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Centre for Sectoral Economic Performance

Sectoral Systems of Innovation and the UK's Competitiveness

Fine Chemicals Sector 2025

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Executive Summary

We are extremely grateful to Lord David Sainsbury and the Gatsby Charitable Foundation for generously supporting this sectoral study of the fine chemicals industry. It is a sector with significant contributions to the UK's economy (both directly and by underpinning other sectors) but is facing multiple challenges within and outside the UK. As such, it deserves a closer inspection of its status and the development of potential interventions. We aimed to provide a diagnosis of the industry by looking at its landscape, productivity, skills requirements, technology, innovation, business, and regulatory environment. We coupled these with deep dives with UK chemical industry organisations to support our findings. Based on these analyses and stakeholder engagements, we developed our high-level conclusions, recommendations to stakeholders, and areas of further detailed study.

Our key conclusions so far are the following:

- The global fine chemicals industry is a thriving and growing industry marked by a competitive market, wherein the major players dominate at 40% to 45%. Most of the fine chemicals businesses are involved in manufacturing (80% of the market). Having R&D capabilities, manufacturing expertise & efficiency, supply chain management, global presence reach, and regulatory compliance are crucial competitive advantages in the global landscape.

- Being the birthplace of fine chemicals, the UK's industry has been well-established with highly diversified products. The UK's fine chemicals sector interlinks its own bulk (or commodity) chemicals industry to various end-use sectors within the country and internationally. Our estimates show that fine chemicals contribute 40% of the GDP value of chemical manufacturing (£11bn to £12bn), which is commonly reported.

- The UK's broad chemicals industry (bulk + fine), while significant, has struggled with consistent productivity growth since the global financial crisis. The industry's international competitiveness, particularly against countries like China and India, is being challenged by high energy prices, raw material shortages, and skilled labour shortages. Zooming in on the UK fine chemicals sector, it may in principle be insulated from these challenges due to its nature of business and the high value of its products. Drivers of productivity growth in the fine chemicals industry include technology and product innovation and scaling up, meeting skills requirements, an enabling business environment, and an enabling policy and regulatory environment.

- Our calculations show that the UK's fine chemicals industry has a Gross Value Added (GVA) of £33 billion and employs over 231,000 people, which translates into a labour productivity of £143,000 per employee as of 2024. The top five contributing subsectors are Catalysts, Contract chemicals, Specialty polymers, Pigments & dyes, and Construction chemicals. This highlights the fine chemicals sector's importance, beyond its own KPIs, as it underpins other key industries of the UK including pharmaceuticals, agrochemicals, fast-moving consumer goods, automotive, aerospace, and building and construction.

- The fine chemicals industry primarily uses chemical synthesis and biotechnology, with chemical synthesis being the focus of this report due to its extensive toolbox of available reactions. Fine chemicals production typically occurs in multi-purpose batch plants, which are designed to handle various chemical reactions and synthesis, and purification steps, allowing for efficient production of a diverse range of products. These plants, while costly, offer flexibility and cost-effectiveness, especially when compared to dedicated plants for each product. Key technology innovation and scale-up requirements include competency in synthesising complex fine chemicals, flexible manufacturing, process intensification, and increasing biotechnology integration. Drivers of innovation include product design, sustainability, the net-zero transition, biomass conversion, and synthetic biology. Digital technologies are another driver that will revolutionise sustainable manufacturing of fine chemicals whilst increasing efficiency and reducing costs. Lastly, the battery industry is another technology innovation driver, which driven by the net-zero transition, will create demand for innovative fine chemicals.

- The current UK chemical industry requires skilled workers, particularly technicians with level 3 to level 5 qualifications. There is a shortage of a skilled workforce due to a "lost generation" and labour shortages. While the industry currently relies on external labour markets and in-house training, future skills requirements must be met; these include topics such as chemistry and engineering innovation, data analysis, and leadership, which are going to be crucial for addressing complex commercial challenges and opportunities brought about by the UK's net-zero commitment and the advent of Industry 4.0. These emerging skills requirements reflect a transitioning chemicals industry requiring new thinking and strong leadership.

- Business-to-business transactions, custom manufacturing, and R&D-driven fast-to-market products are integral in doing fine chemicals business. Considering these, enabling mechanisms for the UK fine chemicals sector include strategic procurement, government-supported logistics, market access support, prioritising IP ownership, and SME acceleration. These mechanisms aim to drive innovation, competitiveness, and economic growth within the sector.

- Fine chemical manufacturers, both globally and in the UK, are subject to a range of regulations, including the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). While the UK REACH is largely aligned with the EU REACH, its potential divergence of standards and processes from internationally accepted regulations may pose additional overhead compliance and hamper trade, considering how chemical value chains are integrated across the globe. A new development in the EU is that of "Safe and Sustainable by Design" which may create additional opportunities for innovation in new chemicals and materials while also subjecting these to increased scrutiny.

- Our deep dives with organisations in the UK's chemical industry revealed insights that resonated with our review and analysis, to date. According to the Chemical Industry Association (CIA), the UK fine chemicals industry faces challenges including energy and feedstock costs, consistent sustainability reporting, and a skills gap. CIA recommends streamlining regulations, supporting alternative feedstocks, and regionalising policies as pathways toward better international competitiveness of the industry. On the other hand, the Society of Chemical Industry (SCI) reported that the UK chemical industry faces challenges in policy coordination and investments, despite its historical importance and innovations. SCI recommended that the UK must address industry structure, energy productivity, and regulatory alignment to capitalise on growth opportunities, especially from new chemistries and circular carbon, and overcome threats. Lastly, The Centre for Process Innovation (CPI) stated that the challenges of the UK chemical industry are due to declining domestic production and reliance on global supply chains. CPI recommended, to improve competitiveness, the UK should incentivise platform chemicals production, support disruptive technology adoption, and bridge the gap between academic research and industry application.

We believe our recommendations to stakeholders (academia, industry, and government) are going to be a collective and collaborative effort. These can be grouped into six interconnected priorities to form a robust enabling ecosystem for the UK's fine chemicals sector.

Priority 1. Sector strategy planning:
An agreed industry-led sector strategy is vital to address immediately the short-term challenges and create a supportive ecosystem in the long term.

Priority 2. Economic and business development:
An enabling chemical business environment to enhance the industry's GVA and grow its global competitiveness.

Priority 3. Regulation and policy:
A more streamlined policy environment to prevent deviations from international standards and to foster innovations creating a competitive edge.

Priority 4. Skills:
A skills roadmap to meet both the skill required now, and the skills required in the future to ensure a globally competitive workforce.

Priority 5. Innovation:
A strong focus on the R&D of product innovation, flexible manufacturing and process intensification whilst ensuring the IP developed is exploited first within the UK.

Priority 6. Mindset change:
A need for greater recognition of our home-grown chemicals industry in terms of its importance and role in everyday life of British citizens.

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1. Introduction

1.1. Background

The global chemical industry generates £3.7 trillion in revenue annually, representing about 4% of the world's GDP, and directly employs more than 15 million people.[1] The UK's chemical industry* is a significant global player with annual revenue of £75.2 billion, GVA of £30.7 billion, and direct employment of 141,000 people in 2021.[2] It is an important sector in the UK's economy[3] with public and private research and development (R&D) spending of £8.2 billion (representing 0.4% of the national income) and a further £5.8 billion of capital investments (representing 17.2% of private sector manufacturing expenditure) in 2021.[2]

The UK's chemical sector has a diverse range of products[4] that can be generally classified into[5]:

- Commodity chemicals: aka bulk chemicals, organics from fossil and biomass feedstocks and inorganics from various metals and minerals;
- Fine chemicals: complex**, single, pure chemicals synthesised in tailored batches: and
- Specialty chemicals: blending of two or more fine chemicals to create a substance with unique functions.

Traditionally, the UK's chemical industry started with commodity chemicals in the early 19th century and gradually transitioned to be dominated by fine chemicals due to the success of its pharmaceuticals industry by the 1950s and the diversification into agrochemicals and paints businesses by the 1980s.[6] It was also at this period that fine chemicals became a distinct industry due to an increasing trend among chemical firms to outsource production of highly sophisticated organic molecules. This is also called contract manufacturing, which became integral to deciding whether to make or buy chemicals in the supply management of chemical firms.[7]

Fine chemicals are often produced in small and restricted volumes (<1,000 tonnes per year) via batch chemical or biotechnological processes and followed by synthesis, segregation, and purification. Due to laborious procedures and stringent product standards, fine chemicals are frequently sold at high prices (> $10 per kg).[8] These are mostly used in the pharmaceuticals industry (60% of global market[8]) and are also used by agrochemicals (20% of global market[8]), electronics, automotive, construction, and fast-moving consumer goods (FMCG) industries.[5]

The UK is a key player in the global fine chemicals industry through UK-owned and/or UK-based companies along with UK-based transnational corporations and smaller UK-owned companies, many of which have UK-based manufacturing facilities.[9] Historically, the UK is a major player in the growing fine chemicals market.[5] However, it is now facing many challenges, such as offshoring of production facilities in more cost-competitive regions; increasing Chinese and Indian imports;[9] fewer domestic supply options for inputs due declining local bulk chemicals industry;[10] mixed abilities to integrate Industry 4.0 for digital manufacturing, circular economy implementation, and customer-driven solutions;[8] commitment to greenhouse gas (GHG) emissions reduction and the net-zero transition; more stringent environmental regulations;[2] and a need to increase the utilisation of renewable materials and energy.[11]

There is a need for system-wide interventions to increase productivity through innovation and to enable a resilient and secure fine chemicals industry. The main objectives of this sectoral study are to undertake a review of the UK's fine chemicals industry focusing on its dynamics and to propose strategies and policies that could enhance its firm and overall competitiveness amid changing national and international factors.

1.2. Motivation

The core motivations of this sectoral study are to:

- Gain insights into the factors influencing the changing dynamics of the UK's fine chemicals industry, especially those relating to its global competitiveness and national productivity; and
- Develop recommendations for stakeholders (academia, industry, and government) that ensure the UK's fine chemicals industry transformation into a resilient and flexible sector within the changing global landscape.

1.3. Scope

In this report, we cover the following:

- Part 1. Our landscape analysis of the fine chemicals industry both global and domestic;
- Part 2. Our high-level manufacturing and innovation analysis of the UK's fine chemicals sector;
- Part 3. Our deep dives with the UK's chemicals industry organisations; and
- Part 4. Our high-level conclusions, recommendations to stakeholders, future work, and areas of further detailed study.

* The statistics provided are the combined chemicals and pharmaceuticals businesses in the UK.

** Complex is a key term that sets apart fine chemicals from commodity chemicals. Commodity chemicals can be single pure substances but NOT necessarily complex.

2. Taxonomy

To facilitate a shared understanding for this report, we collated typical terminologies used in the fine chemicals industry. The types of fine chemical products are defined in Table 1. While typical product types refer to the formulated products (i.e., made up of two more fine chemicals, also sometimes known as specialty chemicals), some fine chemical products are sold as single formulations (i.e., one fine chemical only), such as specialty polymers, pigments, dyes and surfactants. Note that articles and reports about the fine chemicals industry do not follow a standard set of terminologies for the product types and application types and industry classifications (e.g., UK Standard Industrial Classification (SIC) and The Data City). Table 2 presents the types of applications for fine chemicals, i.e., the end-use industries. Lastly, the two business types of fine chemicals market are shown in Table 3, which is related to how companies engage in the industry and market of fine chemicals.

Table 1. Products made from fine chemicals according to FMI[8].

Product type	Definition
Pharmaceuticals	Fine chemicals used in producing a range of prescription drugs
Agrochemicals	Fine chemicals used in producing fertilisers, pesticides and herbicides
Construction chemicals	Fine chemicals used in the building and civil repair service to enhance concrete strength and quality and provide water tightness
Additives	Variety of fine chemicals added to food, medications and polymers
Specialty polymers	Mostly water-soluble fine chemicals used in variety of industries like textile, packaging, food and beverages
Pigments & dyes	Fine chemicals used to colour surfaces and textiles
Flavours & fragrance ingredients	Organic volatile fine chemicals used in making perfumes and masking odours of other ingredients
Water treatment chemicals	Fine chemicals used in water treatment facilities to eliminate lingering pathogens
Surfactant	Fine chemicals used to self-assemble micelles in solution and interface between a solution and another phase
Other products	Fine chemicals utilised as catalysts and enzymes

Table 2. Applications of fine chemicals according to FMI[8].

Application type	Definition
Pharmaceuticals & nutraceuticals	Fine chemicals applied to the health and wellness industry
Agriculture	Fine chemicals applied to farming and crop protection
Cosmetics & home/personal care	Fine chemicals applied to cosmetics, personal care items and home care products (e.g., detergents, cleaning, etc.)
Petrochemicals & plastics	Fine chemicals applied for plastic manufacturing to increase productivity, reduce costs and optimise product quality
Food & beverages	Fine chemicals applied to human and animal food industry
Electronics	Fine chemicals applied to electronic industries
Paints & coatings	Fine chemicals for specific paints and coatings industries to influence performance and provide unique functionalities
Building & construction	Fine chemicals for building and construction industry such as adhesives, sealants, inhibitors and among others
Lubricants & oil	Fine chemicals for machinery industry
Textiles	Fine chemicals for textile industry
Other applications	Fine chemicals of the catalyst industry

Table 3. Business type of the fine chemicals sector according to FMI[8].

Business type	Definition
Captive	Market involved in the manufacturing of fine chemicals primarily for internal use
Merchant	Market involved in the manufacturing and distribution of fine chemicals

3. Global industry

The UK's fine chemicals industry is not immune to the ebbs and flows of the global economy. Hence, it is critical to understand the international context and how it relates to the UK. This chapter of the report presents the global market trends in Section 3.1 followed by the generalised fine chemicals value chain in Section 3.2. Section 3.3 presents the current supply and demand scenario. The key drivers of the fine chemicals sector are discussed in Section 3.4. A SWOT analysis of the global fine chemicals industry is presented in Section 3.5. Section 3.6 concludes this section with the success factors in the global arena.

3.1. Global market trends

The historical market value and volume of the global fine chemicals industry from 2018 to 2023 is shown in Figure 1 below. In 2023, the market value of the global fine chemicals industry was £147 billion, which is forecast to grow to £270 billion in 2033 at 6.8% cumulative average growth rate (CAGR).[8] This translates to a global market volume of about 18 million tonnes (Mt) in 2023 (see Figure 1).

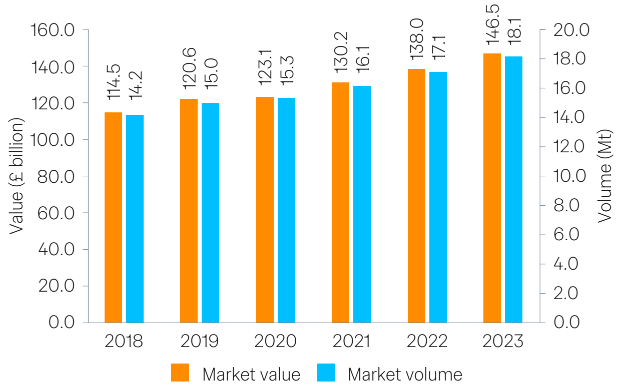


Figure 1. Market value and volume of the global fine chemicals industry from 2018 to 2023, plotted from FMI[8] data.

The next set of pie charts depict how the global fine chemicals market value is shared (or distributed) in 2018 and 2023. Figure 2.a shows the global market share by end-use product type. Products used in the pharmaceuticals sector dominate the global market at over 60% within the 5-year period, which is mainly attributed to high demand and prices of intermediates and active pharmaceutical ingredients (APIs)[8]. Agrochemicals is the second dominant product type at about 20% of the global market. The rest of the product types have minor contributions ranging from 1% to 4% to the global market of fine chemicals.

The global market share by application type is presented in Figure 2.b, which consistently shows the dominance of the Pharmaceuticals & nutraceuticals industry at about 60% in the last five years, because of its high consumption of pharmaceuticals.[8] Agriculture has the second largest share at 20% of the global market due to its consumption of agrochemicals. The third and fourth largest shares are in the Cosmetics & home/personal care, and Paints & coatings industries at about 5% and 4% of the global market, respectively. The rest of the industries have minor shares ranging from less than 1% to about 3% of the global fine chemicals market.

Figure 2.c shows the global market share by business type. 'Captive businesses' have market advantages such as cost control, quality assurance, IP protection, flexibility, speed, and supply chain stability.[8] Captive businesses either involve in-house manufacturing or integrated production and internal consumption within the same or other parts of the fine chemicals industry. In contrast, merchant businesses focus on producing/formulating and distributing a wide range of fine chemicals to a wide range of customers.[8] Captive business is overwhelmingly dominant, at over 80% of global sales, with a slight growth of 0.5% from 2018 to 2023. The value chains of the industry are complex, with fine chemicals primarily being a business-to-business (B2B) sector,[12] and the molecules making their way into a very wide range of final products or being used within manufacturing processes.[13]

The regional distribution of the global fine chemicals market is presented in Figure 2.d showing a consistent trend from 2018 to 2023. The largest share, 32% of the global market, is in East Asia, which is attributed to the region's low cost of production and sizeable domestic demand[8]. In 2023, the demand for fine chemicals in East Asia was 6 Mt (see Figure A - 1), more than two-thirds of the global demand. Referring again to Figure 2.d, North America and Western Europe are the second and third largest markets for fine chemicals at 24% and 16% of the global share, respectively. Emerging fine chemicals markets of South Asia Pacific and Latin American regions represent the fourth and fifth largest of the global share at about 13% and 6%, respectively. The rest of the world regions have a share ranging from less than 1% to 3% of the global market.

Figure 3 presents the share by player (i.e., manufacturer and/or company) of the global fine chemicals market in 2022. The major players account for 40% to 45% of the global market and they significantly lead the overall growth of the global market[8]. These companies can be further classified into Tier 1 and Tier 2. Tier 1 companies have dominant market positions owing to their extensive global presence, wide range of product portfolios, strong R&D capabilities, and/or robust financial resources. Toray Fine Chemicals Co., Ltd, BASF SE, Pfizer Inc., Merck & Co., and BAYER AG are Tier 1 companies. Tier 2 companies specialise in niche markets or specific product lines by taking advantage of their regional focus, agility, and/or flexibility. GlaxoSmithKline plc, Novartis International AG, Evonik Industries AG, Solvay SA, and DuPont de Nemours Inc. are Tier 2 companies.

