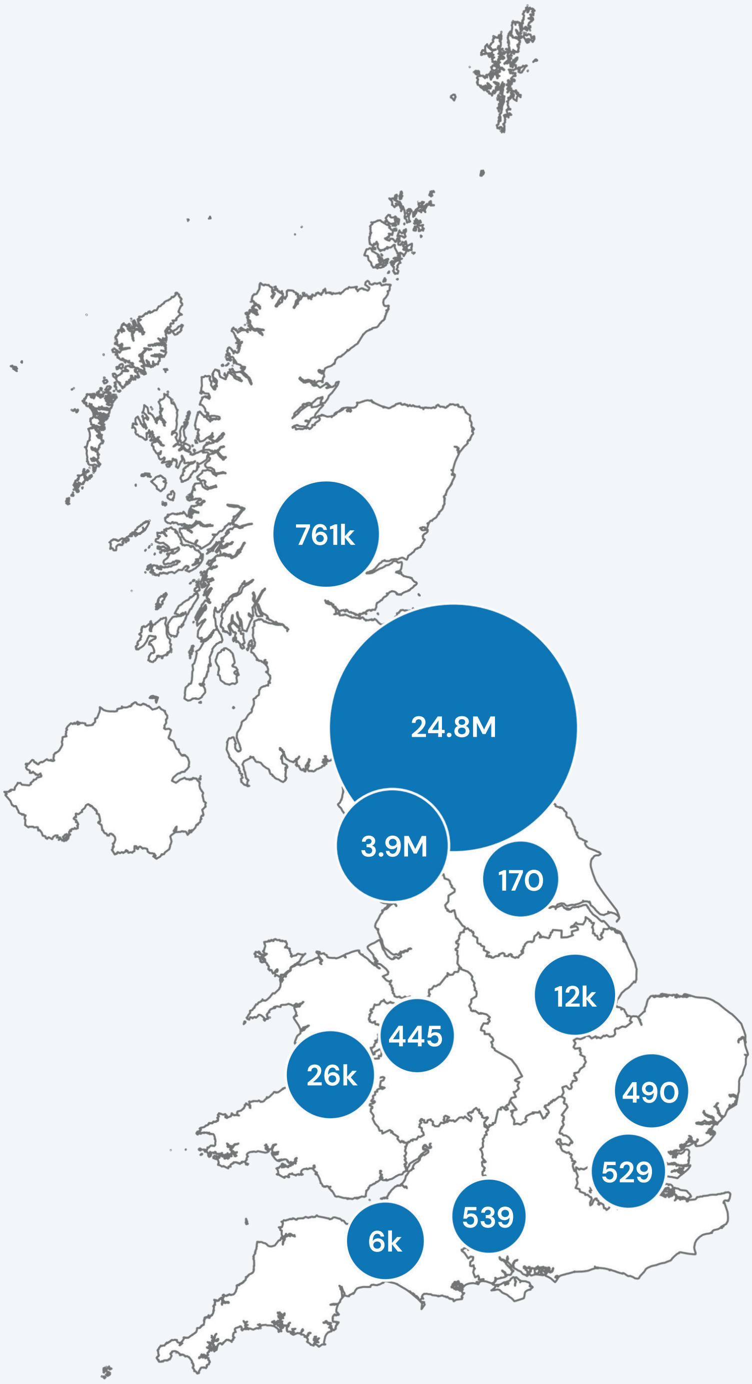
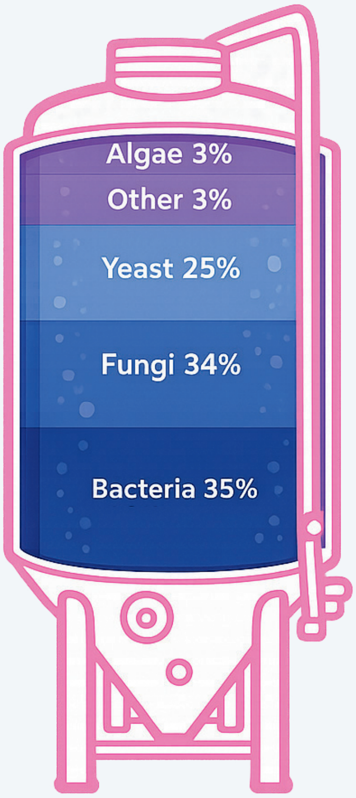


Figure 3. Total fermentation capacity in litres, by region

The overall reported fermentation capacity in the UK, excluding applications for human and animal health, stands at 29.5 million litres (Figure 3). This capacity is spread across most ITL1 regions of England, Wales, and Scotland. The largest regional capacities are located in the North East and North West of England respectively, followed Scotland. Indeed, a small number of high-volume facilities in these industrial heartlands of the UK account for over 99% of the total national capacity.

Total capacities reflect both regional sectoral specialisation and the technology readiness supported by assets based in those regions. These nuances are further explored in following sections, to provide a clearer picture of the innovation and commercial ecosystem across the UK.



UK fermentation capacity is equipped to work with a broad range of organisms across major classes represented in engineering biology processes. The greatest proportion of capacity is dedicated to bacterial (35%) and fungal (34%) fermentations, followed by yeasts (25%) (Figure 4). This reflects not only the common choice of these groups as production organisms for engineering biology processes, but also their established use at the largest industrial manufacturing scales.

Smaller proportions are equipped for niche or emerging production organisms. These nonetheless represent important capacities and expertise in biological systems including algae (3%), and 'other' organisms (3%) such as plant cells. Relatively lower capacity reflects the smaller number of organisations working in these systems, and also scale requirements and the maturity of processes in the UK.

Figure 4. Proportion of fermentation capacity by organism type

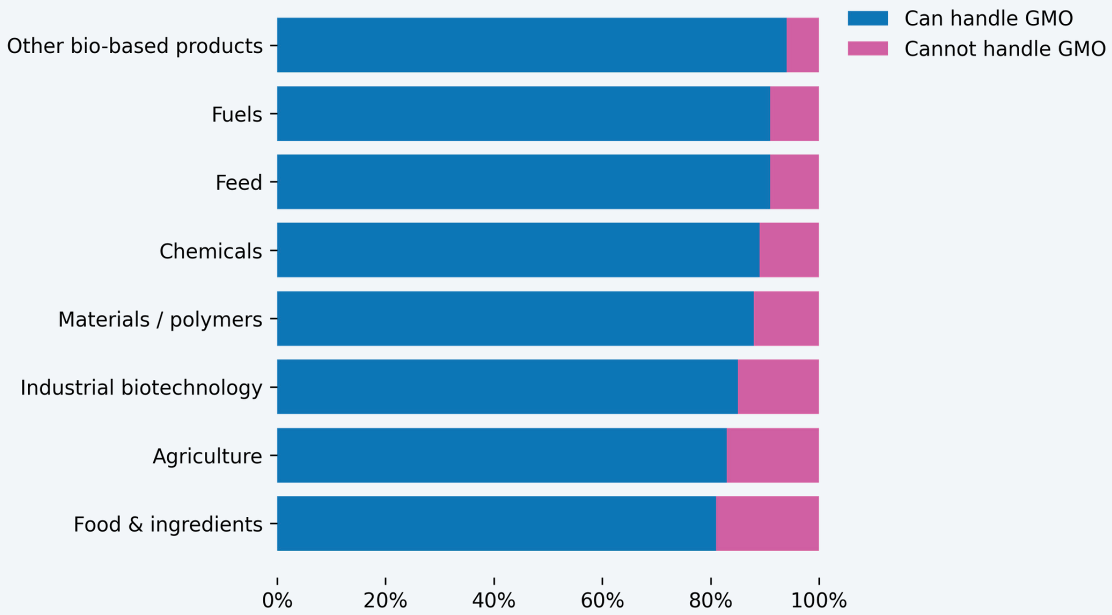


Figure 5. Proportion of facilties able to handle GMO, by sector

UK fermentation capacity is equipped to handle genetically modified organisms in every sector, with individual facilities setting policy based on operational or regulatory requirements (Figure 5).

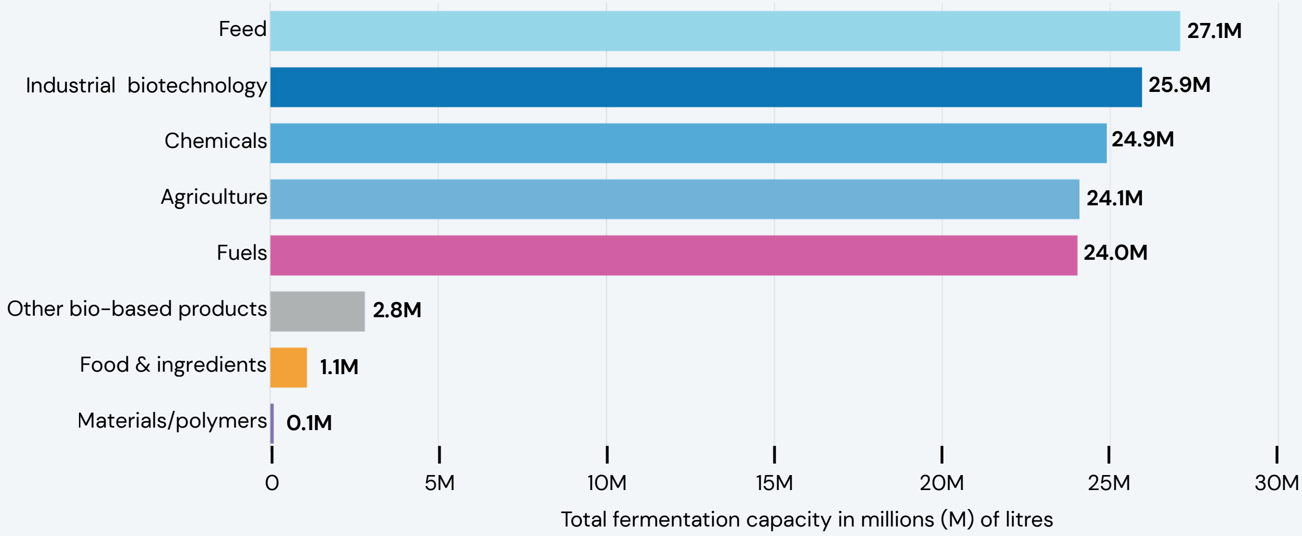


Figure 6. Total fermentation capacity by application sector

Organisations were asked to identify the application sectors they address, to understand total capacity in different markets. Since some organisations address a number of sectors, often as multiproduct manufacturers, the same assets may be represented across a number of application sectors. Overall capacity within the commodities sectors of feed, fuels, agriculture, and chemicals is dominated by a single commercial manufacturing site that constitutes at least 88% of the total fermenter capacity in each.

Total fermentation capacities in other application sectors are relatively smaller, but sectoral totals are best understood in conjunction with data in Figure 7 examining that capacity in terms of the process development and commercialisation stages it supports. The profile of assets across all sectors is remarkable similar, suggesting that strengths and barriers in innovation and commercialisation persist across all applications.