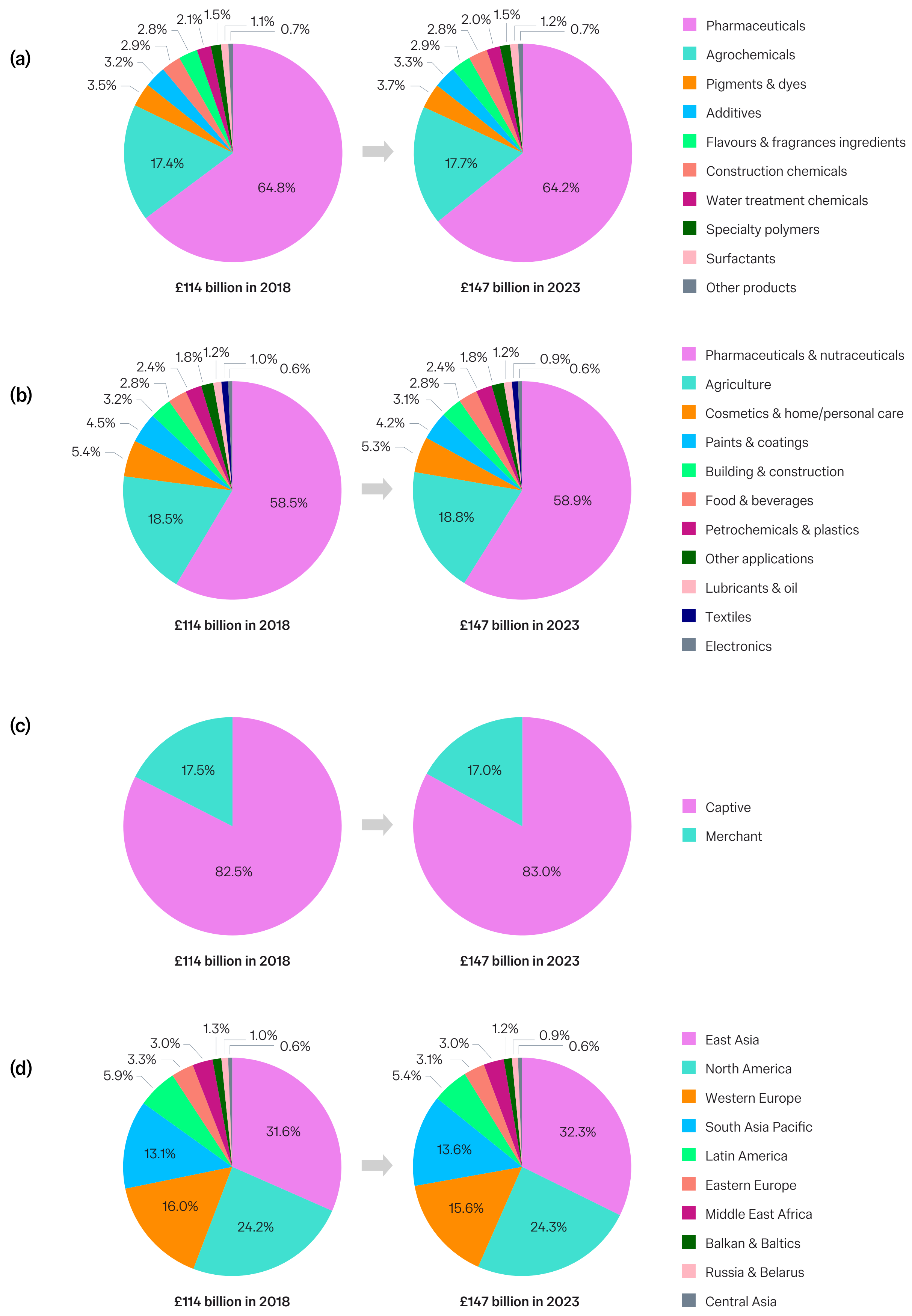


Figure 2. Global fine chemicals market value share by product type (a), application type (b), business type (c), and region (d) in 2018 and 2023, plotted from FMI[8] data. (See Figure A - 1 for the market share by volume.)

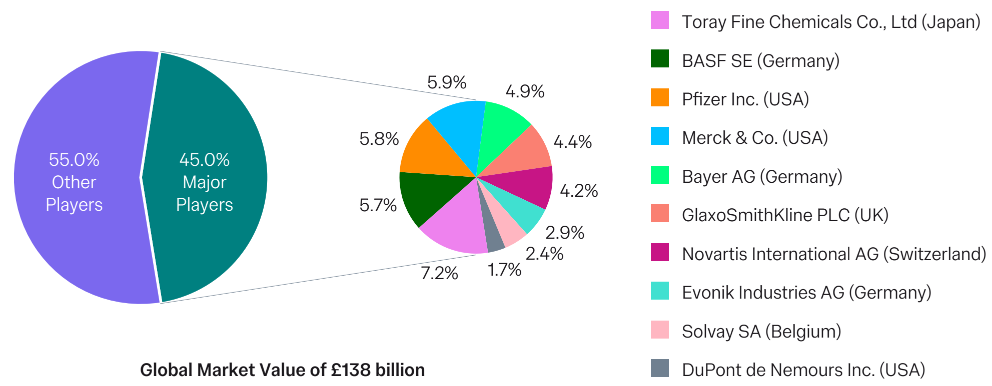


Figure 3. Global fine chemicals market by players in 2022, plotted from FMI[8] data.

3.2. Value chain analysis

A generalised value chain of the global fine chemicals industry is shown in Figure 4, which depicts how the key players relate to each other. Note that companies may be involved in two or more parts of the value chain:

- The fine chemicals industry starts with raw materials suppliers, e.g., Eurolabs Ltd (UK), Interstate Chemical Company (USA), and Toray Fine Chemicals Co., Ltd (Japan).
- Fine chemical manufacturers follow in the value chain, with familiar multi-national companies and corporations like BASF SE (Germany), Novartis International AG (Switzerland), Bayer AG (Germany), Merck & Co. (USA), GlaxoSmithKline PLC (UK), Pfizer Inc. (USA), and AstraZeneca PLC (UK).
- Manufactured fine chemicals are distributed by companies such as Apollo Scientific Ltd (UK), BOC Sciences (USA) and Zhejiang Jiuzhou Pharmaceutical Co., Ltd. (China).
- Finally, end-users include key players such as Abbott Laboratories (USA), Johnson & Johnson (USA), L'Oréal (USA), P&G (USA), British Petroleum (UK), LG Electronics (South Korea) and Syngenta (Switzerland).

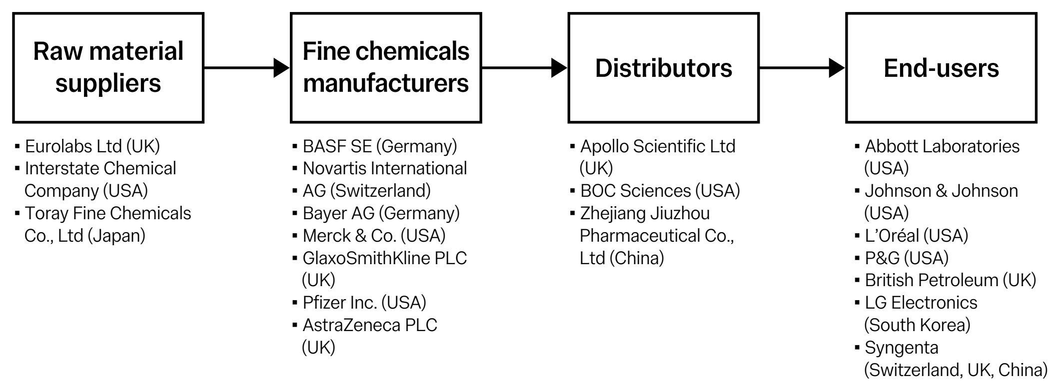


Figure 4. Generalised value chain of the fine chemicals industry based on the report by FMI[8].

3.3. Global supply and demand – current situation

The current supply and demand by volume for fine chemicals per world region is presented in Figure 5 below. The East Asian region is the primary supplier and consumer of fine chemicals, which both accounts for 34% of the total supply and demand, respectively. The regions of North America and Western Europe come in second and third place, with both supply and demand accounting for 24% and 15%, respectively, of the total. The growing economies of South Asia Pacific and Latin American regions are the fourth and fifth largest, which account for 13% and 5%, respectively, for both the global supply and demand. The rest of the regions have their supply and demand for fine chemicals ranging from 1% to 3% of the world supply and demand.

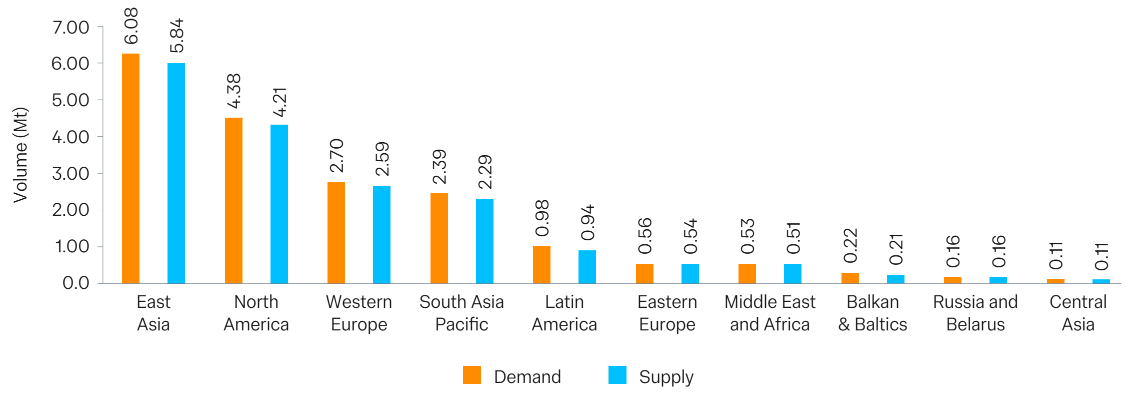


Figure 5. Supply and demand for fine chemicals per world region in 2022, plotted from FMI[8] data.

Global supply trends

- On the global supply side, the general trend is shifting towards specialisation, whereby manufacturers focus on niche product lines and offer customised solutions. Another trend is towards sustainability and green chemistry practices to meet regulatory requirements and address environmental concerns as well as to boost material productivity and reduce waste.[8]
- Players in the global market are expanding manufacturing capacity and R&D activity.[8] The trend in R&D initiatives and investment activities by leading companies is to enhance the effectiveness and efficacy of their existing products, and to launch new innovative products. Companies are also increasing their capacity to produce fine chemicals (e.g., intermediates, formulation ingredients and APIs) to meet the rising demand from pharmaceuticals industry.[8]
- The competition among major players in the global fine chemicals market is intense. Multinational companies and industry consolidation further intensify the competition. To gain a foothold in the global market share, companies are having to focus on high product quality, superior technology, efficient production and strong customer relationships.[8]
- In terms of bargaining power of suppliers, fine chemical manufacturers are largely influenced by suppliers of raw materials and intermediates. These entities can dictate prices or impose unfavourable contractual terms when stocks are scarce and/or the pool of suppliers is small. In the global landscape, however, there are several players, which reduces the overall bargaining power of suppliers. Fine chemical manufacturers also enter long-term contracts to secure supply of inputs, which also reduces the bargaining power of suppliers.[8]

Global demand trends

- There are four general trends of the global demand for fine chemicals. First, the growing market influence of the pharmaceuticals sector, which is evident in products (Figure 2.a) and applications (Figure 2.b) of fine chemicals. This is because of its significant demand in drug discovery, formulation and production, which is being driven by ageing global populations, prevalence of chronic diseases and neurological disorders, and heightened spending on health care in many countries. Second, global demand for fine chemicals is influenced by regional variations in economic growth, industrial activities and government policies. It is expected that the growing economies of South Asia Pacific and Latin American regions will drive global fine chemicals demand required for their burgeoning health and wellness, consumer goods, agriculture and general industries. Third, global demand for fine chemicals with lower environmental impacts, reduced health and safety risks and produced in a sustainable manner, is increasing due to more stringent environmental regulations and a system-wide push towards a more sustainable chemicals industry (cf. the "Safe and Sustainable by Design" or SSbD initiative in the EU). Fourth, which is related to the third trend, more consumers of fine chemicals end-use products are preferring organic and nature-based options, clean-labelled ingredients, and sustainable packaging, which is driving demand for fine chemicals that can provide eco-friendly and sustainable solutions.[8]
- The bargaining power of buyers (i.e., pharmaceutical, agrochemical and specialty chemical companies) varies. Often, those who buy fine chemicals in bulk can negotiate favourable prices and/or better contractual terms due to the large volumes purchased or the availability of alternative suppliers. However, substantial costs of switching to alternative suppliers can reduce the bargaining power of buyers. Additionally, fine chemicals are frequently customised to meet product specifications (e.g., high purities), thus diminishing product substitutability and reducing buyer power.[8]

3.4. Drivers of the global landscape

This section presents the key drivers of the global landscape. The following drivers influence the overall growth and development of the fine chemicals industry on a global scale. Some of the drivers can directly impact the global landscape, while others have indirect impacts.

Macroeconomic factors

Two macroeconomic factors directly influence the global fine chemicals industry. First, the fine chemicals business is cyclical, and it is intricately linked to the fluctuating GDP of countries. Output from developed economies is expected to exceed pre-pandemic projections due to significant US policy support to increase production potential. The emerging regional markets of Asia and Latin America account for about 50% of fine chemicals. An increase in their GDP together with regulatory compliance reforms is expected to boost the sale of fine chemical end-use products.[8]

Second, the rapid inflation rates in some economies, both developed and developing, are attributed to supply-demand mismatches due to the COVID-19 pandemic and subsequent higher prices of commodities and capital equipment. Should similar supply-demand mismatches continue further, then price pressures will be sustained, and rising inflation will be expected, which could lead to tightened financial conditions in developing countries.[8] Persistent inflation results in decreased purchasing power of consumers, in turn reducing demand for materials produced by the chemicals sector (e.g., polymers, engineering plastics, coatings and industrial fibres) that are used by other cyclical sectors, such as transport and construction.[14]

Growth of end-use industries

The growth of end-use industries has a direct impact on the demand for any product. Pharmaceuticals & nutraceuticals, Cosmetics & home/personal care, Food & beverages, Electronics, and Building & construction industries are projected to increase fine chemicals demand over the forecast period. The Pharmaceuticals & nutraceuticals industry, particularly post-pandemic with an estimated market demand of 2.6 million tonnes by 2030[8], will particularly drive the growth of the global fine chemicals market. Due to people's changing food habits and lifestyles, expenditure on health-related products is increasing, subsequently, it is rapidly changing the global healthcare landscape. Fine chemicals demand will further increase as they are needed in the production of high-quality APIs, customised drug formulations, and advanced drug delivery systems, and support R&D activities of the growing global pharmaceutical and healthcare sectors.[8] The global cosmetics and personal care industry is valued at £179 billion in 2018 and is projected to grow to £302 billion in 2029. Its growth is attributed to higher standards of living, the direct impact of beauty and personal care on self and social status, and the stable demand for luxury cosmetic products.[8] On the other hand, the global food and beverages industry was valued at £205 billion in 2020 and will grow to a £420-billion industry by 2028, with an average growth rate of 9.4% per year.[8] The tremendous global demand for electronic devices and computing power (e.g., GPUs) is also driving the fine chemicals sector. Fine chemicals are used in making semiconductors, electronic components and displays in many consumer electronics. Manufacturing of integrated circuits, circuit boards, conductive films and specialty coatings also uses fine chemicals. Developing high-energy density and efficient energy storage technologies (e.g., batteries and supercapacitors) also requires fine chemicals (e.g., electrolytes, binders and additives). Increasing construction activities and infrastructure development worldwide are expected to increase the demand for sealants, adhesives and inhibitors, among others,[8] all of which drive the growth of the global fine chemicals sector.

Research and technology developments

Major players in the fine chemicals market invest a substantial portion of their revenues in R&D, with a direct high impact on the global fine chemicals sector. R&D activities are aimed at developing technologies and solutions to meet the growing demand for end-use products. They are also aimed at developing innovative and advanced products for sustainable development.[8] However, there has been a perceived lack of innovation in the chemicals industry since the 1970s due to many Western firms focusing their assets and diversifying to pharmaceuticals. Subsequently, they divested into subsidiaries involved in bulk chemicals manufacturing or no longer undertaking R&D to improve chemical production technologies (e.g., the divestment of Bayer of the Lanxess and Covestro businesses). While firms may continue to make structural and/or organisational changes to suit their needs, the growing considerations for the environment and sustainability will drive innovations in chemical production technology, even if incremental.[15] For example, there is a rapid shift from producing fine chemicals in multi-purpose batch processes to continuous-flow and modularised production, which can create competitive, sustainable and faster-to-market products. The fine chemicals industry has also rapidly integrated microreactor technology (MRT), which has lower energy and environmental impacts than conventional large production plants.[16]

Other drivers

- Effect of major players: Considering the significant control on the supply by major players, their growth or decline directly impacts the global and UK fine chemicals sector. Their capacity expansions result in positive effects to market growth. The financial opportunities of the major players also represent potential market growth.[8]
- Raw materials availability: Production of fine chemicals is highly dependent on the availability and price of raw materials. Should raw materials become scarce, this can hamper the production of fine chemicals. Subsequently, the manufacturing of end-use products slows down.[8]
- Overall chemicals industry growth: The global fine chemicals industry contributes a significant share to the overall chemicals industry through interconnections. Growth of the overall chemicals industry also leads to growth in the fine chemicals industry.[8]
- Global trade: The fluctuations in global trade can significantly affect the growth of the fine chemicals sector. Impacts can be attributed to trade disputes among leading economies, changing trade policies, and volatile geopolitical situations. Global trade of crops is also expected to drive the demand for fine chemicals as agrochemicals are critical inputs in agriculture.[8]

Wider factors

The following drivers indirectly impact the fine chemicals industry or the overall chemicals industry:

- Sustainability requirements: In 2015, the United Nations established the Sustainable Development Goals (SDGs) Framework, which is comprised of 17 aspirational goals to end poverty, protect the planet, and ensure peace and prosperity for all peoples by 2030. This universal call to action is being adopted by governments, organisations and industries across the world.[17] The chemicals industry can support the SDGs through responsible chemical production, utilisation and management.[18] While the rapid growth of the chemicals sector provides thousands of beneficial products used by several downstream industries, the chemicals sector contributes emissions and industrial pollution to the already heavily-strained environment and negatively impacts human health.[19] There is a need for the chemicals sector to adopt innovative products and cleaner processes that minimise negative impacts, protect the environment, promote circularity and support socio-economic growth.[18] Hence, driven by sustainability, major players in the fine chemicals industry are pouring money into R&D investments to discover novel products with lower negative environmental impacts and reduced health and safety risks and to develop cleaner production methods. For example, fine chemical firms have also adopted a range of net-zero targets, all of which include Scope 1 and 2 emissions and Scope 3 emissions for some of their product lines. Also, shifting consumer preference for healthier, eco-friendly, and/or sustainable end-use products is being driven by the rapid adoption of sustainability in many societies.[8] The fine chemicals sector has not been known for material efficiency historically (i.e., the mass ratio of waste to final products is high relative to other industries; typically being 5-50[20]) and there are now many initiatives (often labelled “Green Chemistry”[20]) to improve this.
- Industry 4.0: The fourth industrial revolution or Industry 4.0 involves the integration of advanced digital technology platforms into physical manufacturing operations of facilities resulting in flawless integrated processes and/ or systems. Given its benefits to energy efficiency, workflow optimisation, quality analysis and control, safety management, preventive maintenance, and supply chain management, the chemicals industry has gradually adopted Industry 4.0. In particular, the sector’s R&D activities focus on novel and improved products using integrated systems.[5]
- Pandemics: Before the COVID-19 pandemic, the growth of the global fine chemicals industry had been consistent due to increasing demand across the various end-use industries. A sharp decline in growth was experienced in 2020 due to strict lockdown measures to curb the virus outbreak, resulting in a demand reduction for fine chemicals across all end-use industries. Through government initiatives to spur economic development, the demand for fine chemicals bounced back in the second half of 2021.[8] As mentioned above, rapid inflation rates were brought about by pandemic-related supply-demand mismatches. In spite of this, the growth of global fine chemicals is projected to steadily increase post-pandemic, because of the sustained demand across the end-use sectors. Its growth is expected to peak in 2029 and then decline back to pre-pandemic levels in 2033.[8]
- Geopolitics: The Russia-Ukraine War triggered an energy crisis that has strong negative impacts on the chemicals industry[2], particularly in the Western European region. The consequences are the prohibitive cost of natural gas (used both as fuel and feedstock by the chemicals industry), decline in profit margins, and competitiveness of the region.[21] As mentioned above, global trade is also affected by volatile geopolitical situations.[8] Hence, geopolitics poses a long-term risk to the chemicals industry.[21]

3.5. Global industry SWOT analysis

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis of the global fine chemicals landscape is presented in Figure 6 below. This analysis is carried out from a global perspective.