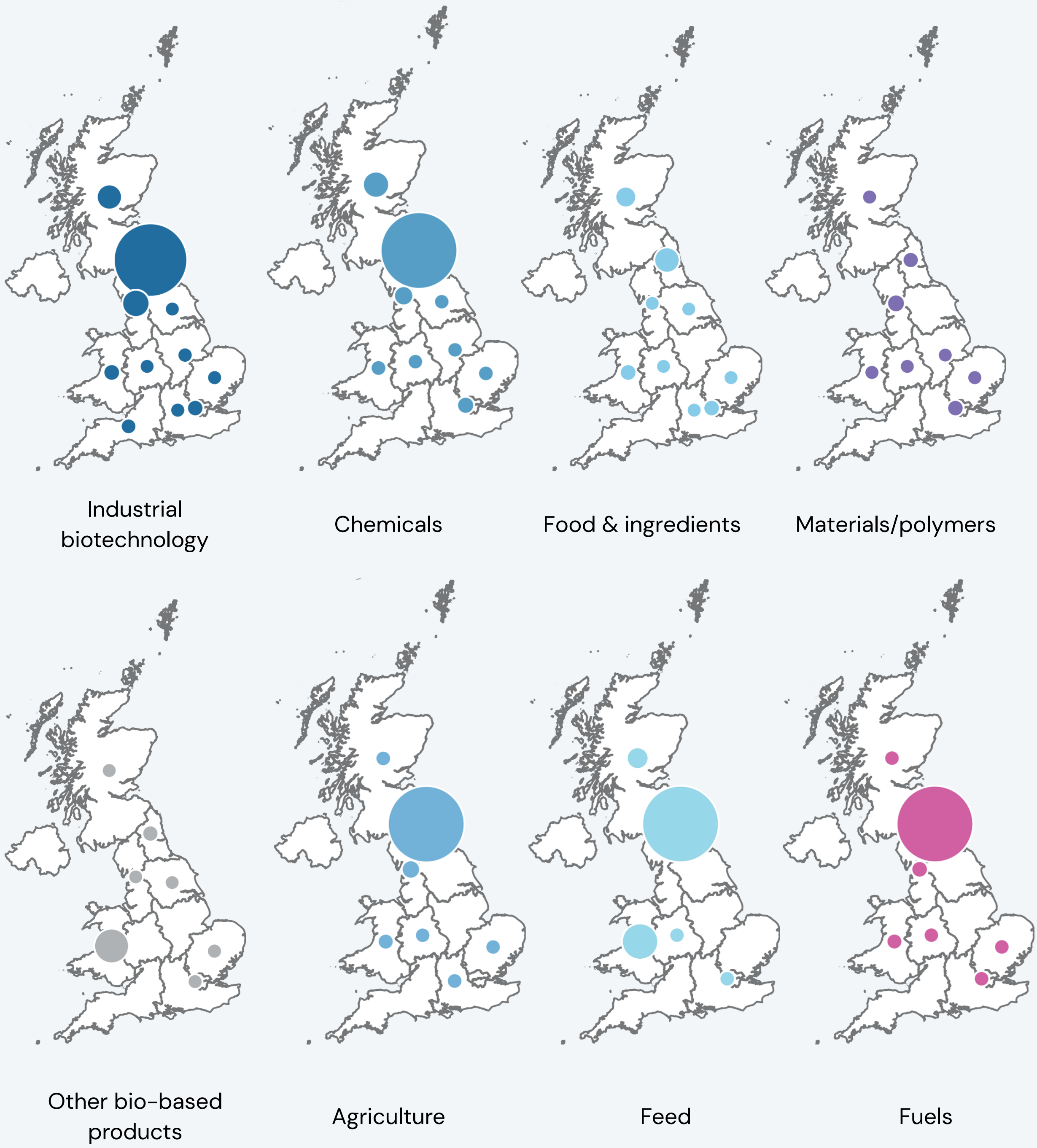


Figure 7. Total fermentation capacity in regions, by application sectors

Reported fermentation capacities across ITL1 regions of the UK were analysed by application sector. Respondents were asked to identify the primary sector(s) they serve, noting that some organisations address more than one sector. Total capacities across Industrial Biotechnology and the commodity sectors – feed, fuels, agriculture, and chemicals – are dominated by multiproduct commercial manufacturing based in the North East of England (Figure 7).

The strengths and diversity of sector applications is illustrated by the number of respondents addressing a range of sector applications, once again noting that the same organisation may work across multiple sectors.

'Industrial Biotechnology' is an expansive descriptor, highlighting capabilities rather than the end uses of products. It was therefore, perhaps unsurprisingly, the most common response, with 46 organisations. Fermentation capacity was identified spanning research and innovation through to commercial manufacturing, distributed across most regions of the UK.

'Chemicals' was the second most common application sector, with 25 organisations. The geographical distribution of those organisations is notable, with particular concentration around the established industrial clusters of the North East of England, Yorkshire and the Humber, North West of England, and Scotland. Those organisations once again cover the full TRL across all organisation types, spanning academia through to large businesses. Outside of those regions, other clusters of chemicals sector research and innovation were identified in London and the East of England.

'Materials/polymers' was the next most common response, with 23 organisations. Whilst the capacity is much smaller than that of the related chemicals sector, geographic distribution is similar, although also extending into Wales.

'Food & ingredients' was the fourth largest sector, with 17 organisations, noting that some of the largest established industrial fermentation capacities were excluded, since breweries and distilleries are outside the scope of this report. Sector capacity is more evenly distributed throughout the UK, situated in Wales, London, the South East, extending through the East Midlands into Yorkshire and the Humber, and across the North of England, and into Scotland.

'Other bio-based products' constitute a significant proportion of responses, with 16 organisations, reflecting the diversity of engineering biology application sectors.

'Fuels', 13 organisations. Whilst ranking amongst the highest overall capacities, that capacity is overwhelmingly dominated by one manufacturing in site in the North East of England, reflecting the relative immaturity of the other organisations in this sector.

'Agriculture', with 12 organisations and 'Feed', with 11 organisations, were the least common reponses. In both cases, total capacity is once again dominated by megalitre manufacturing in the North East of England. The geographical distribution of both is similar: the North East and North West of England, and Scotland, represent the majority of capacity, with earlier stage innovation facilities located in Wales and London or the South of England.

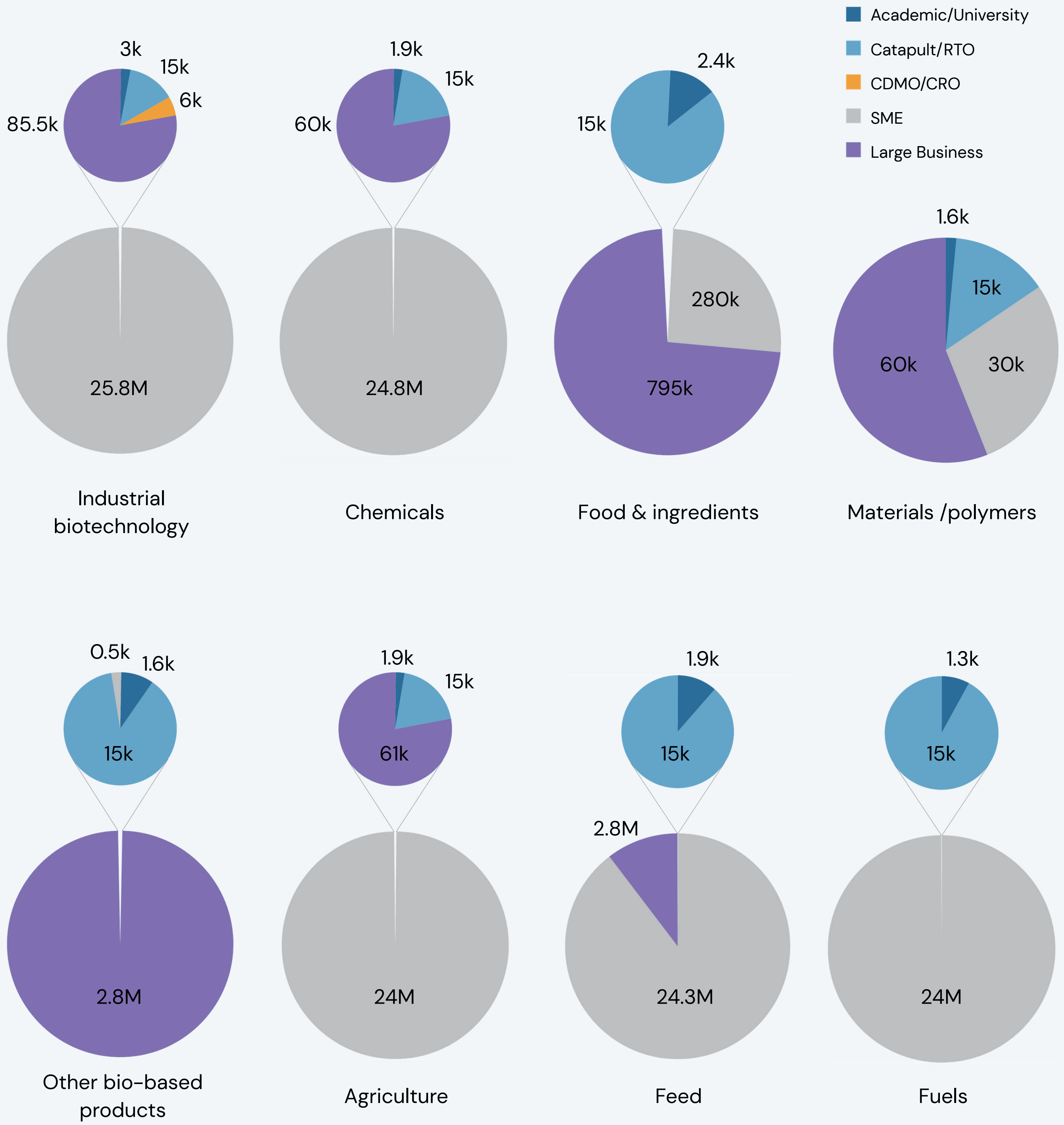


Figure 8. UK Fermentation capacity, by sector and organisation type

Reported fermentation capacities were analysed by application sector and type of organisation. As expected, a large majority of capacity in each sector sits within SMEs and large businesses (Figure 8). It should again be noted that capacity held by a single SME dominates volumes across the sectors of 'Industrial biotechnology', 'Chemicals', 'Agriculture', 'Feed', and 'Fuels'. Academic organisations and universities host relatively small volumes, but these are well distributed and serve every sector. Catapult and RTO also provide capacity across every sector, demonstrating the flexibility of that small number of organisations. CDMO/CRO organisations are also well equipped for applications within the cross-cutting industrial biotechnology space.