Strengths	Weaknesses
▪ Well-established pharmaceuticals market ▪ Increasing demand for fine chemicals	▪ Prohibitive cost of R&D and production ▪ Easily disrupted supply chains
Opportunities	**Threats**
▪ Innovation to meet sustainability ▪ Rising consumer awareness	▪ Rising health concerns ▪ Stringent regulations and trade restrictions

Figure 6. SWOT analysis of the global fine chemicals industry.

Strengths

- Well-established pharmaceuticals market: With pharmaceuticals accounting for, over 60% of the product types and about 60% of the application types (as shown in Figure 2), the global fine chemicals industry is stable, and continuous growth is expected. Since all major players are involved in the pharmaceuticals business, their increasing R&D spending to develop innovative products and cleaner processes is also expected to drive the growth of the global chemical industry.
- Increasing demand for fine chemicals: The growing ageing world population and increasing health awareness are driving the world demand for pharmaceuticals to treat and prevent chronic diseases and disorders. Hence, a growing global demand for fine chemicals to produce these pharmaceuticals is expected. Driven by the rapid growth and rising standard living of developing economies, cosmetics and personal care, food and beverages, energy storage, electronics, and building and construction are end-use industries also driving the growth of the global fine chemicals sector.

Weaknesses

- High cost of R&D and production: The costly R&D activities and production of fine chemicals inhibits the growth of the global industry. It may also curb the application of fine chemicals. This arises out of an empirical tradition in R&D that involves protracted timelines, significant use of expensive materials and high labour requirements. Rational approaches to R&D, aided by modelling, computation and AI promise to reduce this drastically.
- Easily disrupted supply chains: The supply chains of the global fine chemicals industry are easily disrupted, which drastically curbs its growth. Lockdowns, due to the COVID-19 pandemic, decreased demand for healthcare and food and reduced construction activities, which affected the global supply chains.[8] Geopolitical conflicts, such as the Russia-Ukraine war disrupt the supply of natural gas, which is a vital raw material in the chemicals industry.[2]

Opportunities

- Innovation to meet sustainability concerns: Addressing the sustainability challenges of the whole chemicals industry is an opportunity to bolster growth of the global fine chemicals sector and improve material and energy productivity. Novel fine chemicals and cleaner production processes must result in lower environmental impacts, advocate circularity, and foster socio-economic progress.[18] Major companies are leading this through their increasing R&D budget.[8] Transitioning from batch processes to continuous production will also reduce waste and energy consumption while improving capital and labour productivity.
- Rising consumer awareness: Rising consumer awareness is an opportunity to boost the global fine chemicals sector. With higher standards of living and more disposable income, consumers are expected to spend more on cosmetics and personal care products and packaged food and beverage items.[8] The demand for fine chemicals utilised in these applications is expected to have a positive effect on the growth of the global industry.

Threats

- Rising health concerns: Rising health concerns from the harmful effects of fine chemicals is a threat to the growth of the global industry. For cosmetic and personal care applications, some fine chemicals may cause skin allergies, eye irritations and increased skin susceptibility to sunburn and UV radiation.[8] There is a need to evaluate short- and long-term effects of fine chemicals on human health and the environment. Recently, the EU published the SSbD framework, as a guide in chemical and material innovation towards inherent safety and sustainability, wherein the aim is to minimise the use of substances of concern and environmental impact throughout the product lifecycle.[22]
- Stringent regulations and trade restrictions: While vital to protecting human health and the environment, stricter policies on regulating and trading fine chemicals can threaten the growth of the global sector. They can also act as barriers to adopting fine chemicals and their production technologies.[8] This is especially the case where regulations diverge between geographies, causing complexity for

manufacturers who need to benefit from the scale and risk dilution of multiple markets (e.g., EU REACH vs UK REACH - see more details in Section 9).

3.6. Competitive advantages in the global landscape

Success in the current global market of fine chemicals will require the following competitive advantages[7]:

- R&D capabilities in developing new innovative products and/or improving existing products that will cater to evolving customer preferences, maintaining a leading market position and/or emerging market demands.
- Manufacturing expertise and efficiency in innovating and optimising processes, attaining high yields, ensuring product consistency and keeping strict quality standards to meet customer specifications.
- Supply chain management in securing reliable and cost-effective supplies of raw materials, intermediates, and packaging.
- Global presence and market access to expand the industry's geographical reach, forge strategic partnerships, and leverage international trade agreements in seizing new opportunities, capturing market share, and mitigating risks from regional market fluctuations.
- Regulatory compliance in conforming to both national and international regulations on quality, safety and the environment.

4. UK industry

Here, we present our landscape analysis of the UK fine chemicals industry. We describe first its evolution in Section 4.1. In Section 4.2, we discuss how the fine chemicals industry underpins important sectors of the UK. A high-level discussion of the recent market trends is presented in Section 4.3. The major players, international comparisons, and SWOT analysis of the UK fine chemicals industry are discussed in Sections 4.4, 4.5 and 4.6, respectively.

4.1. Evolution of the UK's fine chemicals industry

The UK was the birthplace of the fine chemicals industry in the mid-19th Century, boasting the first firm, Perkin and Sons Dyestuffs in Greenford (a "spin-off" of the precursor of Imperial College).[5] It has historically been a leader in the field but has faced headwinds recently.

A timeline of events in the UK's chemical industry is shown in Figure 7.

- Much of its history is linked to the rise and fall of the chemical company giant, Imperial Chemical Industries (ICI). Early on, ICI was already focused on a diverse range of products from bulk chemicals, fertilisers, insecticides, dyestuffs, paints and explosives. Spurred by R&D investments and innovation, ICI further diversified into polymers, pharmaceuticals and agrochemicals markets.[6]
- During the 1970s, there was an increasing trend among chemical manufacturing firms to produce intermediate and active ingredients in-house as a key competitive advantage in selling pharmaceutical, agrochemical and specialty products.[7] However, in-house production could not keep up with the demand for these products.[13]
- Eventually a trend of outsourcing chemical manufacturing rose among firms in the 1980s, which lead to "make or buy" chemicals as an integral part of their supply chain decision-making. It was at this period that the fine chemicals industry came out as a separate and distinct entity from the bulk chemicals industry, due to the increasing requirement of sophisticated molecules for the pharmaceuticals and agrochemicals sector.[7]
- After the decline of ICI, its legacy lives on with the divestment and mergers of its various businesses into AstraZeneca, Novartis, Syngenta, AkzoNobel and several others. With ICI no longer a separate entity, other chemical company giants like British Petroleum (BP), Ineos and LyondellBasell emerged to maintain the UK's bulk chemicals sector.[6]
- Hence, it can be said that the UK's current fine chemicals industry evolved from product diversification and a presence of a competitive industry within and outside the UK.

4.2. Interlinkages of the UK's fine chemicals industry

The UK's chemical industry is currently active in all key products: basic inorganics, petrochemicals, polymers, pharmaceuticals, agrochemicals, paints, detergents and personal care, adhesives, flavours, fragrances, lubricants, fuel additives, construction chemicals, and catalysts.[2] The high diversity of products of the sector and how its fine chemicals industry sits within it is shown in Figure 8. The supply chains demonstrate how the UK's chemical sector links raw feedstocks and energy to a wide variety of products, such as consumer goods, pharmaceuticals, electronics, and building and construction. Chemical supply chains can be categorised into three broad manufacturing tiers:

- Tier 1 facilitates the production of bulk chemicals from raw materials like fossil feedstocks (crude oil, natural gas and coal), biomass feedstocks (sugars, starch, oil and fats), ores (minerals) and air.[23] Bulk chemicals are the starting substances in the later processes of the supply chains. They are produced by continuous processes that are often energy-intensive. INEOS, SABIC and Lanxess are some examples of chemical companies in this manufacturing tier.[24]
- Tier 2 transforms bulk chemicals through further chemical reactions, blending and/or purifications to produce partly finished (i.e., intermediates) and/or finished single pure substances or mixtures of substances. Batch processes are commonly employed in this tier as there could be several intermediate steps to produce the desired chemicals with these often moved around or traded between production facilities and/or across regions. Pfizer, Syngenta and Huntsman are some examples of chemical companies in this manufacturing tier.[24]
- Tier 3 produces the final formulations used by many downstream industries or end-users such as in consumer products, health and wellness, food and beverages, agriculture, textiles, and industrial products. While Tier 3 employs batch production like Tier 2, Tier 3 produces the final products in contrast to Tier 2. Unilever, Croda and Reckitt are some examples of chemical companies in this tier.[24]

Note that the interlinkages shown in Figure 8 are not exhaustive but are representative of the complexity of the UK chemical sector's supply chains. Several linear supply chain interlinkages, represented by solid arrows, show chemicals directly move from one tier to another tier in the process of creating high-value products. However, supply chain interlinkages are not always linear, which is represented by dashed arrows. Some chemicals can move from one or more tiers with minimal processing to produce the final products as in the case of industrial gases used in the food and beverage sector.[24]

As shown in Figure 8, the fine chemicals sector is a subset within the chemicals industry, with a scope in Tier 2 and Tier 3 of the chemical supply chains. While it may be only a part of the broader chemicals sector, the fine chemicals industry has a significant role as it links the chemicals sector to several downstream industries. One of the downstream industries is the chemicals industry, which means the chemicals industry itself is an important customer of fine chemicals.[4] Therefore, the fine chemicals sector underpins several key sectors of the UK's economy. These include the pharmaceuticals, agriculture, construction, FMCG, automotive and aerospace.

Using nationally reported annual input-output supply and use tables from the ONS[25], we estimate approximately £60 billion worth of fine chemical products flowed into these sectors and other end-users in 2022. Figure 9 presents a Sankey diagram showing the intricate consumption flows of Pharmaceutical products and preparations; Dyestuffs and agrochemicals; Paints, coatings, inks and other related products; Soaps, detergents, perfumes and other related products; and Other fine chemical products into the various end-users of the UK. About 28% or £16.5 billion of the total worth of fine chemical products flow into the UK's own chemicals sector (fine + bulk).

Figure 9 also depicts the major consumers of each fine chemical product groups in the UK (besides in-use within the whole chemicals sector). About 61% of the total worth of Pharmaceutical products and preparations (£32.9 billion) flow into healthcare and related activities, while 7% flow into R&D and related technical activities. For the total worth of Dyestuffs and agrochemicals (£4.2 billion), most flow into agricultural and related products manufacturing at 70%. Paints, coatings, inks and other related products (£5.7 billion) are important to construction activities (35%) and transportation equipment production (21%). Soaps, detergents, perfumes and other related products (£4.3 billion) flow into healthcare and related activities (37%) and construction activities (16%). Similarly, Other fine chemical products (£12.6 billion) are used in healthcare and related activities (20%) and construction activities (11%).

1900's	▪ UK's chemical industry begins with demands for acids, alkalis, soaps, and dyes
1926	▪ Imperial Chemical Industries (ICI) was formed
1929	▪ Levers Brothers (Soaps and detergents company) merged with Margarine Union to form Unilever
	▪ Shell Chemicals was formed
1935	▪ Glaxo Laboratories was incorporated as a distinct subsidiary company in London
1939	▪ ICI ran the world's first commercial polyethylene plant
1950's	▪ ICI ventured into pharmaceuticals
1967	▪ British Petroleum (BP) Chemicals was formed, becoming the second largest chemicals company after ICI
1970's	▪ ICI ventured into agrochemicals
1984	▪ ICI became the first company in the UK to make more than £1 billion in pretax profits from a diverse business of polymers, paints, pharmaceuticals, and agrochemicals
1990s	▪ Decline of ICI's fortunes – it sold off the bulk chemicals business and several of its deals left ICI in debt
1998	▪ INEOS, a major petrochemicals player, was formed from acquisitions of the sites by BP, Crosfield, Dow Chemicals, Eastern Valley Chemicals (EVC), Phenolchemie, and ICI
1999	▪ ICI's Zeneca was spun and merged with Sweden's Astra
2000	▪ ICI's Syngenta merged with Novartis' agrochemicals
	▪ Glaxo Wellcome and SmithKline Beecham merged forming GlaxoSmithKline (GSK)
2005	▪ Basell, a major petrochemicals player, was formed from the merger of Shell's assets and BASF
2007	▪ AkzoNobel, paints and coatings Dutch multinational company, took over ICI
	▪ LyondellBasell was formed when US-based chemical manufacturer Lyondell acquired Basell
2010 to present	▪ UK's chemical industry exported £25 billion worth of products in 2016 ▪ The sector manufactures a wide range of products that includes bulk (or commodity) chemicals, polymers (plastics), consumer chemicals, and specialty chemicals ▪ UK holds a significant position in specialty chemicals, with companies such as Croda (personal care chemicals and oleochemicals), Johnson Matthey (catalysts), Elementis (additives), and Synthomer (specialty polymers)

Figure 7. Timeline of events in the UK chemical industry from its beginnings in the 1900s to its current state, based on data from Flavell-While[6], UK Parliament[4] and Wikipedia[26].

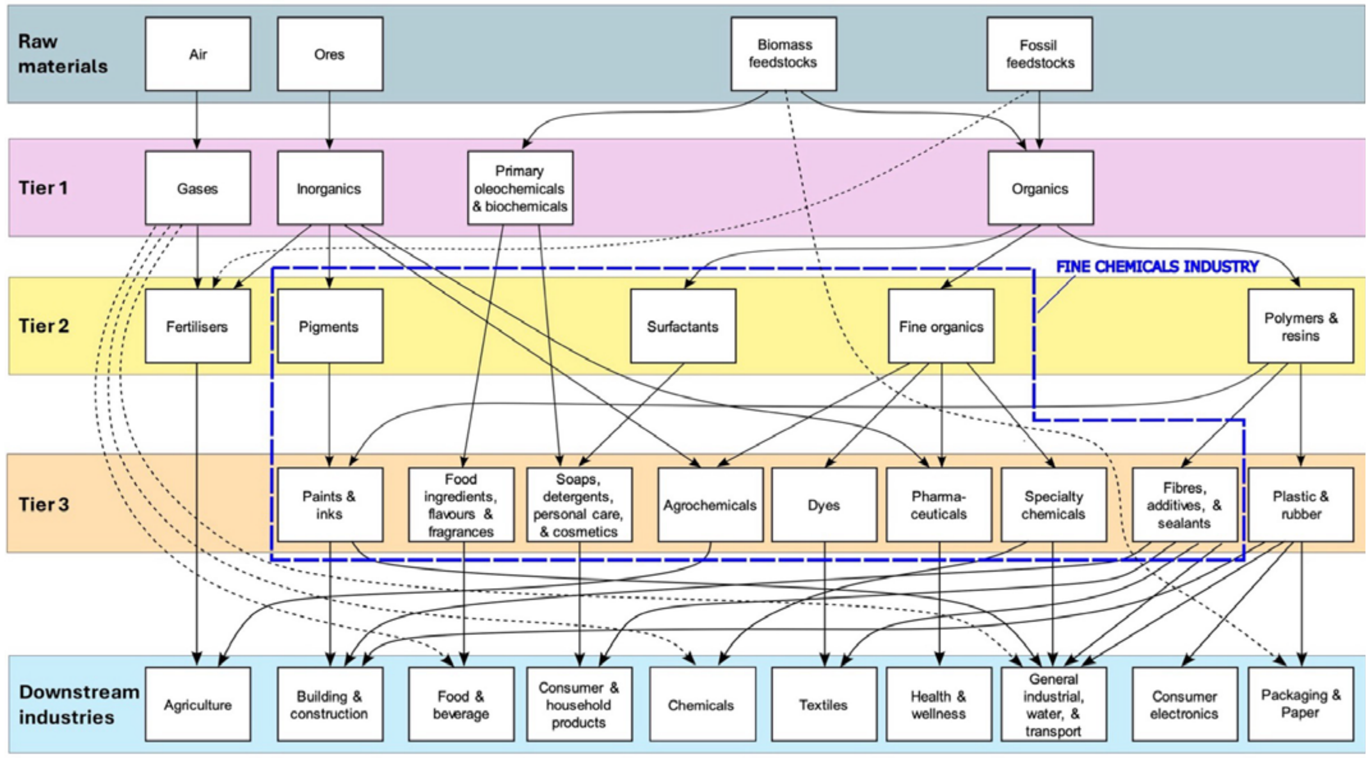


Figure 8. The fine chemicals industry interlinks the UK's chemical sector supply chain to several other industries. Composed using information from the CGSG[23] and UK DESNZ[24].

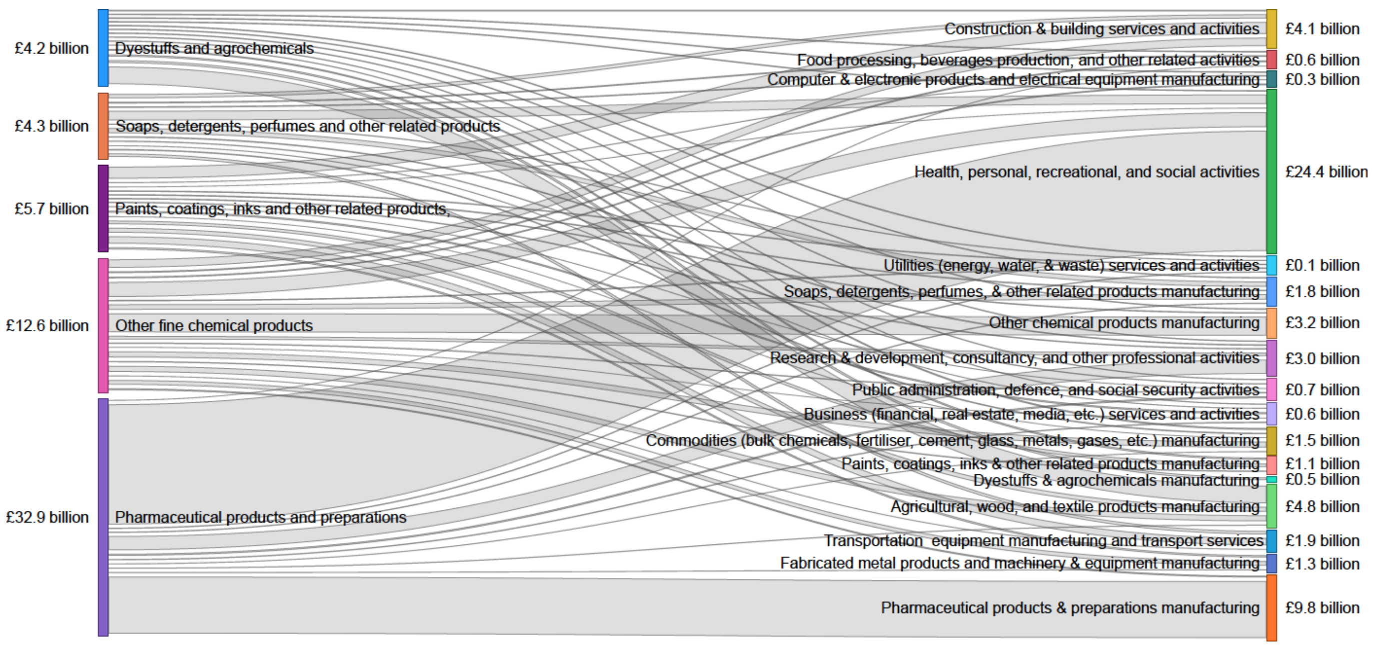


Figure 9. Sankey diagram depicting the consumption of the UK's fine chemical products within the country's various end-user sectors in 2022. The width of the flow is measured in £ billion. Generated by our own post-processing and analysis of the data collected from ONS[25] input-output supply and use tables.

4.3. UK market trends

Given the product diversity and how interlinked the chemicals industry of the UK is to itself and its end-users, we believe it is appropriate to look at the whole industry first (note that this excludes the pharmaceuticals sector). The contribution of the UK's chemical industry to GDP from 2017 to 2022 is shown in Figure 10.a and Figure 10.b. On average, it has a GDP value £11 billion based on chain volume measures or £12 billion based on constant prices.[2] Zooming in to the UK's fine chemicals industry only, this has a market volume of 511 kilotonnes (kt) and market value of £4.3 billion in 2023 (Figure 11), plotted from FMI[8] Assuming this market value is equivalent to the GDP value, the UK's fine chemicals sector approximately contributes 36% to 39%, on average, to the total GDP value of the UK's overall chemicals industry.

In terms of market share by types, the 2023 trends of the UK fine chemicals industry follow the global fine chemicals industry:

- The leading product types in the UK are Pharmaceuticals at about 65% of the market and followed by Agrochemicals (about 17%), Pigments & dyes (about 4%), and Additives (about 4%) as shown in Figure 12.a. The rest of the product types is below 3% of the market share in the UK's fine chemicals industry.
- The top five application types of the UK's fine chemicals industry are the Pharmaceuticals & nutraceuticals industry (leading at more than 60% of the market), Agriculture industry (around 16%), Cosmetics & home/personal care industry (around 6%), Paints & coatings industry (around 4%), and Building & construction industry (around 3%) as shown in Figure 12.b. The rest of the application types represent less than 3% of the UK's fine chemicals industry.
- Regarding business types, the captive market dominates at about 95%, while the merchant market represents 5% of the UK's fine chemicals industry - as shown in Figure 12.c. We expect that the "captive" market is where innovation will take place.

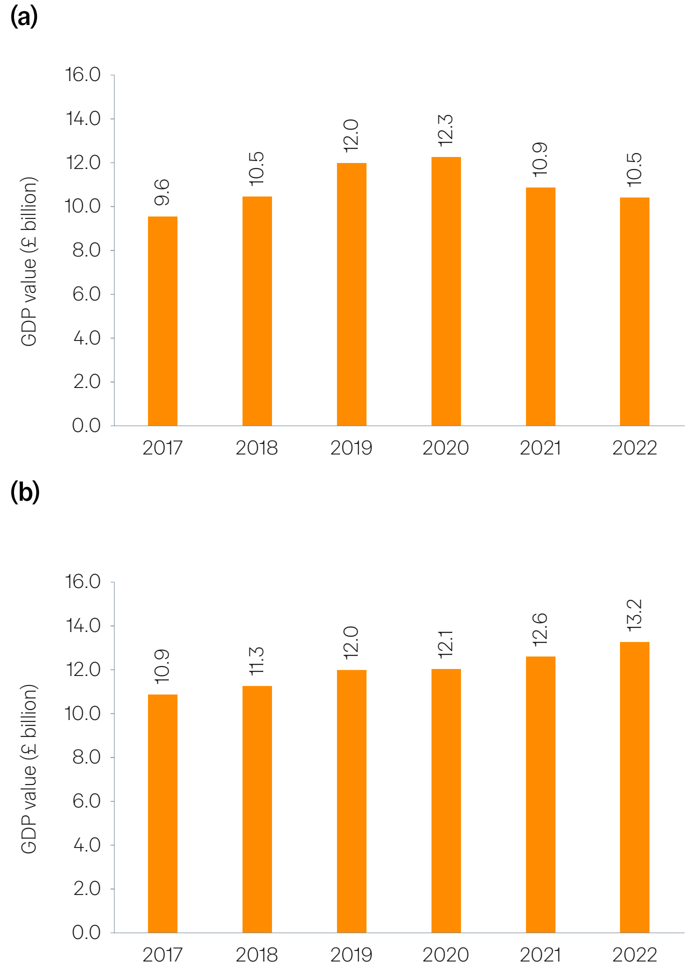


Figure 10. Contribution of chemicals and chemical products manufacturing to UK's GDP from 2017 to 2022 based on chain volume measures (a) calculated in 2023 prices from the ONS[27] and constant prices (b) calculated in 2023 prices from the ONS[28].

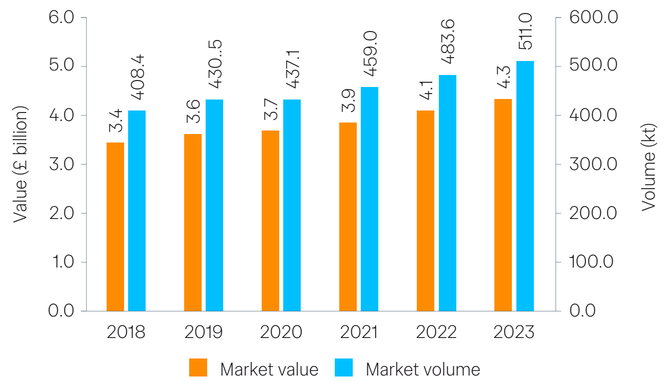


Figure 11. Market value and volume of the UK fine chemicals industry from 2018 to 2023, plotted from FMI[8] data. Note that these values refer to the market demand.

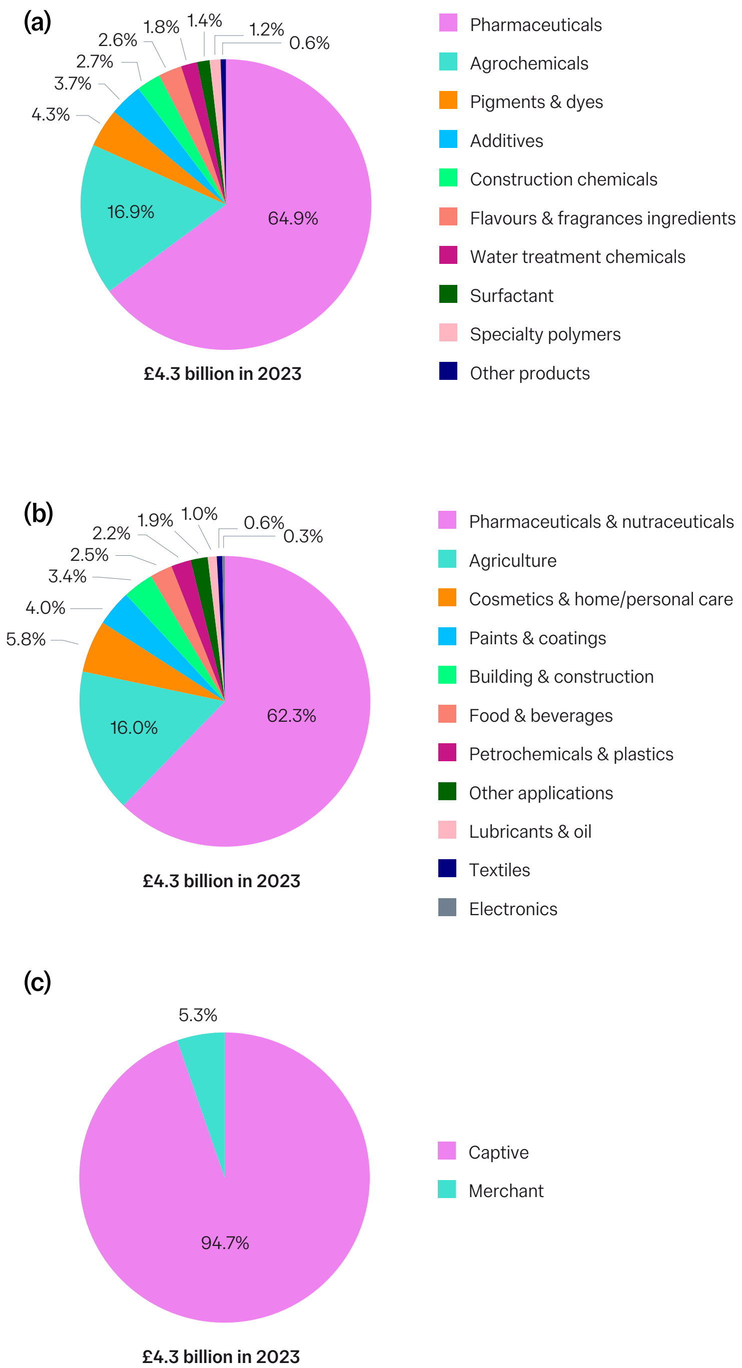


Figure 12. UK fine chemicals market share by product type (a), application type (b), and business type (c) in 2023, plotted from FMI[8] data.

4.4. Major players in the UK's whole chemicals industry

As of 2021, the total number of chemical companies in the UK is 4,535.[2] Our initial research in identifying the UK's major players specific to the fine chemicals industry is according to revenue in 2022 as shown in Figure 13.

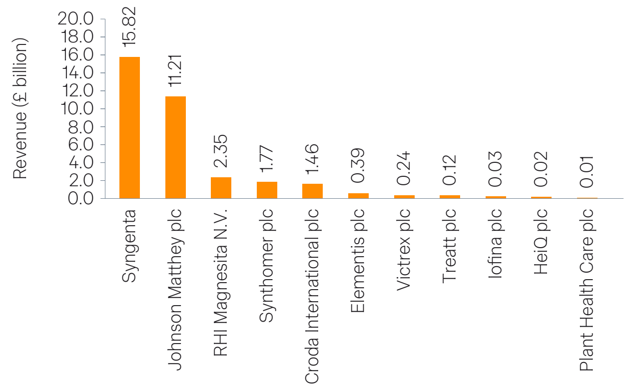


Figure 13. Major players in the UK's chemical industry based on their revenue in 2022. Plotted from Financial Times[29] data, except for Syngenta[30]. Note that not all revenue by these companies is from fine chemicals.

4.5. International comparisons of fine chemicals industry

This section provides a high-level comparison of the UK fine chemicals industry to international counterparts. We examined this in terms of company size distribution, age of assets, value-added growth, and the Swiss chemical industry as a benchmark.

Issue of long tail of small firms

Figure 14 below shows the number of companies in the UK's whole chemicals industry according to company size or number of employees. About 86% of the total number of companies are small-sized. Medium-sized companies and large-sized companies in the UK are 11% and 3% of the total, respectively. There are more medium- to large-sized companies in Germany's whole chemicals industry, which is at 31% of the total as shown in Figure 15. They also represent 41% of the employee distribution and 31% of the generated revenues by the German whole chemicals industry. Compared to Germany, the long tail of small companies in the UK is an issue because they will not be effective in generating value at the scale needed.

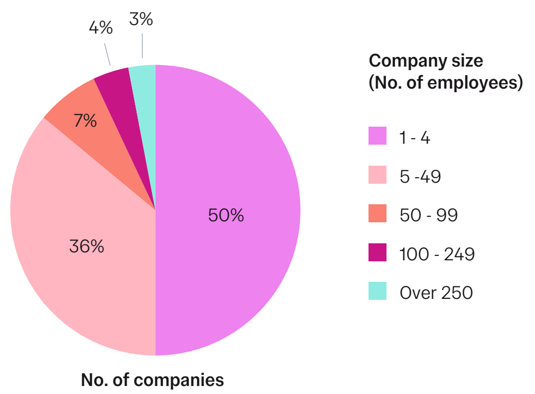


Figure 14. Distribution of no. of companies in the UK's whole chemicals sector according to company size (i.e., number of employees). Plotted from UK Parliament[4] data.

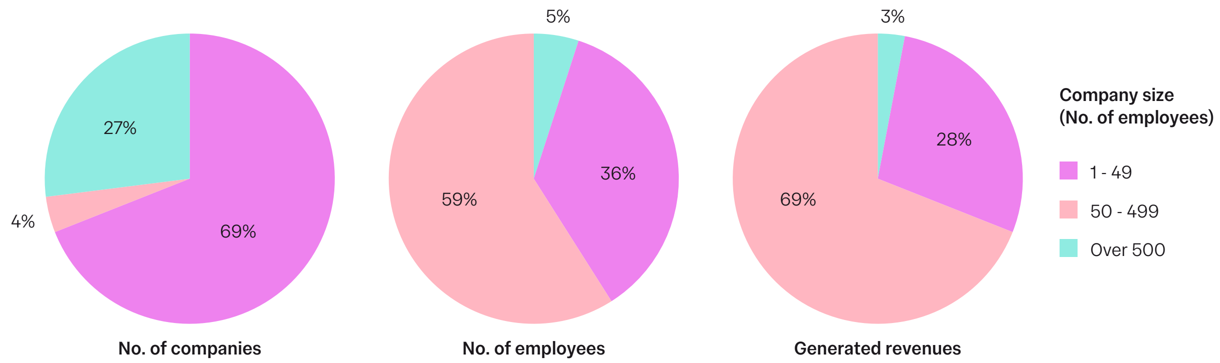


Figure 15. Distribution of no. of companies, no. of employees, and generated revenues in Germany's whole chemicals industry according to company size (i.e., number of employees). Plotted from GTAI[31] data.

Many of these small firms are involved in contract manufacturing. Based on our consultation with stakeholders from the fine chemicals industry during a Roundtable Discussion last 10 March 2025, the proliferation of these small firms could be attributed to a skills gap, an ageing workforce or a lack of ambition. The eventual fate of these small firms includes bankruptcy or dormancy, consolidation into medium- to large-sized companies, or bought by foreign companies. Notably, there have been several spinouts in founded in the UK that were subsequently bought by overseas companies.[32] This trend could have been mitigated if intellectual property (IP) from universities and university collaborations had more protection and exploitation in the UK, which could be achieved through organisations dedicated to utilising publicly funded developments such as the British Technology Group (now a privately-owned entity)[33]. Moreover, this trend of foreign acquisition and takeover of UK companies is also happening to other UK sectors[34] as larger foreign companies generally possess greater resources for scaling up.

Newer assets of competitors

International competitors have been investing in newer assets, with capabilities to produce chemical products with qualities on par with UK-made products. For example, buyers previously presumed fine chemicals from emerging industries were of poorer quality, but buyers have found this is not the case now. (In fact, Chinese and Indian fine chemical companies are leading the global APIs market.[8]) This changing perception is due to the newly acquired assets of Chinese and Indian manufacturers, while on the other hand assets in the UK are ageing.

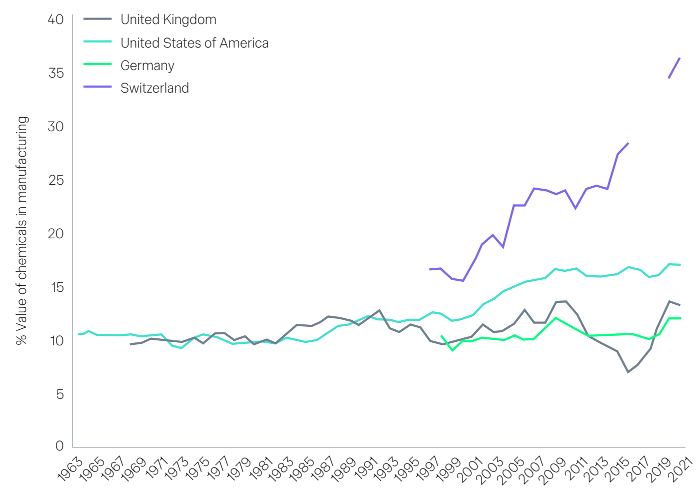


Figure 16. Percentage of value added by chemicals to the total value added in manufacturing in the UK, USA, Germany and Switzerland, plotted from The World Bank Group[38] data. Note that not all countries have complete data, as in the case of Switzerland.