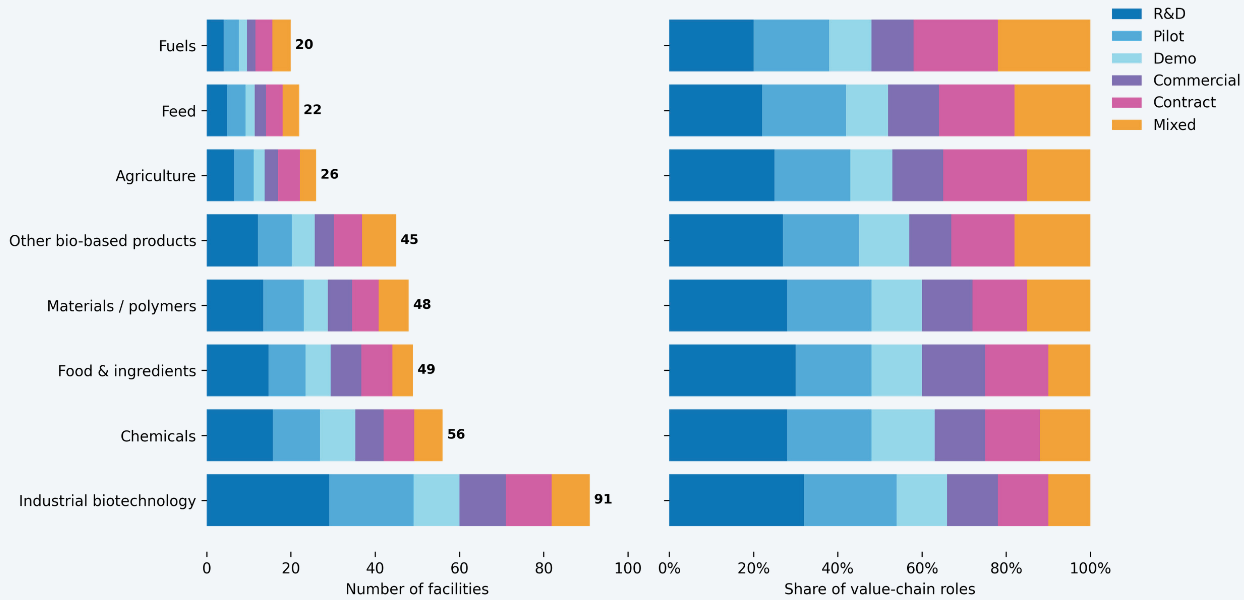
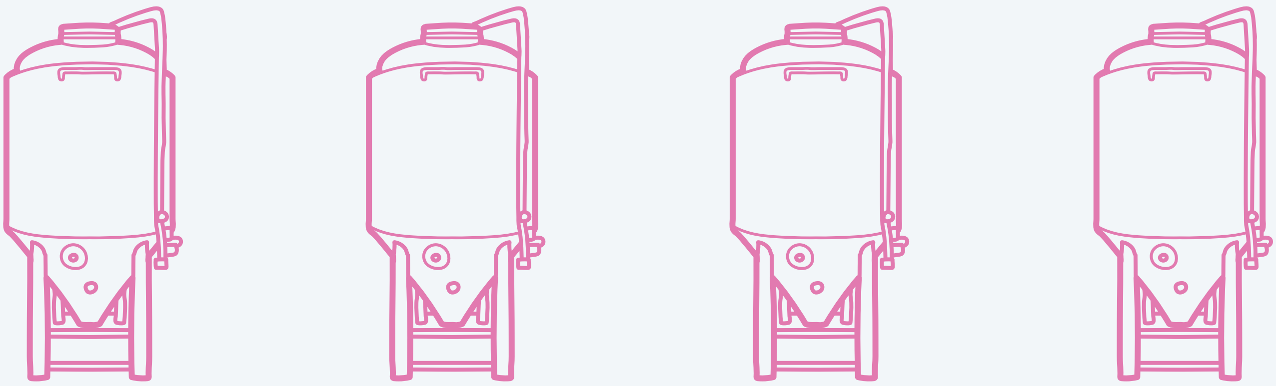


Figure 9. Sector applications and technology maturity: total number of assets available to each sector (left); composition of assets serving each sector by technology maturity (right)

The number of assets available to each sector was assessed based on the technology maturity supported by the provider, ranging from low TRL research and development to contract or commercial manufacturing, or a combination of both. Individual respondents sometimes provided facilities at multiple technology maturity levels, leading to their being counted more than once in the totals.

As shown in Figure 9, for each sector, the asset composition was also reviewed to determine whether certain sectors were better served across technology readiness levels. Generally, all sectors displayed similar trends in early-stage innovation facilities, with most reported assets supporting lower TRL R&D through to pilot scale. At most advanced TRL, all sectors reported assets that included commercial production sites dedicated exclusively to the respondent, contract manufacturing sites serving external clients, and facilities with a mix of both capacities.

All sectors were reliant on a relatively small number of demonstration scale facilities (1,000-10,000L) operated by only eight organisations. Moreover, the true picture for many businesses trying to scale technologies in the UK is even more challenging, since not all of those facilities are accessible to external customers, as discussed later in Section 3.03.



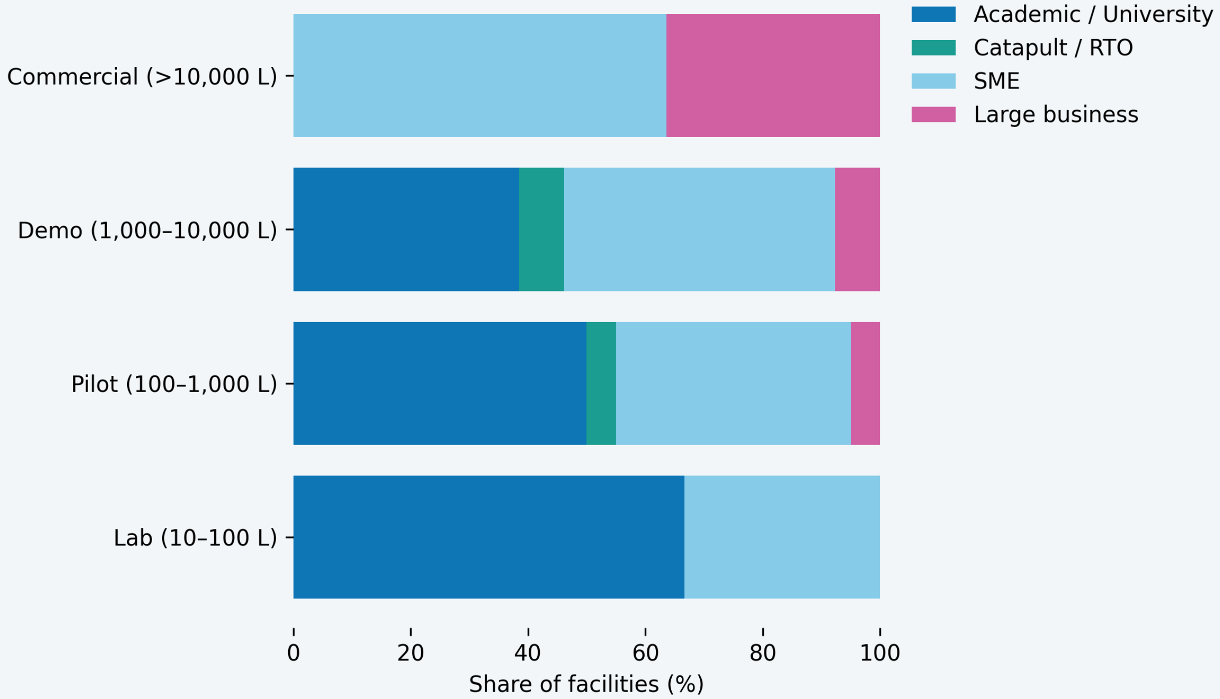
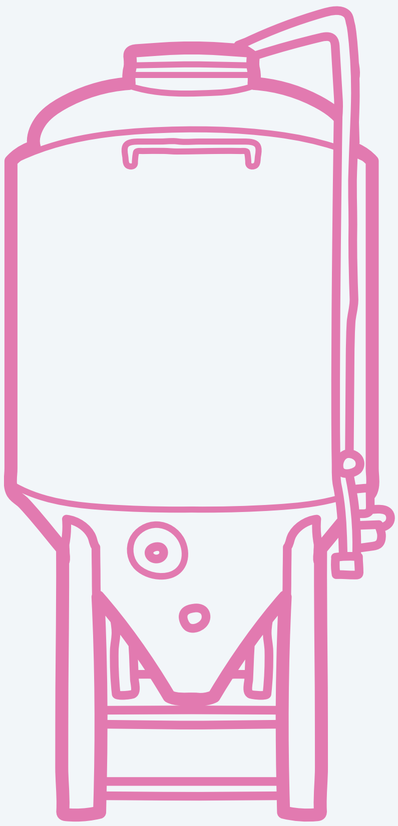


Figure 10. Facilties providing toll manufacturing

Fermentation capacity for toll manufacturing – where a facility performs production outsourced by another organisation – is available in 10 organisations in the UK. Two of those are large businesses, 6 are SMEs, 2 RTO/Catapult organisations, and 3 academic organisations. The majority of facilities are at scales below 10,000 L (Figure 10).

03.02

DOWNSTREAM PROCESSING LANDSCAPE



DOWNSTREAM PROCESSING LANDSCAPE

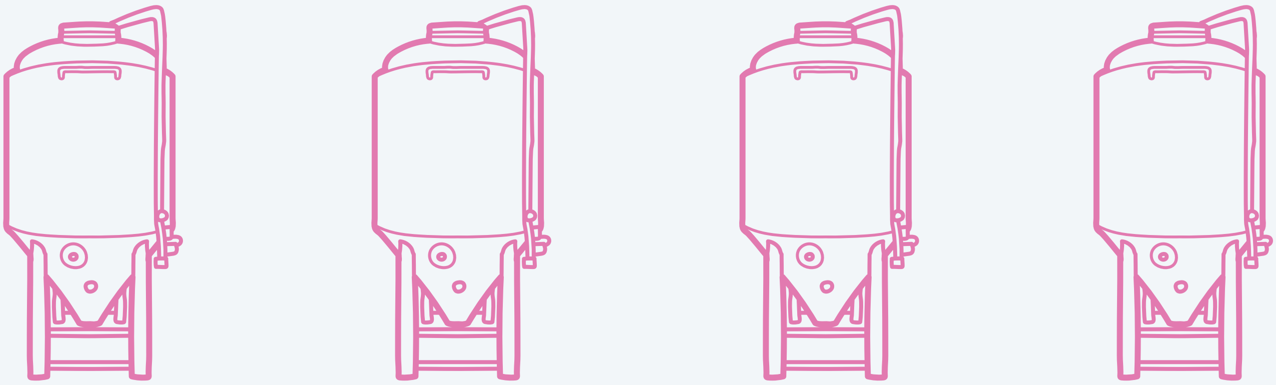
SUMMARY

Effective downstream processing (DSP) of fermentation products is critical for safety, quality, and cost of goods. DSP is highly process and product specific, and it is impossible to comprehensively capture the capabilities and needs of every organisation and sector in this report. However, there are a number of core technologies commonly employed in separation and purification of fermentation products, surveyed here as indicators of the capabilities and capacities for scaling up in the UK.

Reported DSP capacity reveals similar, but slightly more constrained patterns, to fermentation capacity. As seen in Section 03.04, a higher proportion of respondents reported DSP capacity at or near full utilisation compared to fermentation capacity.

This aligns with longstanding industry observations that downstream processing often becomes the limiting factor in scale-up. Fermentation technologies have advanced significantly in terms of titres and productivity, but downstream systems - separation, purification, filtration, chromatography, drying - often lag in scalability and integration.

The data suggests that DSP bottlenecks may be even more acute than fermentation constraints, particularly at pilot and demonstration scales where integration of upstream and downstream processes becomes technically and economically demanding.



KEY MESSAGE

Access to a range of scalable, industrially-relevant downstream processing technologies remains a challenge for UK innovators.