Issue of stalled growth

Figure 16 presents a comparison of the proportion of value added by chemicals to the manufacturing sectors of the UK, USA, Germany and Switzerland from the 1960s to 2021. Generally, the UK's chemical industry's contribution has fluctuated. In the last 10 years, it declined from 2010 to 2017 (well below its historical values) and increased from 2018 to 2020. The UK was hit the hardest at negative growth rate of -0.5%[35] during the global financial crisis from 2008 to 2010, which proceeded the years of decline. The global recession severely impacted the chemicals sector by reducing access to credit for investments, decreasing demand for chemicals from major customers like automotive and construction, and increasing raw material and oil prices.[36] During the financial crisis, chemical sales in the UK fell from £42 billion to £36 billion, a 14% drop, which was particularly steep for bulk chemicals (accounting for 40% of turnover) compared to specialty chemicals (accounting for 60% of turnover).[37]

At the end of the financial crisis, the UK production index for chemicals was 20% below 2008 average level (in constant prices). Before the financial crisis, the chemicals industry had a steady growth due to strong sales of bulk chemicals and a thriving pharmaceuticals sector.[37] Within the global recession, however, outdated UK chemical plants closed because of a failure to secure adequate investments for facilities upgrades, exacerbated by the recession. After 2009, the pharmaceuticals industry was also weakened due to health budget cuts that further delayed the recovery of the UK chemical industry.[37] Post-2017, the value added by the UK's chemical sector has been steadily increasing. With the declining bulk chemicals segment, this growth trend is attributed to the special chemicals segment, mainly by large chemicals industry clusters in the North West of England, which saw the highest number of new chemical firms.[37]

Referring again to Figure 16, Germany's value added has been more stable over time. Like the UK, it experienced a dip after 2010, but Germany, similar with most major chemical producing countries, saw their outputs subsequently recover much more quickly after the recession.[37] The USA seems to have a relatively slower trend from the 1960s and then picked up its pace by 2000. Among the other countries, Switzerland enjoys the highest value added by chemicals and this is generally increasing.

The Swiss success

We considered the Swiss chemical industry as an excellent benchmark because of its increasing value added in manufacturing (>20% shown in Figure 16) and a parallel context of its industry with the UK. In 1859, the Swiss chemicals industry became an economic force when it entered the synthetic dyes market through Chemische Industries in Basel (Ciba). Around the 1880s, Kern and Sandoz Co., another synthetic dyes company was founded. At same time, the production of synthetic medicines became the trend. By the 19th century, Basel became the hub of Swiss chemical and pharmaceutical industries due to the absence of restrictive patent laws at that time, attracting entrepreneurs, and favourable conditions like abundant water, rich capital resources, open culture, an old university town, and good communication network. In 1970, Ciba-Geigy was formed, which merged with Sandoz to form Novartis in the 1990s, the largest chemical firm in Switzerland today. By the 20th century, the Swiss chemicals and pharmaceutical industries is considered among the world's most successful.[39]

We identified the following contributing factors to the success of the Swiss chemical and pharmaceutical industries:

- An early start in focusing on fine and specialty chemicals: During the formative years, Swiss chemical industry players realised the scarcity of raw materials and limited domestic market of their country. Hence, they shifted their focus to high-value and low-volume products, which account for 90% of the Swiss chemicals portfolio with over 30,000 diverse products today.[39]
- Great importance of worldwide exports and presence: While a very small portion of Swiss-made chemicals are consumed domestically, over 98% are exported, with the US and the EU as main buyers. Historically, pharmaceutical products account for the largest share of Swiss chemical exports.[39] In 2023, Switzerland was the fourth leading exporter of chemicals with a total value of $41 billion.[40] Both large multinational firms (e.g., Lonza, Roche, and Novartis) and small-to-medium size companies engage in the world market. Swiss companies both have manufacturing operations in 80 countries and sales operations in almost every country. They also have an extensive international network of research centres.[39]
- Significant investments in R&D: The success of the Swiss chemical industry involved strong innovation, scientific and technological know-how, a creative environment, and significant R&D expenditure. Swiss research intensity index is about 7%, which is more than double that in Japan, the US, and the EU.[39] Moreover, the R&D investments by Swiss chemical companies are spent both domestically and internationally, which largely contributed to the dominant position of Switzerland in the global pharmaceuticals industry.[39]
- Realising the essential ingredients for innovation: The chemicals and pharmaceuticals industries are integral to the Swiss economy as these generate 7% of the country's GDP.[41] These industries are major employers in Switzerland, and sources of the essential ingredients of innovation: scientific and technological know-how, and a highly skilled workforce. Today, research staff accounts for 30% of the Swiss chemical industry workforce.[39]
- Importance of safety, health and environmental progress: Swiss chemical companies consider raising standards on health, safety, and environmental compliance as opportunities to improve efficiency and encourage innovation. Today, the industry has achieved significant reductions in carbon dioxide (CO_2) and volatile organic compounds emissions and process water consumption and improved low lost-time incidents (6 accidents per one million working hours).[39] Sustainability, combining economic success, social responsibility and ecological balance, is crucial for the Swiss chemical industry's long-term success. The Responsible Care® initiative has been implemented in Switzerland since the 1990s with more than 50 participating countries, which aims to improve environmental protection, health, and safety.[42] Recently, the chemical, pharmaceutical and life science industries in Switzerland advocated for a future-oriented sustainability framework that promotes innovation, ensures a secure supply of resources, and removes barriers to the circular economy. This framework includes technology openness, a future-oriented chemicals strategy, and support for education, research and innovation.[42]

4.6. UK industry SWOT analysis

A SWOT analysis of the UK's fine chemicals industry is summarised in Figure 17. Each of the strengths, weaknesses, opportunities and threats are discussed below.

Strengths	Weaknesses
▪ Well-established fine chemicals industry ▪ Diversified products and industry ▪ Proximity to major markets ▪ Strong R&D capabilities ▪ Highly skilled workforce	▪ Prohibitive cost of energy (i.e., natural gas) ▪ Raw material shortages and price increases ▪ Insecure supply chains ▪ Skilled staff availability, recruitment and retention ▪ Competition from emerging markets
Opportunities	**Threats**
▪ Growing demand for specialty chemicals ▪ Custom manufacturing ▪ Net-zero transition ▪ Sustainability movement and trends ▪ Industry 4.0 – digitisation and AI/ML	▪ Regulatory environment ▪ Economic uncertainty ▪ Globalisation ▪ Geopolitical instability ▪ Public perception

Figure 17. SWOT analysis of the global fine chemicals industry.

Strengths

- Well-established industry: The UK has a well-established fine chemicals industry, with a history of innovation and technological advancement.[4]
- Diversified products and industry: The fine chemicals industry in the UK is diverse, with companies operating across a wide range of sectors and applications.
- Proximity to key markets: The UK is geographically close to major European markets, providing easy access to customers and suppliers.
- Strong R&D capabilities: The UK has strong R&D capabilities both in the academe and industry.
- Highly skilled workforce: The industry benefits from a highly skilled workforce, with a strong tradition of academic research and development.

Weaknesses

- Prohibitive cost of energy (e.g., natural gas and electricity): The high cost of energy directly increases the cost of production, reducing the competitiveness of its chemical manufacturing against countries with lower cost of production.[2]
- Raw material shortages and price increases: Plant shutdowns due to the global pandemic have resulted in raw material shortages and delayed deliveries. Brought about by the energy crisis and global inflation, the high cost of energy has been passed through the supply chains resulting in price increases.[2]
- Skilled staff availability, recruitment, and retention: Adverse immigration policy and an ageing workforce in the UK is impacting the availability of skilled staff and their recruitment and retention.[2]
- Competition from emerging markets: The industry faces competition from emerging markets such as India[43] and China,[44] where labour and production costs are lower.[45]
- Lack of joined-up approach: the fragmented industry and interactions across different HMG Departments (e.g., DBT, DEFRA, DSIT, DESNZ) mean that there is no coherent strategy for the sector (although a Chemical Sector Deal has been previously mooted).
- Brexit: The UK's decision to leave the European Union and the establishment of UK REACH has created uncertainty for the industry, particularly in relation to access to markets[46] and regulations.[47]

Opportunities

- Growing demand for specialty chemicals: There is increasing demand for specialty chemicals in a range of industries, particularly in the pharmaceutical and personal care sectors.
- Custom manufacturing: Custom manufacturing is an area of growth, as companies seek to outsource production of fine chemicals to specialised providers.[48]
- Net-zero transition and sustainability movement and trends: The industry has the opportunity to respond to growing demand for sustainable products and processes,[49] through the development of environmentally friendly fine chemicals.[50] Furthermore, the growth of new sectors such as electric vehicles will lead to demands for new chemicals and materials.

- Industry 4.0 – digitisation and AI/ML: The sector can benefit from digitisation, including the use of big data and artificial intelligence to optimise production processes and improve efficiency.
- The transition from batch manufacturing to continuous: Facilitated by Industry 4.0, this is expected to improve capital productivity, safety, and material and energy efficiency, enable automation, and improve labour productivity.

Threats

- Regulatory environment: The industry is subject to strict regulations, which can increase costs and create barriers to entry for new companies.[51]
- Economic uncertainty: The industry is vulnerable to economic uncertainty, which can impact demand for chemicals across different sectors.[52]
- Globalisation: The industry faces competition from global players, particularly in emerging markets, which can impact pricing and profit margins.[45]
- Geopolitical instability: Geopolitical instability in key markets can impact trade relationships and access to customers and suppliers.[53]
- Public perception: The industry faces scrutiny from the public and media regarding the safety and environmental impact of fine chemicals,[8] which can impact the industry's reputation and consumer demand.

5. Productivity

"Productivity isn't everything, but in the long run it is almost everything."
(Paul Krugman[54], economist, 1994)

The second part of this report examines the competitiveness of the UK's fine chemicals sector. How competitive a firm, a sector, an industry, or a nation is linked to its productivity. The growth in productivity translates to economic growth. In this chapter, we discuss first our definition of productivity and the scope of our productivity analysis (Section 5.1). This is followed by our examination of the productivity of the UK's fine chemicals sector (Section 5.2). Finally, the drivers of productivity growth are discussed and how the succeeding chapters of Part 2 are linked to these in the context of the UK's fine chemicals industry (Section 5.3).

5.1. Defining productivity

The conventional definition of productivity is the ratio of output volume to input volume. Alternatively, it is the efficiency[§] of an economy in converting inputs into a specified level of outputs.[55] Productivity is a critical indicator for the production performance of firms and nations, which must be examined and monitored. For firms, achieving productivity growth can translate into more profitable businesses. While for nations, raising productivity can result in gross national income per capita, which consequently can translate to better living standards.[56] Productivity, which is conventionally a business and economics concept, has been recently extended to account for natural resources and pollution. These recent measures of productivity are used as indicators of green growth, which pertains to fostering economic growth while preserving natural resources.[57]

The following are measures of productivity found in the literature:

- Labour productivity: ratio between output and labour input, which is the most frequently computed measure of productivity;[55]
- Capital productivity: ratio between output and physical capital used as input[58] or the efficiency of utilising capital in generating output;[59]
- Carbon productivity: a green growth indicator measured by production (economic value generated per unit of CO_2 emitted) or by demand (economic value per unit of CO_2 emitted to satisfy final demand) and represents the degrees to which economic activity is decoupled from emitting carbon emissions into the atmosphere;[57]
- Energy productivity: another green growth indicator, closely related to but distinct from carbon productivity, given as the ratio between output generated (often in real GDP terms) and total primary energy supply (often in US$ per tonne oil equivalent);[57] and
- Material productivity: defined as output generated in terms of monetary value (i.e. real GDP) per unit of materials used in terms of domestic material consumption, which often focus on non-energy inputs (i.e., fossil-based energy inputs are excluded). This is a green growth indicator that can offer insights to the labour productivity and capital productivity measured.[57]

The choice of measuring productivity depends on its purpose and availability of data.[60] For this report, we use labour as a measure of productivity for the UK's fine chemicals sector, as this is the most widely used. Labour productivity also provides a dynamic measure of competitiveness and economic growth,[59] which aligns to the context of our sectoral analysis of the fine chemicals industry to its contribution of the UK economy. Furthermore, our output volume measure is in terms of gross value added or GVA, which is strongly correlated to GDP.[60] While total number of hours worked is the most appropriate measure for labour input, we use the number of persons employed, which is also often used as a proxy.[59]

5.2. Labour productivity

Current situation of the whole chemicals sector (bulk + fine)

Before diving into the productivity of the fine chemicals sector, we present an overview of the state and competitiveness of the broad chemicals sector in the UK. The aim of presenting this first is to put into context our sectoral analysis. As of 2021, the UK's chemical industry as a whole (bulk and fine chemicals) exports over £54 billion worth of products and adds £30.7 billion of value to the UK economy.[2] About 60% of UK chemical exports are destined for the EU, as well as 75% of chemical imports originating from the EU. These are tariff-free and have favourable Rules of Origin agreed as part of the UK/EU Trade and Cooperation Agreement.

Despite being the second biggest industry in the UK, consistent productivity growth remains a coveted objective for the whole chemicals sector, having eluded it since the global financial crisis (2007-2008) and subsequently overshadowed by the recent pandemic (2020-2023) and energy crisis (2021-2023).[2] Figure 18 shows the GVA per employee of the UK chemical industry from 2010 to 2021.

§ We acknowledge that productivity is more than just about efficiency, as this is also related to several factors such as innovation. We have considered the influence of innovation and commanding higher prices because of it (i.e., the business aspect) that we grouped together with skills requirements and policy and regulatory environment as drivers of productivity – see Section 5.1.

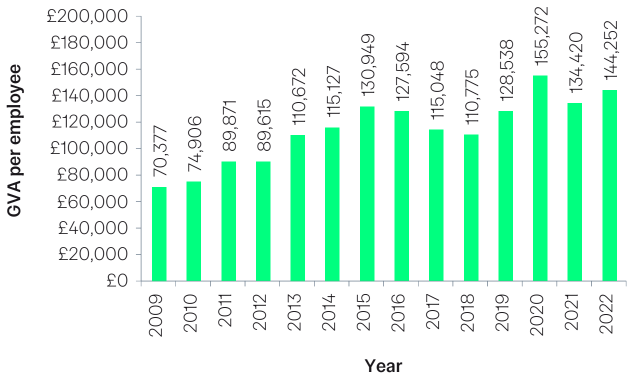


Figure 18. GVA per employee of the UK's whole chemicals industry. GVA data (based on 2024 prices) is from ONS[61] and employment data is from ONS[62].

The UK has an ongoing "productivity puzzle", which refers to the consistent underperforming productivity growth relative to expectations and developments in many other OECD countries, despite the UK having better policy frameworks and favourable business environment.[63] Within the UK, there is also an unusual regional variation in productivity as shown in Figure 19, which could be attributed to concentration of some types of (higher value) manufacturing in some regions. Outside London, workers in the chemicals industry are generally more productive by a factor ranging from 1.2 to 4.5.[2] While productivity is highest in the North West and followed by North East, these are amongst the poorest economic areas in the UK.[2]

Finally, the international competitiveness of the UK's chemical industry is currently facing the following challenges:

- The high cost of energy (i.e., electricity and natural gas, the latter of which is used both as a fuel and feedstock), in the short term, directly impacts the cost of UK chemical production and indirectly impacts demand for UK chemicals and the competitiveness of UK's manufacturing against China and India.[2]
- Raw material shortages and the associated price increases, a short-term challenge, due to the recent energy crisis and global inflation.[2] This is exacerbated by reduced UK-based manufacturing of bulk and intermediate materials and increased reliance on imports and hence price-taker status.[10]
- Availability, recruitment and retention of skilled staff, which is the final short-term challenge, due to an adverse immigration policy and an ageing workforce.[2]
- Implementation of UK REACH, a medium- to long-term challenge,[2] especially when standards and processes diverge from internationally accepted regulations given that chemicals value chains are vastly integrated across the globe.[64]
- The net-zero transition, which poses a medium-to long-term challenge, in deploying technologies and achieving the goals in time.[2]

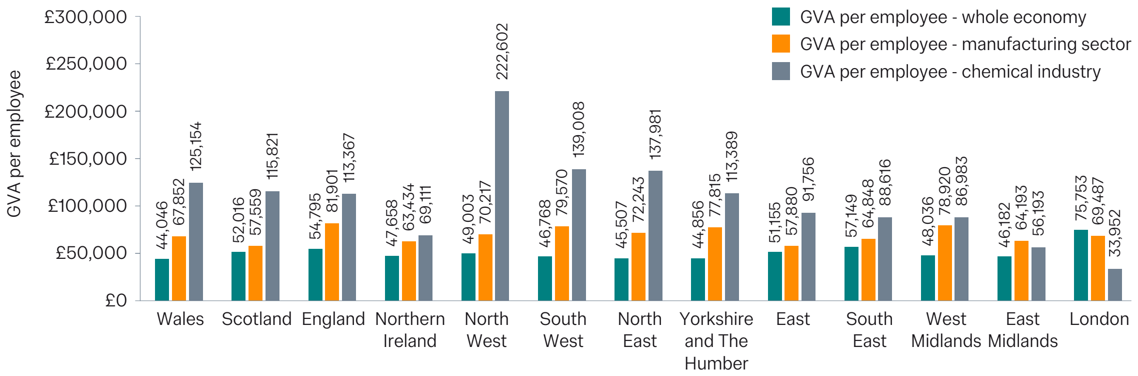


Figure 19. GVA per employee across the regions of the UK in terms of the whole economy, manufacturing sector and the chemical industry. Plotted from Cefic[2] data based on 2023 prices.

Given the extent of the interlinkage of supply chains between the bulk chemicals and fine chemicals sectors, and their end-users, we hypothesise that any growth challenges the entire UK chemicals sector is experiencing are also being experienced by its fine chemicals sector. However, the fine chemicals sector may enjoy some degree of insulation: This could be due to the nature of the fine chemicals sector (i.e., the midstream to downstream portion of the chemicals value chain, B2B, and customer-focused) and the high-value products (i.e., innovation in technologies and products, IP, and faster-to-market), both of which can be tapped for more productivity growth than the bulk chemicals sector. In the next section, we zoom in to the productivity and the drivers of the fine chemicals industry.

Zooming in to the fine chemicals sector

Figure 20 presents available GVA data of the UK for its manufacturing of fine chemicals and related manufacturing and activities that consume fine chemicals from 1990 to 2023 from the ONS[61]. Using this data directly to calculate the GVA per employee of the UK's fine chemicals sector would risk double-counting and would not be an accurate representation of its added value to the economy. Moreover, ONS[61] data also aggregates fine chemicals themselves, rather than individual products or applications (as per Table 1 and Table 2, respectively).

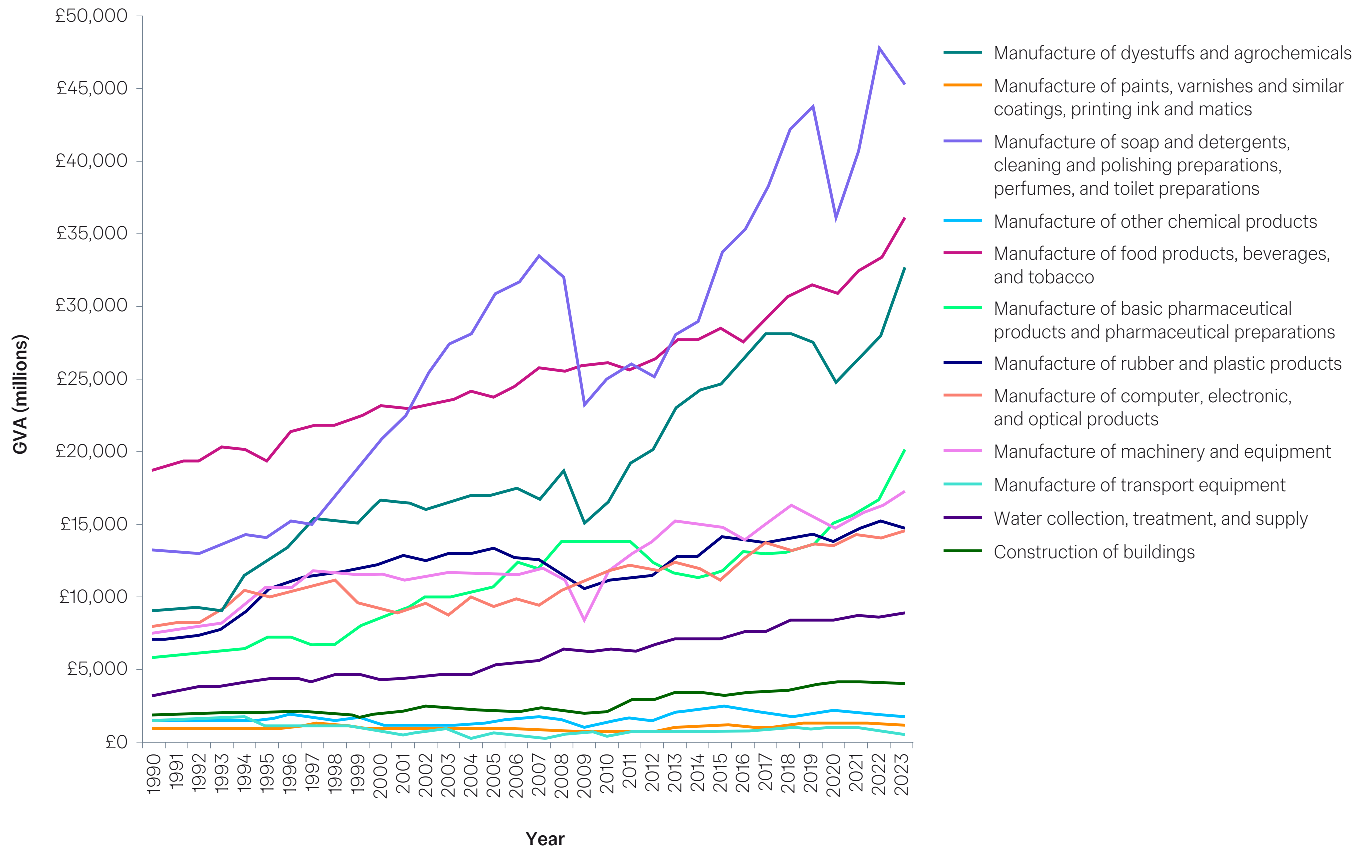


Figure 20. GVA of the UK's fine chemicals manufacturing and related fine chemicals-consuming manufacturing and activities from 1990 to 2023. Plotted from ONS[61] data based on 2024 prices.

Hence, we determined the GVA per employee of the sector from a bottom-up approach using company-level data. (See Figure A - 2 for the schematic diagram of this approach.) To do this, we used The Data City[65], a proprietary machine learning-based platform that can search and classify UK firms based on a set of search keywords or terminologies of typical products for each subsector of the fine chemicals sector. We considered 12 subsectors, which are: 1) Pharmaceuticals, 2) Agrochemicals, 3) Construction chemicals, 4) Additives, 5) Specialty polymers, 6) Pigments & dyes, 7) Flavours & fragrances ingredients, 8) Water treatment chemicals, 9) Surfactants, 10) Catalysts, 11) Electronic chemicals, 12) Contract chemicals. In our keyword search, we assumed a UK firm is involved in the fine chemicals subsector when it either manufactures, distributes, or both specified fine chemicals and/or fine chemical products (i.e., this serves as the boundary of a subsector).

These search results are not wholly reliable, as some are false positives. As The Data City[65] continuously updates their platform, the list of companies may be continually changing†. Thus, we downloaded our list of companies as MS Excel files to set the scope of our dataset to October 2024, and we manually visited each company website to verify their involvement in the fine chemicals industry. This is the most rigorous and laborious step of our data collection methodology.

We found a total of 6,886 firms in the UK that could potentially be involved in the fine chemicals industry as shown in Figure A - 3. However, we found that only 1,756 of these are truly involved in the fine chemicals business across 12 subsectors, also shown in Figure A - 3. The total number of verified fine chemical companies is deemed a good estimate, as this is comparable to the magnitude of estimated total number of companies in the UK's whole chemicals sector, which is about 4,100 as of 2024.[66] The number of verified companies can also imply that about 40% of the UK's chemicals sector are fine chemical firms.

Based on the data of the verified fine chemical firms in the UK, we estimated the total GVA and number of employees of the sector and their distibution per subsector that are presented in Figure 21. The total GVA of the UK's fine chemicals sector is £33 billion and it employs over 231,000 people, which are both comparable in magnitude reported for the whole UK chemicals sector.[2] Therefore, its estimated labour productivity is £143,000 per employee as of 2024, which is also comparable in magnitude to the data of the whole UK chemicals sector (see Figure 18 and Figure 19).

This finding suggests that the productivity growth of the UK's whole chemicals sector is primarily being driven by its fine chemicals segment, which adds weight to another assertion: that the UK needs to focus its efforts on this sector, similar to the way in which Switzerland has with its chemicals industry (see Section 4.5).

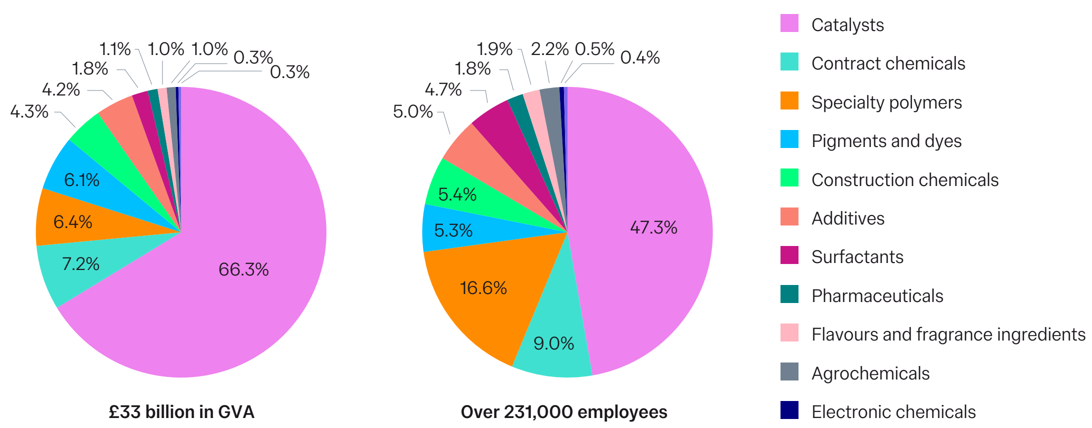


Figure 21. Distribution of GVA and the number of employees per subsector of the UK's fine chemicals sector as of 2024. Generated by our own post-processing and analysis of company-level data collected from The Data City[65].

† The data generated in The Data City is a list of companies that includes the company name, company number, company description, address, URL, and financial data (including GVA) per company.

The top five subsectors of the UK's fine chemicals sector are Catalysts, Contract chemicals, Specialty polymers, Pigments & dyes, and Construction chemicals. While Pharmaceuticals and Agrochemicals are not in the top five, these are being served by Catalysts and Contract chemicals. This is evident when we ranked the top ten fine chemical companies in terms of GVA (Figure 22), wherein AstraZeneca and Johnson Matthey (both under Catalysts) and Sterling Pharma Solutions and Almac (both under Contract chemicals) are leading companies. The other leading companies are Tronox and Venator Materials (both under Pigments & dyes), Specialty Chemicals International (under Additives), Coats Group (under Specialty polymers), Croda (under Surfactants) and FP McCaan (under Construction chemicals). **These findings highlight the underpinning role of fine chemicals in the pharmaceuticals, agrochemicals, FMCG, automotive, aerospace, and building and construction sectors of the UK.**

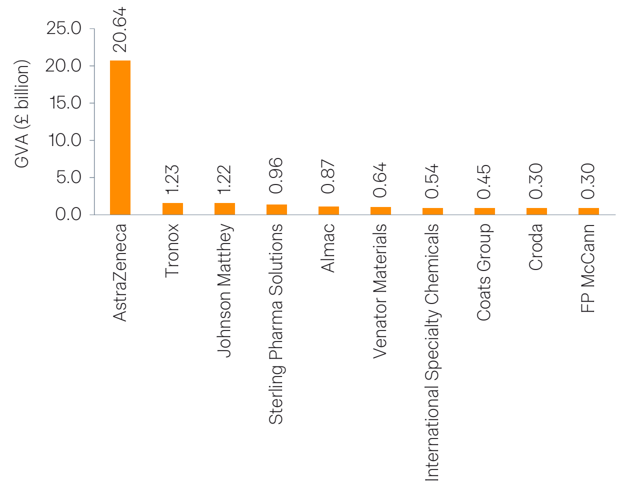


Figure 22. Major players in the UK's fine chemicals sector by GVA as of 2024. Generated by our own post-processing and analysis of company-level data collected from The Data City[65].

We also used the firm-level data to characterise the UK's fine chemicals sector. As shown in Figure 23.a, the majority of fine chemical companies are small-sized (84%), which is consistent with the issue of a long tail of small firms for the whole chemicals sector (see Figure 14). As shown in Figure 23.b, 78% and 22% of the UK's fine chemical companies are involved in manufacturing and distribution respectively, which is also consistent with the trend for the whole chemicals sector (see Figure 12.c).

We have also accounted for the location of the UK's fine chemicals sector. As shown in Figure 24.a, there is a large cluster of fine chemical companies around the North West and Yorkshire regions of England, which is expected having the major industrial clusters of Teesside, Merseyside and Humberside located there. This finding is also consistent with the reported trend by CHEManager International[37] There is also another large cluster of companies located around the London area. This could be attributed to the dataset using registered postcodes of the companies, even though their actual operational activities are elsewhere in the UK.

Lastly, we also found the country of origin of fine chemical companies in the UK as shown in Figure 24.b. The majority of companies have originated within the UK (71%). There is substantial presence of American and Indian fine chemical companies, 13% and 4%, respectively. This is followed by fine chemical companies from Germany and Belgium at 2% and 1%, respectively. The remainder originates from other countries at less than 1% of the total and aggregated together as the rest of the world (8%).

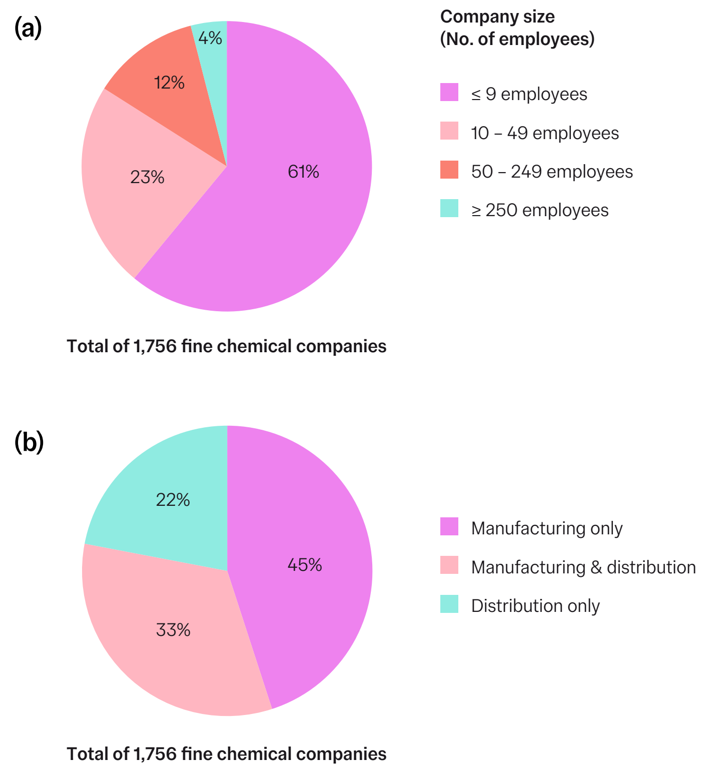
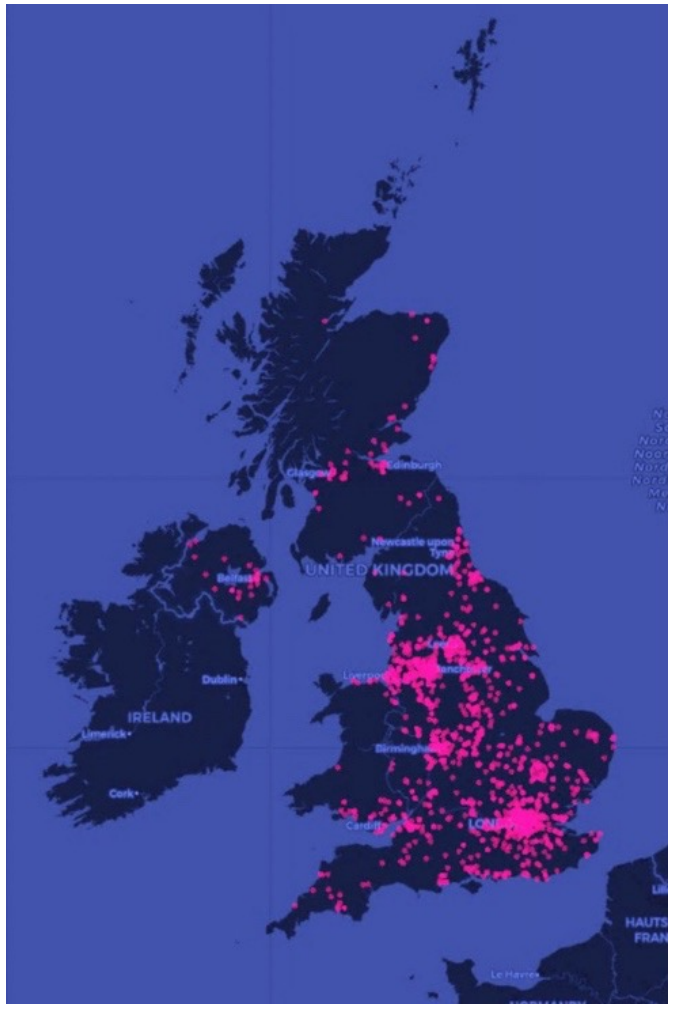


Figure 23. Distribution in terms of company size (a) and business type (b) of the UK's fine chemicals sector as of 2024. Generated by our own post-processing and analysis of company-level data collected from The Data City[65].

(a)



(b)

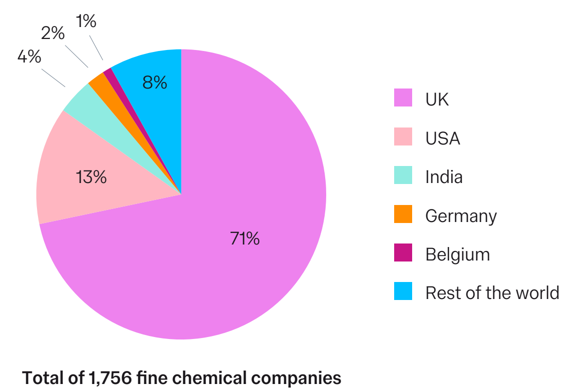


Figure 24. Location of fine chemical companies within the UK (a) and the distribution of their country of origins (b) as of 2024. Both generated by our own post-processing and analysis of company-level data collected from The Data City[65].

5.3. Drivers of productivity growth

Relevant to the fine chemicals industry, we identified the following drivers of productivity growth:

- Technology innovation and scaling up are key drivers as these can create competitive advantage.[67] Whilst innovation (i.e., new processes and new products) and scaling up (i.e., investment in machinery and equipment) can be discussed separately, we discuss this together in the context of the manufacturing technology for fine chemicals. See Section 6 for our review and analysis.
- Meeting the current and future Skills requirements, which we review and analyse in Section 7, can secure the stability of the fine chemicals industry and provide a workforce that will lead research and innovation and, subsequently, commercialise innovative technologies.[68]
- An enabling Business environment is another key driver for productivity growth, especially for the exploitation of fine chemical innovations, in establishing start-ups, in finding new markets, and in supporting their growth and stability, all of which can potentially provide revenue to the UK economy.[68] Our review and analysis of the business environment is in Section 8.
- Finally, an enabling Policy and regulatory environment for the fine chemicals industry, reviewed and analysed in Section 9, can encourage new ideas and/or innovations to develop, support existing markets or develop new markets,[67] and derisk new investments by firms.[68]

While we discuss these separately in the subsequent sections, we also recognise that these drivers of productivity have synergy with each other. Therefore, some of these drivers must be pulled together to drive productivity growth even further.

6. Technology scaling-up and innovation

6.1. Manufacturing technology

Currently, the fine chemicals industry uses four key manufacturing technologies for conversion processes:

- Chemical synthesis – which uses either petrochemicals or natural products extracts as starting materials;
- Biotechnology – either via biocatalysis (i.e., enzymatic methods) for small molecules manufacturing, biosynthesis (i.e., fermentation), or cell culture technology for big molecules manufacturing;
- Extraction – isolation and purification of molecules from plants, animals, and microorganisms, such as alkaloids, steroids, and antibacterials, respectively; and
- Hydrolysis – can be applied to proteins and combined with ion exchange chromatography to produce amino acids.

Chemical synthesis and biotechnology are commonly used in the sector as is, or a combination of both.[13]

Among these four, we focus on traditional chemical synthesis for this report as it represents a large toolbox of available chemical reactions for the synthesis of fine chemicals. Of the 26,000 known synthetic methods, around 10% are used in the industrial production of fine chemicals. Websites of fine chemical firms often mention the following chemical synthesis methods: amination, condensation, hydrogenation, halogenation, Grignard and Friedel-Crafts.[13]

6.2. Technology scaling-up requirements

Industrial production of fine chemicals is typically carried out in standard multi-purpose plants. These are typically operated batch-wise. While there are many kinds of fine chemicals with greatly varied manufacturing, handling, and storing requirements, an efficient production with critical consideration to appropriate technology and high-quality product(s) is a common requirement for all fine chemicals.[7] Achieving this reflects on the plant design of multi-purpose plants.