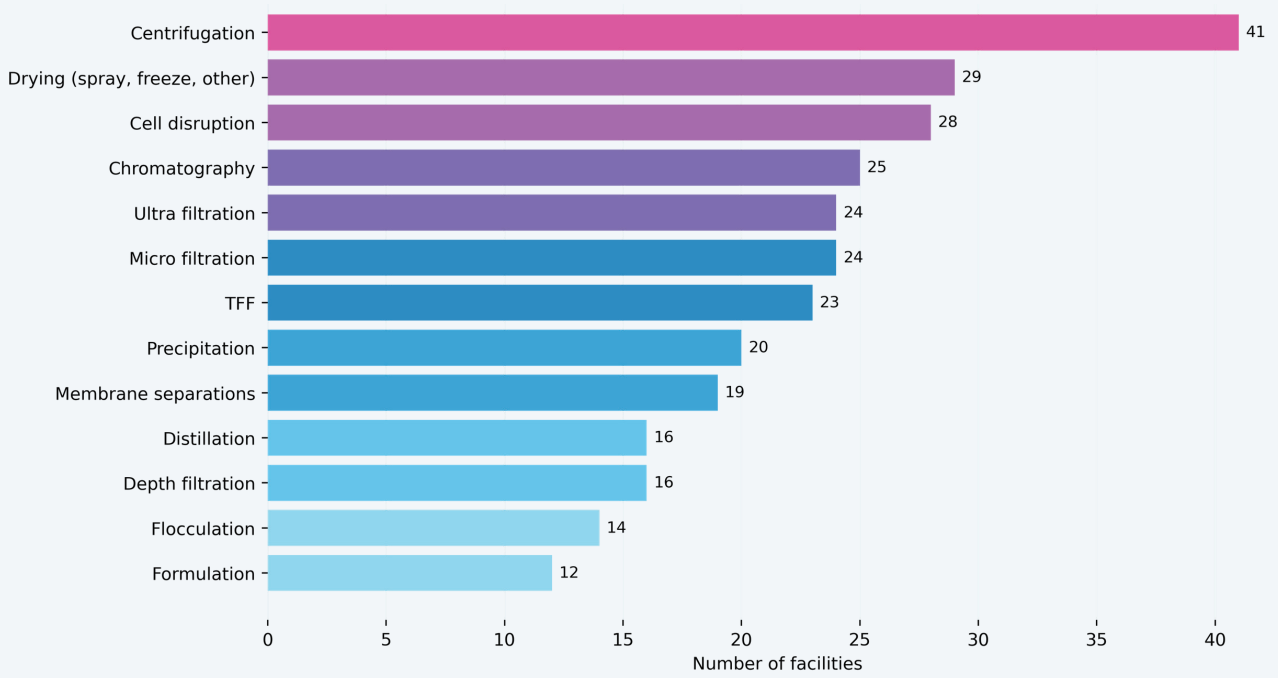


Figure 11. UK facilities offering common downstream processing capabilities

Access to common downstream processing technologies is relatively limited, with a majority of organisations offering capabilities with greater utility in processing fermentation batches and bulk materials, such as centrifugation, cell disruption, and drying (Figure 11). Many of the most commonly reported technologies are also less suited to high volume commercial manufacturing.

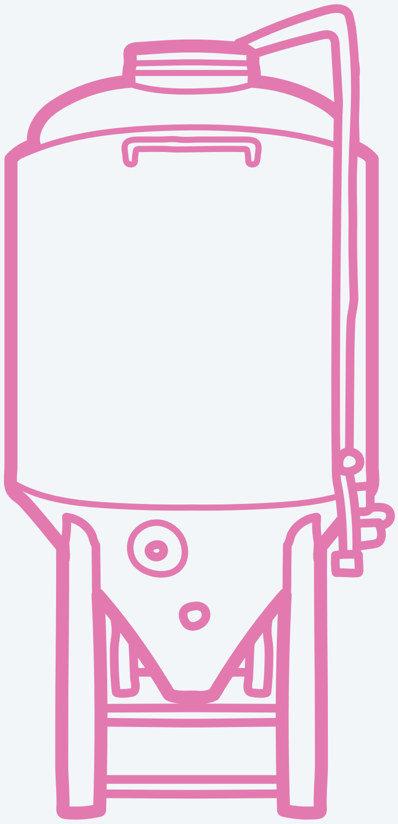
DSP technologies such as chromatography, often used in high-value low-volume processes, are relatively more common.

Downstream processing technologies commonly employed at the largest industrial scales, such as flocculation, precipitation, depth filtration, membrane separations, and distillation, are found in a relatively small number of facilities.

Final product development and manufacturing capabilities are also limited: less than a quarter of respondents reported product formulation capabilities.

03.03

FACILITY ACCESS MODELS



FACILITY ACCESS MODELS

SUMMARY

Accessibility and capabilities across scales and sectors is critical to enable technologies to scale from the lab and their subsequent commercialisation. Importantly, gaps in the ecosystem are key drivers of investment and commercial strategies. Inability to access facilities or friction across capabilities and scale has been repeatedly cited as a factor in companies failing to secure investment rounds, or making the decision to scale outside the UK.

Cost-effective open access and accessible fee-for-service capabilities underpin the transition from the lab to mid-TRL development. Advanced TRL fee-for-service capabilities also reduce the capital intensity of commercialisation and accelerate the pathways to revenue generation. Open access is an important principle for innovation, ensuring facilities are designed to meet the needs of the community, and are accessible through flexible funding sources, often across multiple TRL. The relatively small number of open access facilities, and limits on scale available in the UK, represents major bottlenecks and barriers to development and commercialisation.

Collaborative capabilities offer essential interventions across TRL, forming the basis of many discovery and innovation projects, and operating and business models right through to commercialisation. There are good capabilties and capacities available in the UK, but access is heavily restricted, limiting the ability of innovators to utilise that capacity without friction across TRL and scales.

Capacity available only for internal purposes may reflect mature processes or specialised process needs, but can also reflect capitally-intensive development pathways, where organisations are forced by lack of accessible facilities to build their own capacity.

Overall, UK capacity is highly contrained in scale and accessibility, and these are important factors that drive business to scale overseas, and therefore subsequently establish manufacturing overseas where they scale. At pilot and demonstration scale, capacity is more accessible, but is limited in terms of the numbers and types of facilties. These dynamics limit returns to the UK, where inventions are frequently exported and the major benefits are realised elsewhere.

KEY MESSAGE

Access to fermentation capacities and capabilties across technology readiness levels and scales is limiting the ability of the UK to develop and commercialise processes.

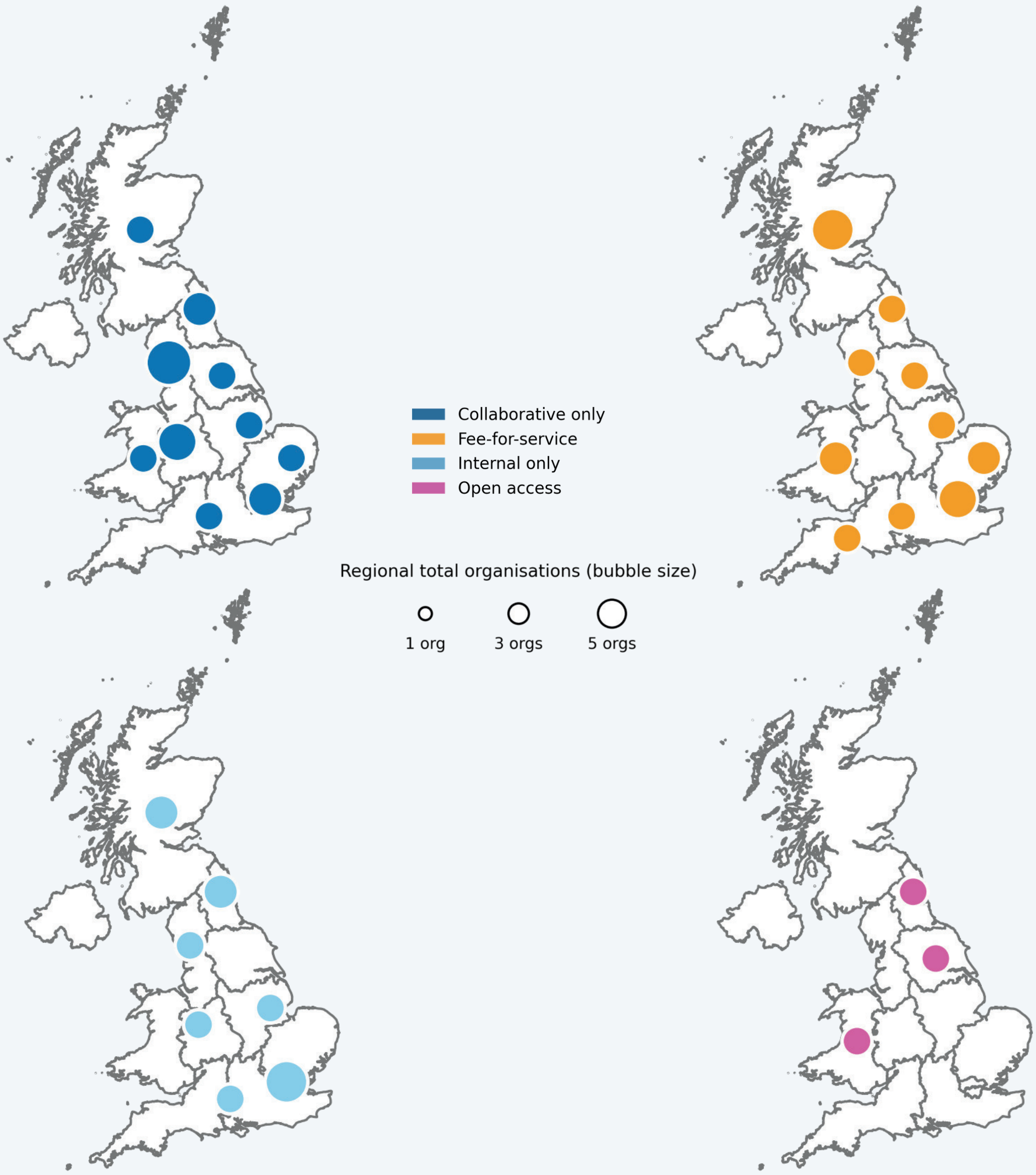


Figure 12. Geographical distribution of UK facilities by access model

The broad distribution of UK capacities was mapped based on the postcode of the site where the fermentation assets are based, according to the access model they operate. '*Internal only*' capacity is dedicated to the sole use of the host organisation. Other access models enable varying levels of access by third parties. '*Collaborative only*' access describes facilities where organisations directly collaborating with the host can access capacity. *'Fee-for-service'* facilities are accessed on a paid basis, often providing highly specialised, streamlined capabilities. *'Open access'* facilities are created and maintained to lower barriers to innovation, supporting any organisation to develop and commercialise technologies. They operate on the principle of enabling broad access for the benefit of society, and are often therefore eligible to recover full costs through public funding schemes.

Figure 12 shows that fee-for-service or collaborative facilities are broadly distributed across the UK. Assets dedicate to internal use are also broadly distributed. By contrast, open access facilities are restricted to only three regions of the UK, albeit clustering with significant concentrations of other organisations in relevant sectors (as shown in Figure 7).