There are two sections of a typical fine chemicals plant:

- A wet section, used for reactions. The fundamental component of the wet section is the train or "chemical manufacturing tool", which is capable of handling one step in the multi-step synthesis of a fine chemical. Three reactors, head tanks, receivers, and a filtration unit (either a centrifuge or filter) usually makes up a train. Reactors are typically fitted with a heating and cooling system.[7]
- A dry section, used for product finishing. Drying, milling, sieving, and packaging of fine chemicals takes place in the dry section.[7]

As opposed to having dedicated plants, why do fine chemical firms have multi-purpose plants? Fine chemicals manufacturers usually offer more products than production trains. They also need to introduce and make new products quickly. This means they need a multipurpose plant instead of a dedicated one. With a multipurpose plant, they can carry out many different chemical reactions and undertake several steps at once. For example, in one train, they can carry out up to 20 or more different synthesis steps every year.[7]

Given the nature and variety of fine chemicals manufactured in a multi-purpose plant, specific containment regulations may apply, particularly for cGMP‡ products. To minimise the risk of cross-contamination, certain activities under cGMP require strict segregation. The level and extent of segregation directly impact investment and operating costs.[7]

A typical investment cost of a cGMP multipurpose plant in the US is presented Table A - 1. The $21 million investment consists of the equipment and their installation and excludes building, property and external services. The $0.9 million per m^3 reactor volume includes the reaction vessel and the equitable part of the ancillary equipment (e.g., feeding tanks, piping, pumps and process control). Generally, increasing the size would substantially reduce manufacturing costs per kilogram. Overall, multipurpose plants can be expensive relative to their outputs. However, the investment cost can vary a lot, depending on location, size and complexity of equipment (e.g., the degree of automation, level of containment, or quality of the equipment). In developing countries like India or China, investment costs are usually lower.

An indicative operating cost breakdown of a fine chemical firm is presented in Table A - 2. The operating costs mainly comprise of raw materials cost and conversion cost. Raw materials cost is based on how many raw materials are used and how much it costs to purchase these. Conversion cost is based on production rates, e.g., kilograms per day in a specific production area. The standard operation of a plant is 7 days per week with four or five shift teams, each working 8 hour per day, which is the most optimal scheme in terms of production costs. Manufacturing costs are usually reported on a per kilogram product basis.[13]

‡ Some fine chemical products require current Good Manufacturing Practices (cGMP), such as key starting materials and advanced intermediates for APIs.

Generally, calculating the exact conversion cost is a difficult task. Hence, an experienced process development engineer or pilot plant chemist can provide a rough estimate. They will use the lab synthesis procedure and break down the process into unit operations, where they have already determined the standard costs. During budgeting, they use past experience to set standard costs for a specific production campaign of a fine chemical. Then, they will compare the actual results with the standard. Having these capabilities in a fine chemical company is beneficial as being able to precisely forecast manufacturing costs can provide an edge over competitor companies.[13]

6.3. Technology innovation requirements

We have determined the following technology innovation requirements that the UK's fine chemicals industry must focus on:

- Competency in synthesising complex fine chemicals: as an example, commercially, single-enantiomer fine chemicals have been on the rise since the mid-1990s. They now make up half of all existing and new drugs. Hence, it is critical to acquire and develop the competitive edge in producing these chiral molecules.[13]
- Competency in separating and purifying fine chemicals: Generally, the UK has strong capabilities in synthesising new molecules but lags behind in separating or purifying these. Based on our consultation with stakeholders from the fine chemicals industry during a Roundtable Discussion last 10 March 2025, while there are advances in separation/purification, R&D investment in this area is much lower than in chemical synthesis, which is given priority due to the high costs of reactor operation still remaining an issue and with synthesis being seen as the most value-adding element.
- Competency in flexible manufacturing: Except for stereospecific reactions (i.e., production of chiral molecules), being able to perform fine chemical synthesis methods no longer enjoys a competitive edge as most can be done in standard multi-purpose batch plants.[13] The race is on for companies to stay ahead by adopting efficient, yet flexible manufacturing methods. This means moving from batch production to continuous-flow and modularised production. By doing so, they can create competitive, sustainable and faster-to-market products.[16] The Innovative Continuous Manufacturing of Industrial Chemicals (ICONIC) project at Imperial, in major collaboration with BASF, is exploring this topic.[69] On the other hand, there is an observed debate between batch vs. continuous-flow in the UK's chemical industry. The reluctance to move to continuous-flow manufacturing could be driven by existing batch manufacturing assets. The lower risks involved in scaling up by batch could be another contributing factor. Both must be considered in pushing for more advanced manufacturing in the UK.
- Competency in process intensification: The race is also on for firms to be competent in process intensification. This entails the replacement of large plants that have high environmental and energy footprints with miniature continuous process plants that have lower energy and environmental impacts. To achieve this, the fine and specialty chemicals industry has rapidly integrated MRT. This innovation has now emerged as one of the most significant process intensification tools in the fine chemicals industry. In MRT, reactor dimensions are reduced to the microscopic scale allowing more control, selectivity, and productivity.[16] Given the increasing trend of outsourcing pharmaceutical fine chemicals production, microreactors are expected to grow at a rate of 50 – 100% annually.[13]
- Competency in increasing integration of biotechnology: Industrial biotechnology, commonly referred to as 'white biotechnology' has significantly transformed the chemicals industry landscape. It enables the conversion of renewable resources, such as sugars or vegetable oils, into more efficient transformations of conventional raw materials into a diverse range of commodities, fine chemicals, and specialty products. Unlike 'green biotechnology', which is associated with agriculture, and 'red biotechnology', which is related to medicine, 'white biotechnology' focuses on enhancing economic and sustainable production of existing products and providing access to novel products, particularly biopharmaceuticals. Within the next ten to fifteen years, it is anticipated that the majority of amino acids, vitamins, and numerous specialty chemicals will be produced through biotechnological or hybrid processes.[13] We recommend the increasing integration of biotechnology in chemicals, pharmaceuticals and MedTech sectors as future area of detail study.
- Competency in being at the forefront of research and development: Fine chemicals have shorter life cycles compared to bulk chemicals. Hence, research and development play a key role in product innovation.[16] The main focus of R&D in fine chemicals is in development rather than research.[13] Generally, product innovation requires a significant amount of resources in the fine chemicals sector.[16] R&D expenditures in fine chemicals are higher, averaging 5-10% of sales, compared to bulk chemicals, averaging 2-5%.[13] R&D activities in fine chemicals involves designing and developing synthesis, transferring processes to industrial scale, and optimising existing processes. Whilst doing these tasks, economy, safety and ecology must be met throughout, and there is substantial scope for AI and robotics to support this activity, if used appropriately.[7]

6.4. Drivers of technology innovation and scaling-up

We have also determined the following drivers of technology innovation in the fine chemicals industry that the UK must tap for opportunities of future competitiveness:

- Sustainability: Sustainability is a major driver for technology innovation and scaling up among fine chemical firms. Their aim is significant reductions in material intensity, solid wastes, wastewater, and GHG emissions. Sustainability is driving the technology innovations from batch production to continuous and modularised manufacturing that can minimise material intensity and waste. Sustainability is also driving process intensification at scale via microreactors that reduce energy and environmental footprints.[16]
- Net-zero transition: Being an inherently carbon- and energy-intensive sector, the net-zero transition is a challenging task for the whole chemicals sector,[70] as it would need, at the same time, to decarbonise its energy requirements and to defossilise its material requirements. Defossilisation is rapidly driving innovation and scaling up of manufacturing technologies (based on traditional chemistries) using fossil-free carbon feedstocks such as biomass, plastic recyclates, and captured CO_2. It is also driving innovations for new and/or circular chemistries from biomass and CO_2.[71] Decarbonisation via scaling up of electrification, hydrogen, and carbon capture technologies for the chemicals industry is also being driven by the net-zero transition.[71]
- Biomass: Not only is biomass fundamental to a climate future free from fossil-based carbon, but it also offers a potentially more secure source of carbon due to its abundance and renewability. Together with recent advances in biotechnology and biorefining, there are now biomass-based fine chemicals from sugars, oils and fats. The future will be innovation and scaling up of technologies for second-generation biomass resources, i.e., lignin-to-fine chemicals and biowastes-to-fine chemicals,[16] and third-generation biomass resources like algae.
- Synthetic biology: The development of new biological components or systems, or modified natural systems, using engineering principle commonly termed as synthetic biology is expected to be a game-changer for the fine chemicals industry. The expected trend is the development of innovative bio-based fine chemical platforms and products based on synthetic biology.[16]
- Industry 4.0: While the application of AI and data science is an emerging trend among pharmaceutical and biopharmaceutical companies, this is only starting in the fine chemicals sector. Quantitative-structure activity relationship models have existed for the last 40 years, but we now have more data to carry this out more systematically. In the future, digital technologies and AI/ML are expected to revolutionise sustainable manufacturing practices while being synergistic with novel physical manufacturing technologies. They can provide real-time performance indicators and analytics to facilitate increased efficiency, better reliability, and reduced overheads.[16]
- Emerging end users: The net-zero transition will usher the rise of the battery industry. This emerging end user is expected to drive the demand for innovative fine chemicals. The UK can also orient itself in terms of quality and reliability for the fine chemicals needed by this emerging sector.[10]

7. Skills requirements

7.1. Traditionally required skills

Like many sectors in the UK, the chemicals industry is challenged by shortages of secure and stable supply of labour. Moreover, securing a workforce with the adequate skillset has been plaguing the chemicals industry for a number of years. Exiting the European Single Market and more restrictive immigration policies are cited as barriers to accessing an overseas workforce with adequate chemical skills. On the other hand, there is also shortage of domestic supply for workforce with adequate chemical skills.[2]

The chemical skills in the manufacturing plant or production facilities were identified by Lewis [72] in 2013. The study focused on technicians who play an important role in the chemicals industry. Technicians are occupied by people with Level 3 to Level 5 skills. Both 'skill trades' and 'associate professional/technical' roles fall under the class of technicians. Technicians who play the 'skill trades' roles are 1) Process operators, 2) Maintenance technicians, 3) Laboratory technicians, and 4) Mechanical testing technicians.

Table 4 summarises the 'skill trades' roles in a manufacturing plant: their function, skills set required, and qualifications required. Generally, these technicians typically have a Level 3 qualifications in the relevant discipline. For example, process operators have Level 3 chemical or process engineering qualifications, and maintenance technicians have Level 3 mechanical, electrical, or instrumentation engineering qualifications. However, laboratory technician roles are typically occupied by graduates with degree level qualifications, even though the kind of work only requires a Level 3 (Certificate in Applied Laboratory Science or Laboratory and Related Technical Activities) or Level 4 (HNC in Chemistry). Overqualified graduates occupying laboratory technician roles are often dissatisfied with their jobs (due to underutilisation of their higher-level skills) and sometimes lack the practical application of their skills despite possessing substantial theoretical knowledge. This pattern of overqualification arose with the abundant supply of graduates in the UK. They represented relatively cheap labour to chemical firms that opted for them rather than hiring vocationally-trained laboratory technicians to fill skill trades and associate professional roles.[72]

Table 4. Skill trades roles in the chemicals industry and their functions in the plant and required skills set and qualification, which were extracted, summarised, and tabulated from Lewis[72].

Role	Function in the plant	Skills set required	Qualifications required
Process operators	- Typically, work in a shift pattern. - Operate industrial plants that produce chemicals 24/7 in a safe and efficient manner. - Control the working plant via a distributed control system or DCS (a system of instruments that controls modern chemical plants), such as starting and shutting equipment, opening and closing valves, measuring and adding chemicals to reaction vessels, preparing equipment for maintenance, and undertaking routine safety checks.	- Capability to develop working procedures, coordinate different parts of production process, and solve operational problems. - 'Need to have a model of the process in their minds' in order to exercise judgement in response from signals of the DCS so that the plant continuously run efficiently and safely. - Increasingly, must have working knowledge of mechanical systems in order to perform initial diagnosis and simple solutions (especially outside normal working hours of maintenance technicians). - Increasingly, must have specialist laboratory sampling and testing skills to monitor production process and required product quality.	Level 3 chemical or process engineering

Table 4. (Continued.) Skill trades roles in the chemicals industry and their functions in the plant and required skills set and qualification, which were extracted, summarised, and tabulated from Lewis[72].

Role	Function in the plant	Skills set required	Qualifications required
Maintenance technicians	- Typically, work on normal working hours - Mechanical maintenance technicians plan & carry out routine, preventative maintenance on the mechanical equipment and systems found in chemical plants and diagnose and solve mechanical faults and breakdowns. - Electrical maintenance technicians maintain plant electrical systems and equipment, perform routine maintenance, fault-finding, and repairs, and assist new plant installations and commissioning. - Control and instrumentation technicians (aka analyser technicians) maintain and repair instruments in DCS systems, check the DCS sends appropriate response signals based on instrument data, calibrate instruments for accurate measurements and transmitting information correctly to ensure the DCS performs its tasks well, maintain and repair instruments, and test and maintain the plant's safety-instrumented trip system. - Senior maintenance technicians (aka assistant engineers) ensure the plant systems are maintained according to relevant safety regulations and company policies, assist junior technicians with complex problems, and liaise with graduate-level staff. - Participates in plant redesigns and modifications.	- Increasingly, must be multi-skilled, i.e., skilled in mechatronics, such that they can perform both mechanical and electrical maintenance to have a more flexible and responsive workforce that could prevent plant down time and reduce costs. - Senior maintenance technicians must have leadership and coaching skills, ability to conduct 'root cause' analysis for complex problems, and project management skills relevant to plant retrofitting/ modification projects. - Practical experience in operating and maintaining a plant is valuable in providing advice in redesign and modification of plants.	Level 3 mechanical, electrical, or instrumentation engineering (but senior technicians typically have Higher National Certificate (HNC) or Higher National Diploma (HND) in engineering).

Table 4. (Continued.) Skill trades roles in the chemicals industry and their functions in the plant and required skills set and qualification, which were extracted, summarised, and tabulated from Lewis[72].

Role	Function in the plant	Skills set required	Qualifications required
Laboratory technicians	- Prepare equipment, reagents, and samples for chemical testing, whether they are working in manufacturing plants or contract analysis laboratories. - Collect samples and/or receive and track submitted samples in the case of contract analysis laboratories. - Document the test results in accordance with established procedures. - Senior laboratory technicians (aka laboratory supervisor or manager) organise the work of junior technicians, lead interpretation of test results, budget and order supplies, keep accounts, and ensure laboratory work is carried out safely and documented. - Senior laboratory technicians may develop new testing procedures and interpret the experimental results.	- In the case of technicians in manufacturing plants, able to perform tests designed to assess chemical properties at intermediate production stages and final products, in strict accordance with standardised procedures - In the case of contract analysis laboratories, able to perform tests designed to determine chemical product composition and/or presence of microbes, DNA, and pathogens, in strict accordance with standardised procedures. - Laboratory preparation skills include calibrating and maintaining equipment, cleaning glassware, and preparing solutions and chemicals used in tests - Capable of knowing which samples to take, and how, from industrial plants (those who work in manufacturing) or through fieldwork (those who work in contract analysis laboratories). - Documentation skills are a must have, and the more senior role must have skills in advanced testing methods and interpretation of results, leadership and coaching, budgeting and accounting, liaising with suppliers, and laboratory organisation.	Level 3 applied laboratory science or Level 4 chemistry
Mechanical testing technicians	- Build and operate experimental rigs and pieces of apparatus in order to carry out various kinds of material testing. - Also develop experimental rigs to simulate operating conditions in a chemical plant that can facilitate pipe corrosion studies. - Collect and prepare samples for testing from constructed experimental rigs.	- Knowledge of materials, corrosion and experimental design. - Machining and material testing skills. - Skills in material collection and sampling for tests.	Level 3 mechanical engineering

On the other hand, there are also technicians who discharge 'associate professional/technical' roles, which are the following: 1) Assistant engineer, 2) Maintenance manager, 3) Project engineer, and 4) Laboratory supervisor/manager. These technicians have at least Level 4 or 5 qualifications (e.g., HNCs, HNDs, or Foundation Degrees in engineering). They may also be technicians who have progressed into a more senior role due to advanced studies or years of experience.

A comparison of the skills requirements between the bulk chemicals sector and the fine and specialty chemicals sector was provided by the UK Parliament[4]. While the bulk chemicals sector is capital-intensive, it is not labour-intensive but requires qualified technicians. Often, the fine and specialty chemicals sectors rely on highly qualified chemists and biochemists from all over the world who are internationally mobile, and production processes tend to be more manual.[4]

Figure 25 presents the total employment in the whole chemicals sector of the UK from 2009 to 2023 as surveyed by the ONS[62] There are few years of increases, but there is a general decreasing trend of the total employed in the sector. This is not necessary problematic with a rising total GVA. However, this trend represents an underlying challenge, a declining workforce with adequate skillset, for the UK's chemical industry.[2] The UK chemical sector's recent history of corporate breakups and privatisations, resulting in firms being scaled down to cut costs and close apprenticeship training schemes, has led to 'a lost generation in the chemicals industry', wherein the age distribution is skewed to late 40s or older. More recently labour shortages are generally experienced by many sectors in the UK due to the increasing number of economically inactive individuals in the population. This number includes those between ages 16 to 64 who are not actively seeking work, between ages 50 to 64 who have long-term sickness, and early retirees, some of which have critical skills within the UK chemical sector.[2] A dip in the mid-career workforce (e.g., 35- to 40-year-olds) can also be attributed to historical underinvestment in retraining. There has been a renewed influx of skilled graduates, but a lack of experienced technicians immediately prior to this. Furthermore, the ageing population, recent pandemic, and changing immigration policies all have contributed to the on-going workforce-related challenge in the UK.[2]

Figure 25. Total number of people employed in the manufacturing of chemicals and chemical products industry of the UK from 2009 to 2022. Plotted from ONS[62] annual employment estimates.

Chemical companies primarily acquire technicians through the external labour market, particularly graduates, for laboratory roles. However, some manufacturers utilise in-house training, including apprenticeships and upgrade training, for process operator and maintenance technician positions. There has also been a trend towards work-based training by chemical firms, particularly for roles requiring degree-level qualifications, which reflects employers' frustration with graduates having limited practical skills and experience.[72]

7.2. Skills required in the future

"We need people who are not constrained by what we're currently doing."
(Chemical industry employer, CIA and Cogent Skills[73])

While the concept of sustainability is already well-established in the UK's chemical sector through continuous improvement, the net-zero agenda and Industry 4.0 are expected to make fundamental changes to daily operations and working practices of chemical companies in the decades to come. Through two roundtable discussions with 14 chemical industry leaders, CIA and Cogent Skills[73] have surveyed the top six skills in descending order of priority:

1. Innovation creation and commercialisation
2. Data analysis and modelling
3. Health and safety
4. Management and leadership
5. Research and development

The emerging requirement of these skills reflects a transitioning chemicals industry, requiring new thinking and strong leadership. These future skills will help address complex commercial challenges including engaging with different sectors and customer bases.