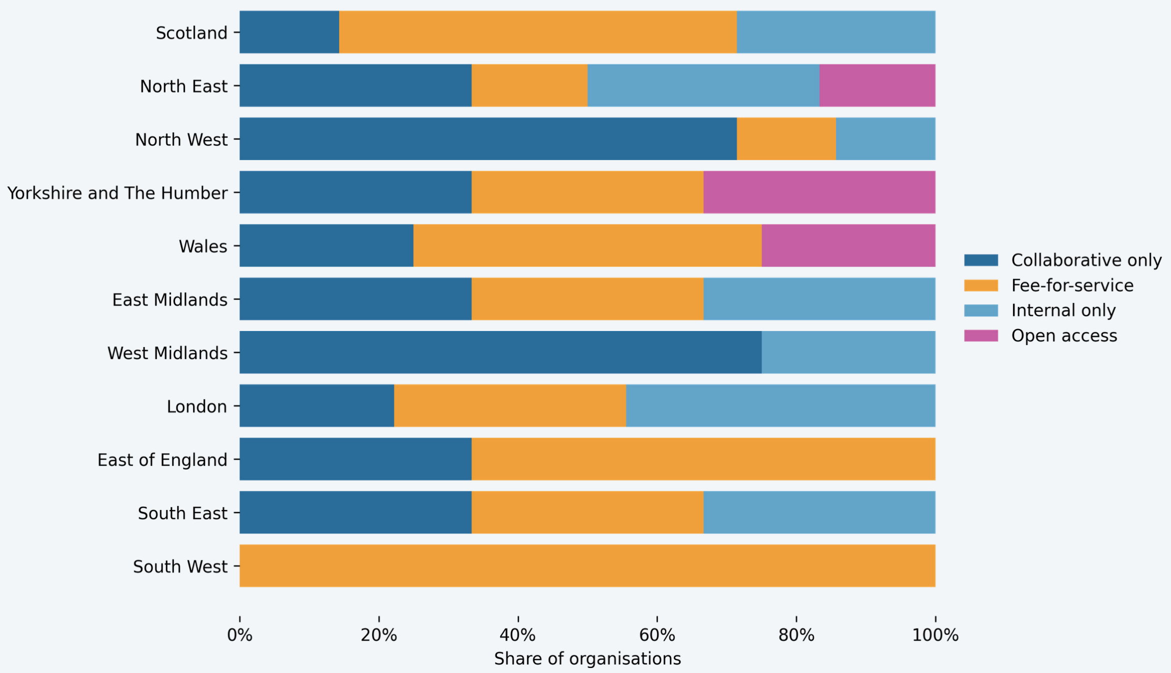


Figure 13. Access models by region

Figure 13 show the proportion of organisations adopting different access models, by region. In contrast to to the similarities when considering the broad distribution of access models, more detailed analysis shows a highly variable picture across the UK in terms of number and types of organisations across regions.

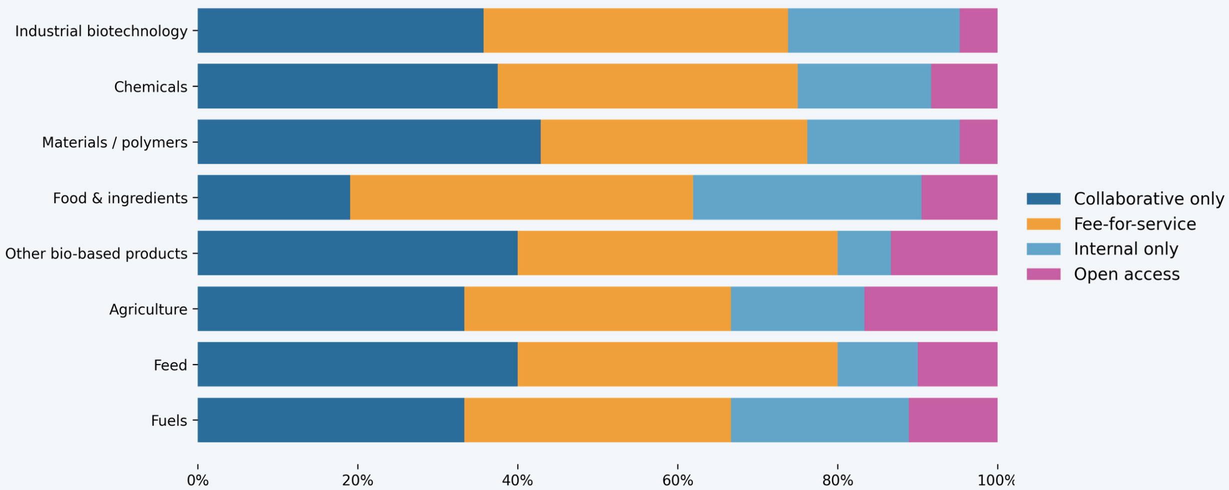


Figure 14. Access models by sector

Despite geographical variation in access models, overall accessibility is relatively similar across sectors. Figure 14 shows the access models of organisations by sector, showing similar trends across all application sectors. Small numbers of organisations offer open access capacity, but some of that capacity is available to all of the sectors surveyed. There is good supply by fee-for-service organisations across all sectors.

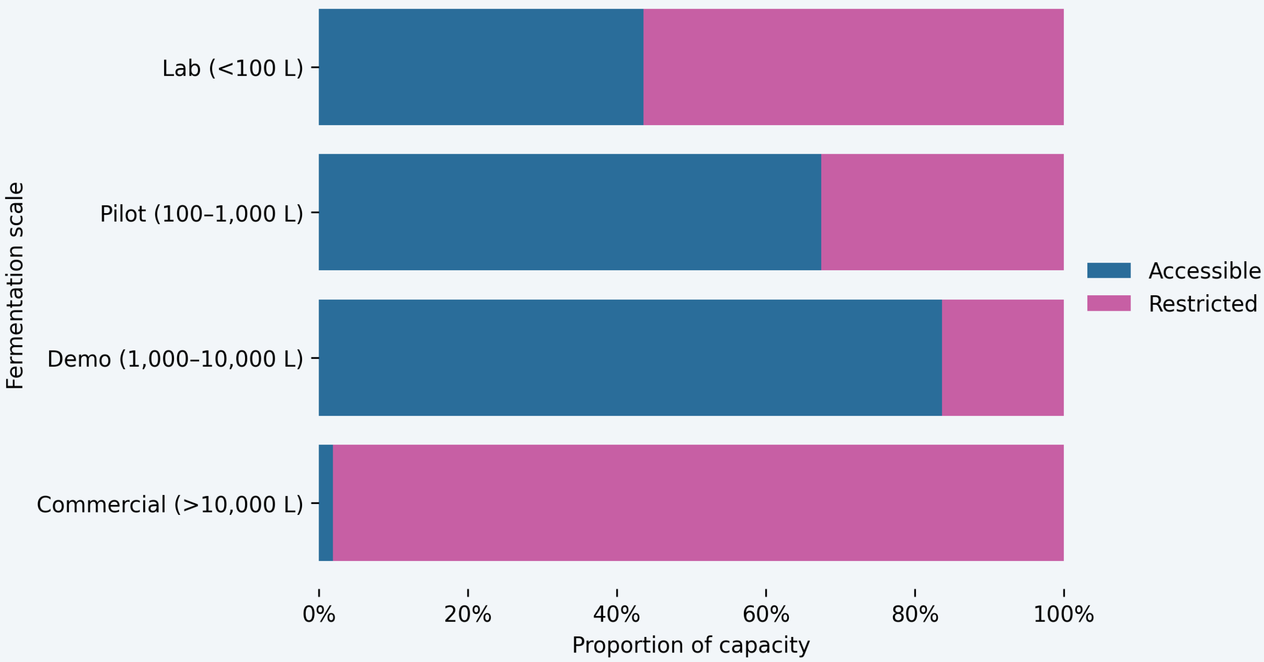


Figure 15. Accessibility of UK facilities across fermentation scales

The accessibility of assets was designated as '*Accessible*', if it is open access or fee-for-service, whereas capacity that is only accessed through collaboration or exclusively dedicated to internal production, was designated *'Restricted'*.

Across all scales, the majority of capacity is restricted access (Figure 15). Although a larger proportion of pilot or demonstration capacity is accessible, it is notable that, even at lab scale, a large majority of capacity is restricted access.

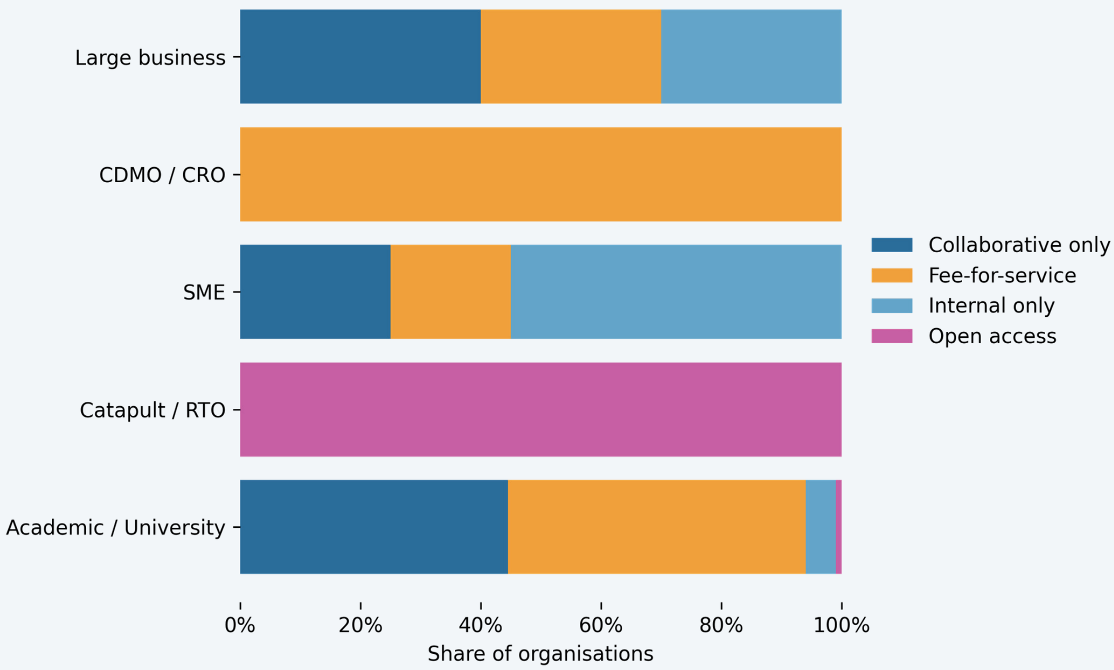


Figure 16. Accessibility of UK facilities across facility type

Figure 16 shows the composition of access models for the different types of respondents. Unsurprisingly, CDMO/CRO organisations are entirely accessed on a fee-for-service basis, and Catapult and RTO organisations operate on an entirely open access basis.

Academic and University organisations may be accessible through a variety of models, with one open access facility, and a small amount of internal only capacity. There is a significant proportion of collaborative access to those organisations, but also models for fee-for-service engagement.

Access to large industry capacity is on the basis a relatively even mixture of collaborative and fee-based models, with a similar proportion dedicated to exclusive internal use.

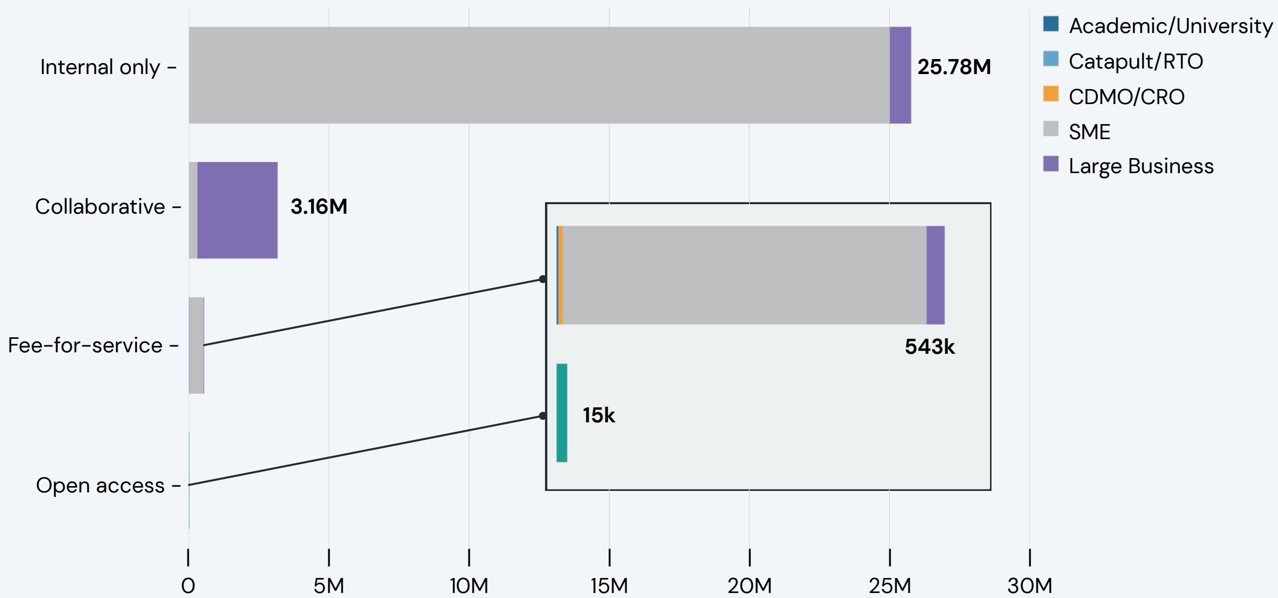
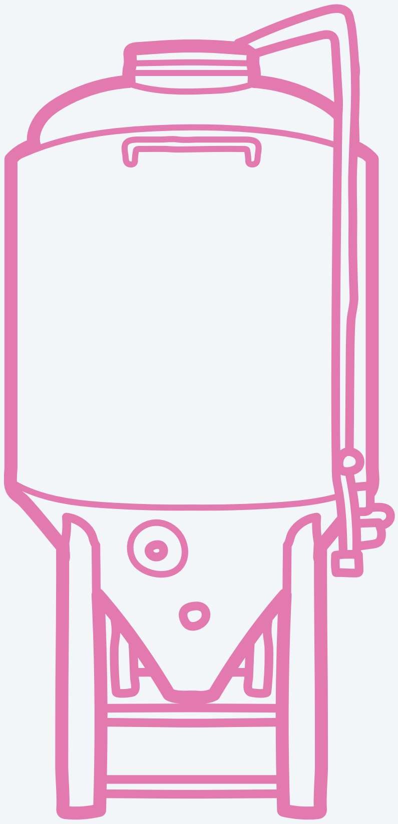


Figure 17. Total UK fermentation capacity, by access model and organisation type

Figure 17 shows the total reported fermentation capacity available under each access model and the type of organisation providing that facility. The inset shows Fee-for-service and Open access.

03.04

UTILISATION OF FACILITIES AND LEAD TIMES



UTILISATION OF FACILITIES AND LEAD TIMES

SUMMARY

Across the fermentation sector, only a small fraction of capacity - up to 25% -is immediately available, with most requiring three to six months lead time. Lead times are longest in agriculture, chemicals, and feed, while food, ingredients, and industrial biotechnology generally benefit from faster access.

Availability is strongly influenced by fermenter size. Smaller units (<100 L) are readily accessible, mid-sized units (100–10,000 L) are moderately available, and large fermenters (>10,000 L) represent a major bottleneck, with over half requiring more than three months to access. Organism type has a modest effect, though bacterial systems tend to face the longest delays, posing challenges for large-scale projects.

Internal capacity is often fully utilised or underused, while open and toll facilities show more evenly distributed mid-range availability, offering greater flexibility for external users. For research-led organisations, these lead times may be manageable, but for venture-backed SMEs with aggressive development timelines, even a three-month delay can materially impact investor milestones, regulatory schedules, and competitive positioning.

This bimodal pattern indicates that capacity constraints are not simply a matter of national volume. Mismatches arise from scale requirements, geographic distribution, sector specialisation, commercial access terms, and technical compatibility. In practice, capacity may exist but is not always accessible or suitable for specific user needs. Facilities operating below 50% utilisation face commercial or coordination challenges, whereas fully utilised facilities are concentrated in high-demand niches.

Overall, the sector shows uneven accessibility. Smaller fermenters and some sectors can act quickly, but large-scale bacterial projects are constrained. Open and toll facilities provide more flexible mid-range capacity. Addressing these challenges requires improved transparency, coordination, and targeted investment to align capacity with user needs rather than indiscriminate expansion.

KEY MESSAGE

Access times increase sharply with fermenter size, making it difficult to scale processes from small to large fermenters without significant delays - affecting investor confidence.

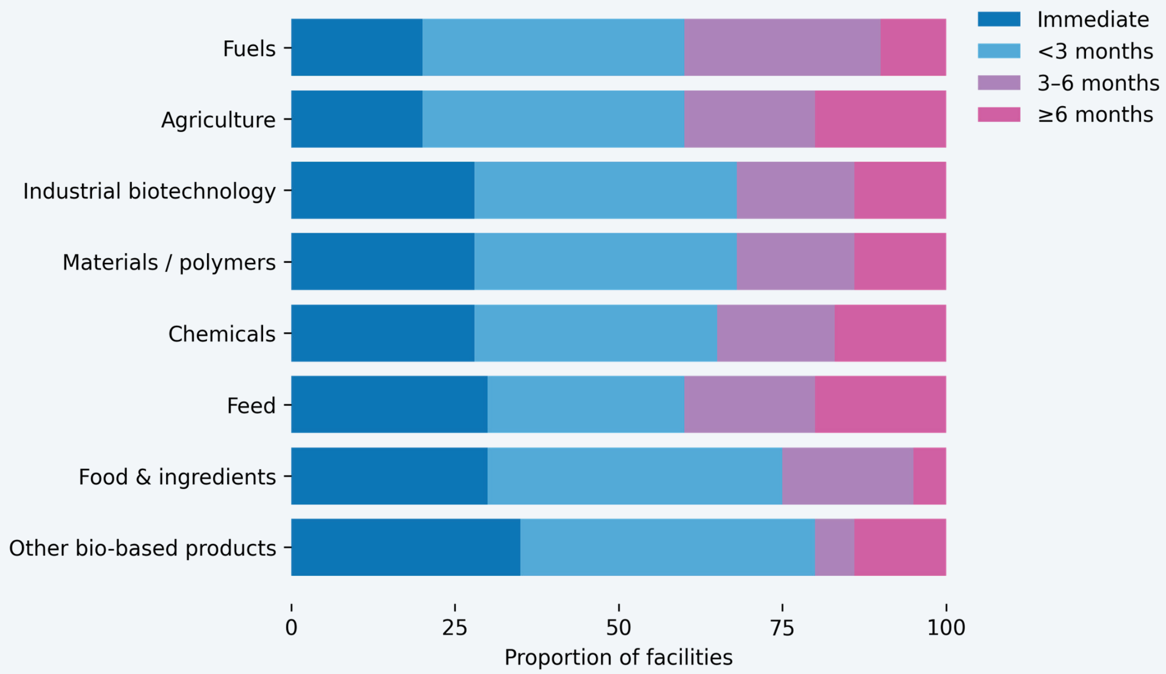


Figure 18. Fermentation access lead time by sector.

Across all sectors, some fermentation capacity is immediately available, accounting for up to 25% of total capacity. However, most capacity becomes available with a lead time of 3 to 6 months (Figure 18 & 19).

The agriculture, chemicals, and feed sectors have the highest proportion of capacity with lead times exceeding six months. In contrast, the food and ingredients sector, along with industrial biotechnology, generally benefits from the shortest lead times overall.

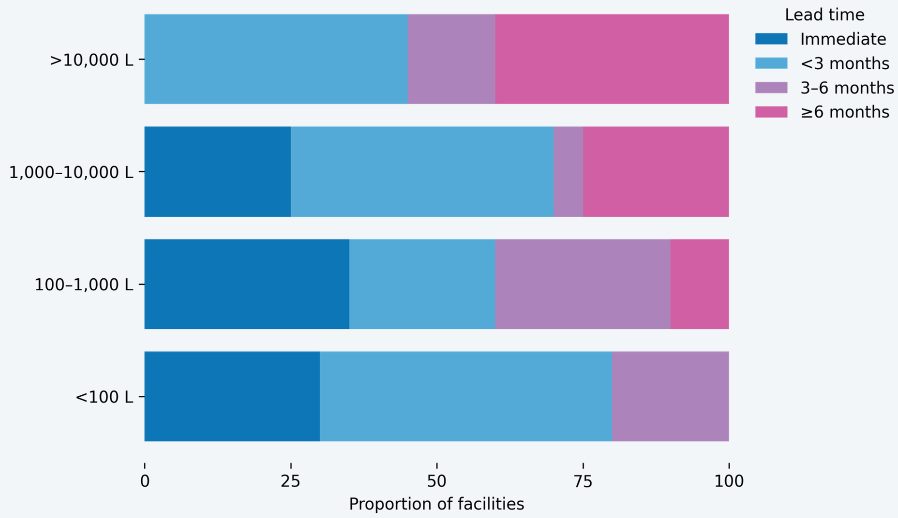


Figure 19. Fermentation access lead time by fermenter size.

Smaller fermenters are available more quickly, which is unsurprising given that there are many more of them compared to larger units. For fermenters under 100 litres, over 75% are available within a lead time of less than 3 months. For 100–1,000 litre fermenters, nearly 90% can be accessed within 6 months. For 1,000–10,000 litre fermenters, roughly 75% can be accessed within 6 months, with around 67% available in less than 3 months.

The largest bottleneck is for fermenters over 10,000 litres in size. Here, more than 50% of capacity has an access lead time of over 3 months, and around 40% of capacity has a lead time of more than 6 months.

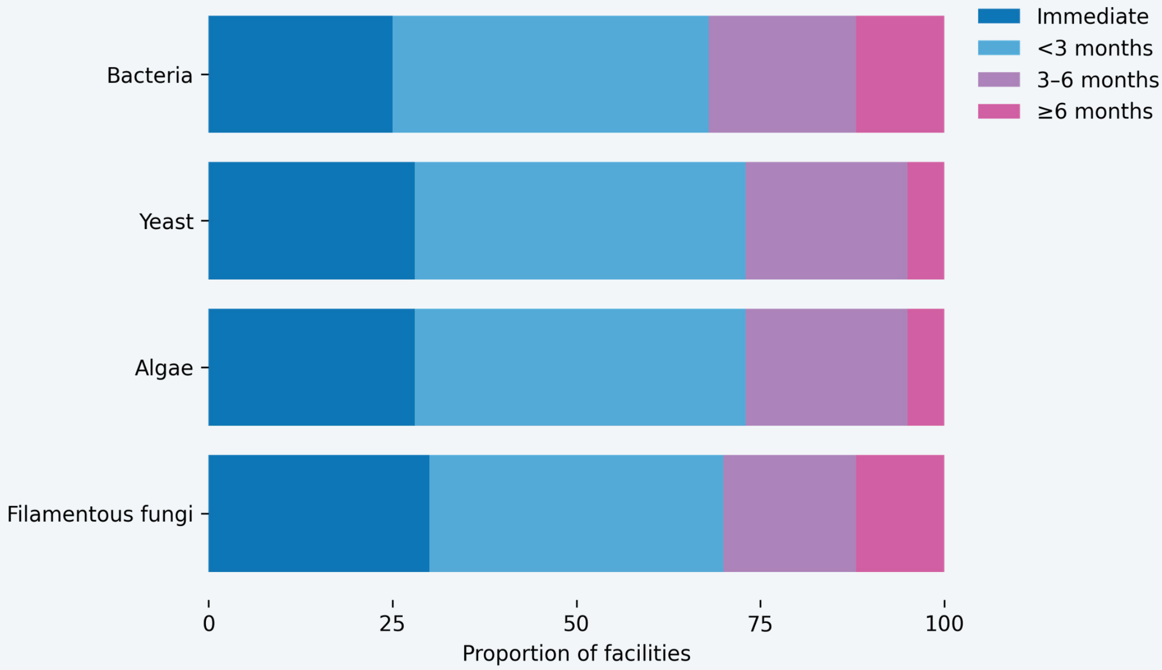


Figure 20. Fermentation access lead time by organism capability

Lead times by organism type are relatively similar across all organisms. Yeast and large fermenters have slightly better access times compared to fungi and bacteria (Figure 20). Overall, bacterial systems have the longest lead times.

Overall, this suggests that organism choice has only a modest impact on access, with capacity constraints affecting all groups. However, slightly longer lead times for bacterial systems may create additional challenges for projects relying on bacterial fermentation, particularly at scale.

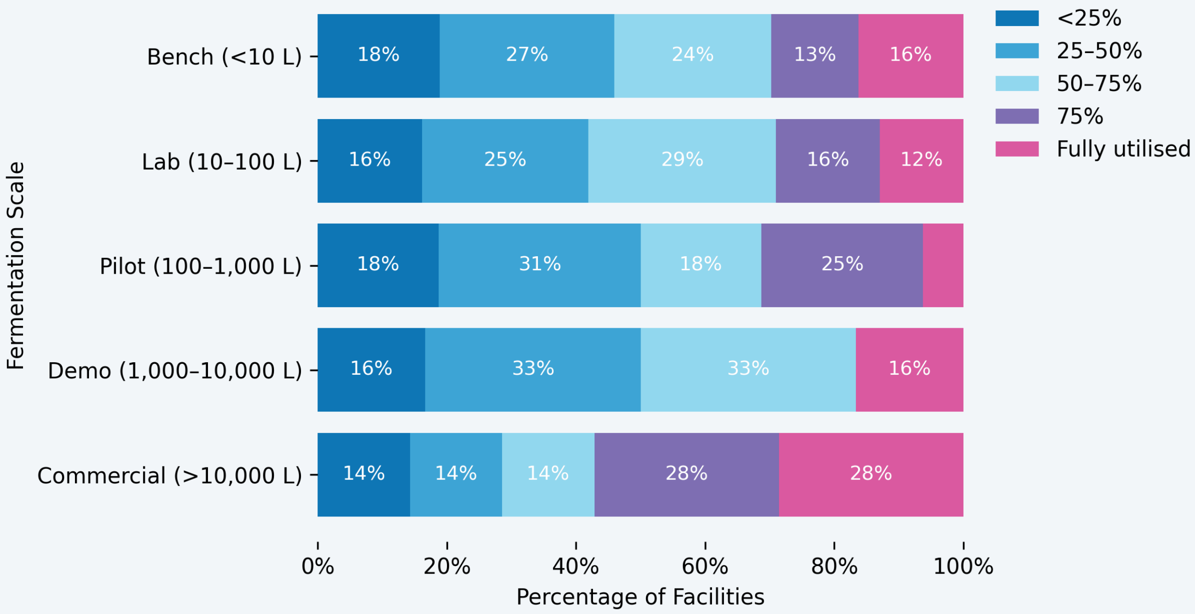


Figure 21. Fermentation utilisation by scale

Where fermentation utilisation rates were reported, they were analysed in terms of scale, noting that some market segments may not perfectly align to literage and scale categories: for example, high-value low-volume products may be commercially produced at less than 10,000 L scale. Figure 21 shows that commercial fermentation capacity is more likely to be highly utilised, with 28% fully utilised and the same proportion at more than 75% utilisation. Smaller scale assets show lower levels of utilisation. Just over half of all bench scale capacity is utilised at 25-75%, with nearly one fifth at under 25% utilisation. The picture for lab scale facilities is similar. Only a third of pilot scale facilities are utilised at more than 75% or fully occupied, and nearly half are utilised at less than 50%.

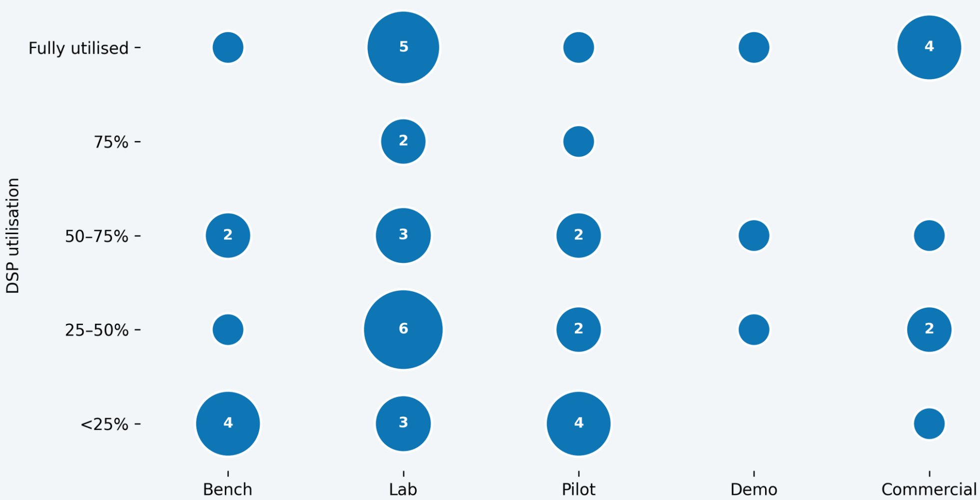


Figure 22. DSP utilisation by scale

Figure 22. shows that reported DSP utilisation shows a similar trend to fermentation, but is potentially more constrained in some organisations and certain scales. Again, smaller scale assets show generally lower levels of utilisation, but the proportion of fully utilised capabilities at both commercial and lab scales is much greater. Commercial downstream processing capacity is more likely to be highly utilised, with half of the capacity fully utilised. Most bench scale capacity is utilised at 25-75%, with half at under 25% utilisation. The picture for lab scale facilities is more mixed, with a third of capacity utilised at 75% or above, but nearly half utilised at less than 50%. More than half of pilot scale facilities are utilised at less than 50%. Two thirds of demonstration scale DSP facilities are utilised more than 50% or fully occupied.

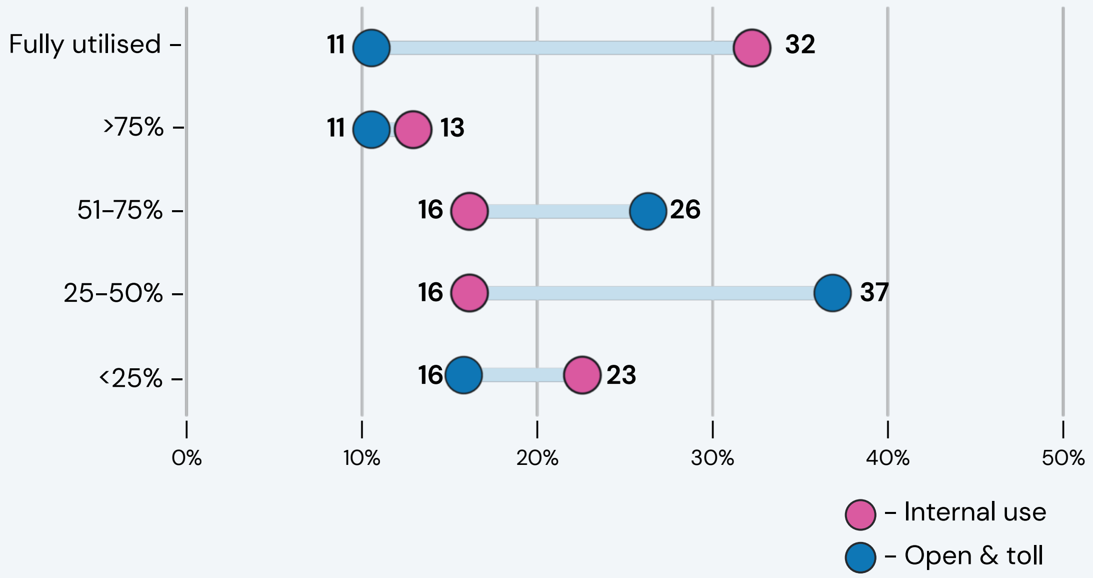


Figure 23. Fermentation capacity utilisation, open & toll versus internal use

Figure 23. shows that internal fermentation capacity is more likely to be fully utilised, with 32% in this band compared to 11% for open or toll capacity. Open and toll facilities, by contrast, have more capacity in the mid-range utilisation bands, with 37% operating at 25–50% and 26% at 50–75%, suggesting greater availability for external users. At low utilisation levels (below 25%), internal capacity is also higher at 23%, compared to 16% for open or toll facilities, indicating some underused internal assets. Little capacity falls within the 75–100% band, particularly for internal facilities.

Overall, internal fermentation capacity tends to be either fully or under-utilised, while open or toll capacity generally offers more accessible mid-range availability.

04 KEY CHALLENGES

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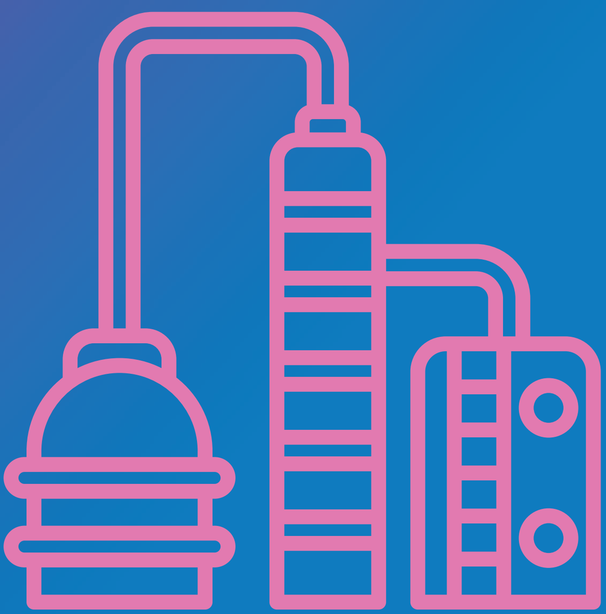
KEY CHALLENGES

The survey responses and industry insights reveal a consistent and systemic challenge in the UK's fermentation landscape, centred on a fundamental weakness in the scale-up pathway from laboratory research to commercial production.

While the UK is widely perceived to have strong capabilities at laboratory scale, and some access to large-scale manufacturing, often located overseas, there is a pronounced and recurring gap across the intermediate stages of development.

This 'missing middle' spans approximately from 10 litres to 10,000 litres, and extends further into pre-commercial scales of 50,000 to 200,000 litres. Stakeholders repeatedly describe this as a critical bottleneck where technologies are too advanced for lab environments but not yet sufficiently de-risked or economically viable for industrial deployment.

At the same time, looking forward over the next 3 to 5 years, respondents emphasise that addressing this gap will require not simply more capacity, but a fundamentally different type of infrastructure: one that is integrated, flexible, and accessible, particularly at pilot-to-demonstration scale.



> *"This isn't just an infrastructure problem, it's a system design problem. The UK lacks a connected, affordable, end-to-end bioprocessing ecosystem that allows companies to scale continuously from idea to industry."*

Scale-Up Bottleneck and the 'Missing Middle'

A dominant theme across all responses is the difficulty of scaling from lab to industrial production. The UK lacks a continuous and accessible progression through pilot and demonstration scales, particularly in the ranges of 10–500 litres, 100–1,000 litres, and up to 10,000 litres. This creates a "valley of death" in development, where companies are unable to generate the data and confidence required for commercialisation.

Looking ahead, stakeholders consistently identify the 5,000 litre to 20,000 litre range as the most urgently needed area of investment. This scale is seen as critical for translating laboratory success into commercially viable processes, enabling companies to produce representative volumes, validate techno-economic assumptions, and de-risk scale-up. Without this capability, many organisations experience delays, are forced to seek overseas facilities, or must invest heavily in building their own infrastructure. In addition, there is a clear and urgent need for UK-based commercial-scale capacity, particularly in the 50,000 to 200,000 litre range. This is viewed as essential for bridging the 'second valley of death' between demonstration and full commercial deployment, where companies currently face a lack of domestic options and often turn to international providers.

Downstream Processing as a Critical Constraint

Closely linked to the scale-up challenge is a significant and persistent deficiency in downstream processing (DSP) capability. While fermentation capacity is often available, the ability to purify, isolate, and finish products at relevant scales is far more limited. Stakeholders consistently highlight gaps in both infrastructure and expertise, particularly in key unit operations such as centrifugation, membrane filtration, distillation, crystallisation, solvent recovery, spray drying, and chromatography.

Across both current gaps and future needs, DSP emerges as a primary bottleneck to commercialisation. Many stakeholders stress that DSP cannot be treated as a separate, downstream activity, but must be developed in parallel with fermentation. The lack of integrated facilities combining upstream and downstream capabilities increases technical risk, slows development, and limits the ability to generate commercially relevant data—particularly for non-pharmaceutical applications, where cost constraints restrict the use of expensive purification methods.

Need for Integrated and End-to-End Infrastructure

A central and unifying theme is the need for integrated, end-to-end bioprocessing infrastructure. Stakeholders highlight the importance of facilities that span the full value chain—from feedstock handling and fermentation through to downstream processing, formulation, and final product finishing.
Looking forward, there is strong demand for co-located fermentation and DSP capabilities, enabling iterative development, optimisation, and rapid learning cycles. Integrated facilities are seen as essential for producing scalable processes and avoiding the inefficiencies associated with fragmented service provision. This includes not only physical integration, but also the incorporation of automation, digitalisation, and advanced process control to improve reproducibility, scalability, and data quality.

Flexible, Modular, and Accessible Infrastructure

The importance of flexibility and modularity is another recurring insight. Respondents call for 'plug-and-play' facilities capable of accommodating diverse organisms, feedstocks, and process configurations. This reflects the breadth of applications within engineering biology and the need for infrastructure that can adapt to different technical requirements.

There is also a strong emphasis on open-access and toll-manufacturing models, particularly to support SMEs and startups. Affordable access to pilot and demonstration facilities is seen as critical for enabling innovation and reducing barriers to scale-up. However, current provision is often described as expensive and difficult to access, with long lead times and limited flexibility.

Gaps in Upstream and Supporting Infrastructure

In addition to fermentation itself, gaps were identified in upstream and supporting capabilities. These include biomass pretreatment, feedstock logistics, and integration with downstream processes, all of which are critical for engineering biology applications. Broader industrial factors - such as access to affordable energy, suitable sites, and utilities for handling hazardous materials - also constrain the ability to scale biomanufacturing effectively in the UK.

Cost, Funding, and Accessibility Barriers

Cost and accessibility emerge as pervasive constraints across both current and future needs. Many stakeholders emphasise that the challenge is not solely the absence of infrastructure, but the difficulty of accessing and utilising it. High capital costs, expensive facility access, and limited funding for both infrastructure and operational use all contribute to restricted utilisation. There is a clear need for affordable mid-TRL infrastructure, supported by appropriate funding mechanisms, to ensure that SMEs and academic spin-outs can progress beyond early-stage development. Without this, even where infrastructure exists, it may remain inaccessible to those who need it most. Some stakeholders also highlight structural issues within funding systems, including high institutional overheads and insufficient support for experimental work.

Supporting Technologies and Industrial Readiness

Beyond core fermentation and DSP, respondents identify a range of supporting technologies and capabilities that are critical to future capacity. These include feedstock pre-treatment and blending, advanced separation technologies (e.g. simulated moving bed chromatography), energy-efficient cell disruption methods, and novel bioreactor designs with lower capital and operating costs. There is also recognition of broader industrial constraints, including access to affordable energy, suitable sites, and utilities capable of handling complex or hazardous materials. These factors are essential for enabling large-scale biomanufacturing and ensuring economic viability.

Skills, Expertise, and Knowledge Transfer

Importantly, the challenge is not solely one of physical infrastructure, but also of skills and expertise. Stakeholders emphasise that successful scale-up depends on the availability of experienced personnel who can design, operate, and optimise processes at scale. Skills are often embedded within specific facilities, meaning that limited access to infrastructure also restricts access to critical knowledge. There are calls for increased investment in training, including industry placements and exposure to industrially relevant equipment within academic settings. In addition, respondents highlight the importance of data-rich environments that support techno-economic analysis, digital twins, and AI-driven optimisation, all of which require both infrastructure and expertise.

Ecosystem Fragmentation and Coordination Challenges

The UK's fermentation ecosystem is widely perceived as fragmented and poorly coordinated. Stakeholders report limited visibility of available capacity, difficulties in obtaining timely and transparent cost estimates, and challenges in coordinating across multiple providers. This fragmentation increases complexity, cost, and risk, particularly for SMEs. There is a clear need for improved coordination, including shared-use models, better communication between facilities, and more transparent access mechanisms. A more integrated ecosystem would enable more efficient use of existing infrastructure and reduce barriers to scale-up.

"Without accessible, integrated infrastructure between the lab and commercial scale, bio-based innovations in the UK are not failing scientifically – they are simply running out of road before they can scale."

IDENTIFIED INFRASTRUCTURE GAPS

Qualitative responses from the survey and stakeholder engagement consistently highlighted several infrastructure gaps:

- **Demonstration-Scale Fermentation (1,000–10,000 L)**
  This scale was repeatedly identified as insufficiently available within the UK, particularly when integrated with downstream processing capability.
- **Large-Scale Commercial Fermentation (10,000–100,000+ L)**
  Respondents noted limited UK-based access to high-volume contract manufacturing. This can lead to offshoring of production and potential long-term loss of economic value.
- **Integrated Fermentation and DSP Facilities**
  The lack of end-to-end demonstration facilities capable of simulating commercial operations was a recurring theme.
- **DSP-Specific Capability**
  Protein purification, complex extraction processes, and advanced separation technologies were identified as areas needing expansion.
- **Regulatory and Commercialisation Support**
  Beyond physical infrastructure, stakeholder noted the need for stronger regulatory guidance and commercialisation pathways.

What single intervention would most improve the UK's non-human health bioprocessing ecosystem?

05
CLOSING THE GAP

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STRATEGIC IMPLICATIONS

If current capacity gaps are not addressed, the UK engineering biology sector could face a range of significant challenges. Extended lead times and limited access to mid- and large-scale fermenters will inevitably slow the commercialisation of new products, delaying the translation of research innovations into market-ready solutions. This could also increase reliance on overseas infrastructure, creating exposure to geopolitical risks, supply chain uncertainties, and higher operational costs.

Capacity constraints may discourage inward investment, as venture-backed SMEs and global companies could be reluctant to locate high-value R&D or manufacturing activities in regions where scaling processes is slow or uncertain. Over time, these limitations could reduce the UK's competitiveness in key growth areas such as industrial biotechnology, alternative proteins, advanced therapeutics, and other high-value bio-based sectors. They may also constrain the UK's ability to achieve its ambitions in sustainable biomanufacturing, including targets for net zero and circular economy initiatives.

Conversely, targeted investment in mid-scale and large-scale integrated fermentation infrastructure presents a clear opportunity. By improving access and reducing lead times, the UK could accelerate innovation, attract inward investment, and strengthen its position as a global hub for bio-based industries. Strategic development of flexible, well-coordinated facilities would not only support commercialisation timelines but also enable the scaling of processes from lab to pilot to full production, unlocking substantial economic, environmental, and societal benefits.

CONCLUSIONS

The UK possesses a strong foundation in fermentation science and early-stage bio-based innovation. However, this report indicates structural weaknesses in demonstration and commercial-scale infrastructure, particularly where integrated fermentation and downstream processing are required.

The most acute bottleneck lies in the pilot-to-demonstration transition, followed closely by demonstration-to-commercial scale-up. Downstream processing constraints amplify these challenges.

Addressing these gaps would not merely solve operational bottlenecks; it would materially strengthen the UK's ability to retain value from its research base, attract investment, and build a resilient domestic biomanufacturing ecosystem.

The findings provide a clear strategic direction: targeted expansion and integration of mid-to-large-scale fermentation and DSP capacity will be essential if the UK is to fully realise its engineering biology ambitions over the coming decade.

RECOMMENDATIONS

1 EXPAND DEMONSTRATION-SCALE INFRASTRUCTURE

Investment in 5,000–20,000 L integrated fermentation and DSP facilities is critical.

2 FACILITATE LARGE-SCALE COMMERCIAL ACCESS

Public-private partnerships to help de-risk expansion of 50,000–100,000 L capacity within the UK.

3 STRENGTHEN DOWNSTREAM PROCESSING CAPABILITY

Dedicated DSP development centres and integrated process optimisation platforms should be prioritised.

4 IMPROVE COORDINATION AND TRANSPARENCY

A national capacity map and streamlined access framework could reduce fragmentation.

5 ENHANCE SCALE-UP FUNDING MECHANISMS

Targeted financial instruments aimed specifically at pilot-to-demo transition could bridge the valley(s) of death.

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The Bio-based and Biodegradable Industries Association (BBIA) is the UK's only trade association dedicated to the bioeconomy and engineering biology. Our vision is for a more sustainable future, where the UK is a global leader in developing, manufacturing, using and exporting bio-based solutions.
www.bbia.org.uk

BDC
Biorenewables
Development Centre

The Biorenewables Development Centre, part of the University of York, is an open-access innovation organisation that helps businesses turn biomass—such as plants, microbes, and waste—into sustainable chemicals, materials, and fuels. It supports development, scale-up, and commercialisation through pilot-scale facilities, technical expertise, and business support, enabling companies to bring bio-based solutions to market.
www.biorenewables.org

Pioneer

Pioneer Group is a UK-based platform that supports science and technology companies through a combination of specialist real estate, investment, and business support. With a strong focus on life sciences, it provides lab and office space, access to funding, and connections to experts and partners. By bringing together entrepreneurs, researchers, and industry, it helps innovative companies grow and scale successfully.
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