8. Business environment

8.1. Nature of the fine chemicals business

The chemicals industry itself is the largest customer of chemical products – healthcare, agriculture, manufacturing, and industries depend on chemical firms for raw materials.[74] In the chemicals universe, the fine chemicals industry is positioned as the supplier of the specialty chemicals sector and several end-user industries, and their customers[13] (also refer to Figure 8). As defined in Table 3, fine chemical companies act as manufacturers, distributors, or both within a complex and rapidly growing network of B2B chemical supply chains.[12]

The B2B supply chain is crucial for procurement and logistics in the chemicals industry, particularly in managing material flow, information, and finances. It is essential in managing constant changes and risks due to the dynamic nature of the supply chains. Customer loyalty is inherent in the B2B chemical market which can be influenced by perceived value, social bonds, inertia, and switching costs. Moreover, customer satisfaction with chemical products is essential in B2B contexts, hence, diverse services are offered. Reference pricing is also inherent as it influences B2B transactions, in terms of how prices are strategised, how the buyer and seller interact with each other, and the outcome of the negotiations.[12] Digital technologies are increasingly integrated in B2B chemical transactions (i.e., marketing and sales), which increases the range of suppliers and provides more market information to buyers.[75] There is also increasing integration of sustainability and resilience, in the context of capacity expansion of B2B chemical supply chains, to meet growing demands. On top of the requirements for sophisticated demand forecasting and strategic planning, B2B chemical firms must now integrate environmental considerations and anticipate disruptions.[12]

Another important aspect of the fine chemicals business is custom manufacturing, whereby the customer specifies the manufacturing process and is served exclusively.[16] Other terms found in websites of companies are custom synthesis, bespoke manufacturing and toll manufacturing. When fine chemical companies mainly focus on exclusive products, they are called Custom (or Contract) Manufacturing Organisations (CMOs). In general, CMOs involve high asset intensity, run batch production campaigns, spend more than industry-average on R&D, and maintain close, multi-level, and multi-functional relationships with customers. On the other hand, the custom manufacturing industry is fragmented due to a lack of economy of scale.[13] Moreover, while custom manufacturing boomed in the 1980s and 1990s, it declined after 2000s due to underutilised assets, as new drug launches declined from the pharmaceuticals industry.[7]

Finally, not only is R&D integral in the technical aspect of the fine chemicals sector (as discussed in Section 6.3), but it is also essential to its business nature. Due to shorter life cycles of fine chemical products than commodities, product innovation must be quick to replace obsolete products. When developing new products and new processes, the companies consider business and technical parameters together, such as attractiveness and strategic fit, and used these to assess the projects and portfolios for the directions to take. Typically, R&D spending in the fine chemicals sector is 5 to 10% of sales, higher than in the bulk chemicals sector at 2 to 5% of sales. While that is the case for established firms, establishing and growing fine chemical start-ups require a significant amount of investment to develop and patent innovations before their cash-flow become positive.[68]

8.2. Enabling mechanisms for fine chemicals business

Considering the nature of the fine chemicals business, some of the enabling mechanisms we identified that will benefit the UK context are:

- Strategic procurement through the government: Considering the dynamic nature of B2B chemical supply chains, the development of a procurement strategy is crucial, which would prioritise efficiency, source high quality products, partner with suppliers aligned to goals of companies and build long-term relationships with these suppliers, minimise supply chain risks based on geographic considerations, reduce the supplier base to benefit from economies of scale, and invest in R&D with key suppliers.[76] The government's role in procurement policy[77] could be used to drive innovation and competitiveness in the UK's chemical supply chains, e.g., through local content mandates. For example, the NHS could be a major fine chemicals customer, should the focus shift to products having home-grown local and green content.
- Provision of logistical infrastructure through government: The B2B chemical supply chains not only include manufacturers and distributors but also logistics companies that transport, store, import, and export fine chemical products. Hence, disruptions in their operations would be an economic disaster for the industry. Together with manufacturing and regulation, import/export logistics must be included in developing a government-wide dedicated chemical strategy in partnership with the industry.[78]
- Support in increasing range and access to new markets: Increasing the range of fine chemical suppliers opens them to new buyers. Accessing new markets allow fine chemicals businesses to respond and create innovative products. To facilitate this, trade advisers and government personnel in key export markets must work together in providing information and support to the industry.[67] Government could also provide grants, especially for SMEs, to engage with new business partners within the country and exhibit at international trade fairs.[10]
- First priority to IP ownership and exploitation within the UK: Innovations in green chemicals and circular chemistries, driven by sustainability and net-zero targets, offer new opportunities for businesses.[79] A well-thought-out IP strategy (i.e., inclusive of patents, trade secrets, and branding) is crucial for exploiting these innovations and navigating the evolving commercial landscape. The strategy must ensure that this IP is owned and exploited within the UK as far as possible to stimulate new businesses and add more revenue to the economy.[80] The National Wealth Fund could be instrumental in relation to this strategy.[81]
- Continuous support of SMEs from laboratory to scale up: The journey of a successful startup, from R&D in the laboratory to industry scale, is long and may take years for profits to be realised. An accelerator program must be provided to undertake staff recruitment, mentoring and training, provide specialist advice from trade advisers and government personnel in the sector, facilitate connections with larger organisations to accelerate technology deployment, provide information on grants, and advice on and access to facilities in the UK.[68]

9. Policy & regulatory environment

9.1. Global compliance

UK producers of fine chemicals tend to operate in an open and global marketplace and hence are subject to regulations by a range of external bodies[8], including:

- US Food and Drug Administration for pharmaceuticals and food ingredients;
- European Medicines Agency;
- EU REACH (more below);
- SSbD framework by the EU (on voluntary-basis, to date)
- SEMI Standards for electronics manufacturing inputs; and
- Emerging markets authorities, e.g., China National Food Safety Standard, India Drugs and Cosmetic Acts.

9.2. UK compliance

Within the UK, manufacturers will need to comply with environmental standards (typically regulated by the Environmental Agency) and health and safety regulations (supported by and regulated by the Health and Safety Executive or HSE).[64]

A current particular concern in the sector is UK REACH, which is summarised below from HSE [82]:

- Following the UK's departure from the EU, the process for registering chemicals in the UK has changed. However, the UK has largely maintained the existing regulatory framework for chemicals, which was based on the EU's REACH regulation.
- The UK has implemented its own version of REACH, called UK REACH, which is largely aligned with the EU regulation. Under UK REACH, companies that manufacture or import chemicals into the UK in quantities greater than one tonne per year are required to register their substances with the HSE.
- The registration process for UK REACH is like that of EU REACH and involves several steps, including:

Pre-registration: Companies must pre-register their substance with the HSE within 120 days of first importing it into the UK.

Preparing a registration dossier: Companies must prepare a dossier containing information about the substance, including its properties, uses, and potential hazards.

Submitting the registration dossier to the HSE: Companies must submit their registration dossier to the HSE through an online portal.

Paying registration fees: Companies are required to pay registration fees based on the tonnage of the substance being registered.

Compliance with any additional requirements: Depending on the properties and intended use of the substance, additional testing or risk assessment may be required.

- It is important to note that UK REACH requires separate registration from EU REACH. This means that companies that export chemicals to the EU and the UK will need to register their substances separately under each regulation.
- Some substances, covered by more specific legislation, have tailored provisions under UK REACH, including a) Human and veterinary medicines; b) Food and foodstuff additives; c) Plant protection products and biocides; d) Isolated intermediates; and e) Substances used for research and development.
- In 2024, an analysis by Jones and Burns[64] revealed that UK and EU chemical regulatory regimes are diverging, with the UK being unable to keep pace with EU developments. This divergence is due to the UK's lack of capacity, expertise, and capability compared to EU counterparts.
- On the other hand, based on our consultation with stakeholders from the fine chemicals industry during a round table discussion last 10 March 2025, they highly regard the UK's strengths in developing standards. Hence, rather than weaker capability, it is the lack of certainty on UK policy direction that is more concerning for stakeholders. They also added that manufacturers have expressed their concern regarding additional compliance overheads, i.e., the re-registration would cost the UK chemical industry about £2-3 billion. Given that opportunities are in the export of fine chemicals, and compliance with two sets of regulations could be costly, these make divergence of the UK REACH from EU REACH more of a burden than a benefit.
- Environmental NGOs have also expressed concerns about dilution of protections and watering down of chemical safety rules due to the divergence. For example, CHEM Trust [83] highlighted the UK's decision to only match EU classifications for endocrine disrupting chemicals (EDCs) when it becomes globally accepted, while the EU has already planned the phasing out of EDCs from toys to better protect children.

10. Deep dives with organisations in the chemicals industry

We have conducted deep dives with the Chemical Industry Association (CIA), the Society of Chemical Industry (SCI), and the Centre for Process Innovations (CPI) for their views of and insights on the UK's fine chemicals industry. (See Appendix A.4 for our list of typical interview questions we asked.) In this section we present the key points of our deep dives.

10.1. Key points of the deep dive with the CIA

- Fine and bulk chemicals companies face similar issues given the highly interconnected industry. Hence, conditions that are good for one are good for the other, so when one has the right conditions, the others will flourish too.
- The number of contract manufacturing firms in the UK has decreased compared from 10 to 15 years ago. The chemicals industry has shifted production closer to raw materials and skills.
- Energy and feedstock costs impact bulk chemicals companies more than fine and specialty chemicals companies. While the fine and specialty chemicals companies recognise these costs are passed along the supply chain, they are less affected.
- UK sustainability reporting needs simplification due to six different policies requiring carbon emissions reporting in various ways.
- The chemical annex in the UK-EU trade agreement should be implemented, along with a data sharing agreement, to benefit the UK chemical industry. Joint recognition of registrations is preferred over duplicate submissions and payments. Duplicate registrations and differing legal jurisdictions between the UK and EU REACH regulations pose challenges. CIA members welcome alignment of the regulations, suggesting the UK incorporate stakeholder engagement in decision-making.
- Opportunities for improving the international competitiveness of the UK's fine chemicals industry are found on 1) Affordable and fair energy fees as the UK industries are transitioning; 2) Reducing traditional feedstock costs while supporting biomass, waste plastics, and captured carbon dioxide as alternatives; 3) Certainty of policy and regulations by streamlining reporting schemes to avoid duplication and enhance productivity, and by broadening policy objectives to include biodiversity conservation alongside the net-zero transition and the SDGs; 4) Better permitting and planning processes for the chemicals industry and related infrastructure; and 5) Regionalisation of policies and strategies emphasising the importance of industrial clusters and their benefits to the surrounding region.
- The North East region, with its dominant chemicals industry, faces long-term skill availability concerns, while the North West, with a fragmented chemicals industry, struggles with immediate skill shortages.
- The UK lost its R&D innovation advantage post-Brexit, impacting its reintegration into Horizon Europe. While trade continues, the skills gap is a significant challenge, hindering industry growth.

10.2. Key points of the deep dive with the SCI

- The UK chemical industry, despite its importance and innovation, faces challenges in policy coordination and investments. Fine chemicals, crucial for various sectors, are particularly vital, as seen during the pandemic.
- The UK fine chemicals industry presents growth opportunities due to earning margins, IP, and effect base. However, it faces threats from the risk of its potential health and environmental impacts and international competition in rolling out green carbon technologies and products. The UK must tap the strengths of its chemistry, biology, and AI, and must overcome the hurdles of its existing industry structure, marked by a few large companies and many small ones.
- Energy productivity, not just labour productivity, should be a focus. Hence, long-term planning for low-carbon and renewable energy, like Bayer's wind farm investment, is crucial.
- UK REACH, a standard separate from its international counterpart has no value. Notwithstanding the importance of regulation in protecting and sustaining the health of humans and ecosystems, it fosters discoveries and innovations. The UK must tap its effective leadership in making and implementing new policies.
- The UK Government must understand the role of chemistry in the economy. "How can we solve world problems without chemistry?"

10.3. Key points of the deep dive with the CPI

- The challenges of the UK chemical industry are due to declining domestic production and reliance on global supply chains. To mitigate these, the UK needs a stable economic platform and government intervention to stimulate investments in the fine chemicals sector.
- The following offer opportunities for better international competitiveness of the UK's fine chemicals sector:

1) Nuclear energy, specifically small modular reactors (SMRs), presents a stable and potentially cost-effective

alternative to traditional energy sources for reindustrialisation of UK industries. SMRs could power individual facilities or clusters of companies, providing a sovereign and decarbonised energy source for industries like aviation and chemicals.

2) Captured carbon, biomass and plastics are potential carbon sources. The Flue2Chem program, which transforms stranded carbon into detergent materials, is highlighted as a relevant initiative.

3) Legislative measures should promote recycled and de-fossilised materials in fine chemicals. This approach, similar to that used for EVs in the EU, can kickstart the industry and drive economic scale.

4) Synthetic biology, combining chemistry and biology, is crucial for creating high-value materials. Engineering skills, particularly chemical and biochemical engineering, are essential in harnessing the benefits of this field.

5) The UK's strong scientific base presents an opportunity to develop new materials and chemicals. Stabilising the current manufacturing base is crucial to avoid losing skills and infrastructure for future manufacturing.

- The CPI has the following recommendations to stakeholders of the fine chemicals industry to improve its competitiveness and promote productivity growth:

1) The UK should incentivise platform chemicals production through guaranteed prices, similar to the energy industries, attracting investments and fostering a thriving chemicals industry.

2) A national framework is needed to support disruptive technology adoption in the UK chemical sector, especially for SMEs. This framework would bridge the gap between academic research and industry uptake.

3) Bridging the gap between academic research and practical application in the chemicals industry is crucial for skills development and industry competitiveness. Collaboration between academia, industry, and research organisations is needed to address recruitment challenges and skills transfer.

4) The UK chemical sector needs to integrate academic research with industry to translate IP into tangible products. This would involve demonstration-scale capabilities, targeted finance, strong supply chains, and local champions, all of which are crucial for global competitiveness.

11. High-level conclusions

- Our review of the global fine chemicals landscape reveals a growing demand for fine chemicals (in terms of market value) with Pharmaceuticals & nutraceuticals (59%), Agriculture (19%), Cosmetics & home/personal care (5%), Paints & coatings (4%), and Building & construction (3%) industries as the top five consumers. The East Asian region represents the largest share (32%) of fine chemicals demand, followed by North America (24%) and Western Europe (16%) as second and third largest sources of demand, respectively. Competition among major players of the industry is intense to gain a foothold in the global market by focusing on high product quality, superior technology, efficient production, and strong customer relationships.
- The fine chemicals value chain can be generalised with two main components: 1) manufacturers that produce the fine chemicals and 2) distributors that bring the fine chemicals to end-users. However, actual fine chemicals supply chains are far from simple, because the industry is mainly a B2B sector, and fine chemicals end up in a very wide range of final products or are used within production lines of the chemicals industry itself.
- The main drivers for the overall growth and development of the global fine chemicals industry are macroeconomic factors (GDP and inflation), growth of end-use industries (which is led by the pharmaceuticals and nutraceuticals), and research and technology developments. Growing sustainability requirements, integration of digital technology, recent global pandemics, and ongoing geopolitical conflicts also impact the global fine chemicals landscape.
- Our review of the UK fine chemicals landscape reveals a well-established industry, being the birthplace of fine chemicals, with high product diversification and interlinkages to end-users within and outside the country. The fine chemicals industry is estimated to contribute about 40% to the total GDP value of the whole chemicals industry in the UK. Like the global industry, the demand for UK fine chemicals (in terms of market value) is growing with Pharmaceuticals & nutraceuticals (65%), Agriculture (16%), Cosmetics & home/personal care (6%), Paints & coatings (4%) and Building & construction (3%) as the top five end-user industries.
- Our calculations show that the UK's fine chemicals industry has a GVA of £32 billion and employs over 231,000 people, which translates into a labour productivity of £143,000 per employee. The top five contributing subsectors are Catalysts, Contract chemicals, Specialty polymers, Pigments & dyes, and Construction chemicals. This highlights the fine chemicals sector's importance, beyond its own KPIs, as it underpins other key industries of the UK including pharmaceuticals, agrochemicals, fast-moving consumer goods, automotive, aerospace, and building and construction.
- A particular feature of the UK fine chemicals industry compared to peer countries is the relatively small firm size, and a firm size distribution which is characterised by a long tail of small companies. Although the latter tend to be specialised, this characteristic means that many firms may lack critical mass to embrace new technologies and particular support systems will be required. Hence, a regional innovation strategy and concepts similar to extension services may be important, especially when considering wider drivers such as decarbonisation.
- Because of this size distribution feature, the sector also lacks a strong voice, and this has led to a lack of a joined-up strategy in government. A particular opportunity here would be the use of procurement as a lever to drive innovation and competitiveness. An example of a policy challenge which is often mentioned is UK REACH, where both industry and NGOs appear frustrated by potential diversions from EU REACH. This is a topic we shall investigate further.
- For the sector as a whole, and for the UK in particular (where the science base is still strong), opportunities exist in relation to the desire for more sustainable products, the ability to innovate in product design to improved understanding of product physics (supported by robotics and AI in discovery research), the transition from batch to continuous manufacturing and the adoption of Industry 4.0 principles and improvements in material and energy efficiency.

12. Recommendations to stakeholders

Our recommendations are grouped into six themes, collectively designed to create a robust enabling ecosystem which brings together stakeholders from industry, government and academia. These themes address overall sector strategy planning, economic and business development, regulation and policy, skills innovation, and an underpinning mindset change theme.

We have prioritised these themes below, although they need to be seen as an integrated sector strategy. Beginning with Priority 1, we will bring together the industry stakeholders who will refine these broad recommendations into a series of specific and detailed actions. These will be further developed and tested in regional workshops with industry representatives to produce a fine chemicals sector strategy.

Priority 1. Sector strategy planning

The first priority is to agree an industry-led sector strategy, prior to more detailed work to develop specific recommendations aimed at addressing (a) the immediate short-term challenges faced by the UK's fine chemicals industry, and (b) creating a supportive industrial and innovation ecosystem in the long-term to ensure the industry's future economic sustainability by building on its existing strengths, supporting innovation, and growing exports. Hence, the development of this industry-led sector strategy must consider the following at its core:

- Identification and engagement with the key industry stakeholders to agree the strategy's scope, timescales, actions and deliverables.
- Balancing top-down government and regulatory direction and support for the industry against bottom-up, industry-led approaches: This will be led by the fine chemicals industry but there will be challenges that must be overcome in achieving this, such as: the high fragmentation of the industry; multiple bodies representing firms that may have differing views on which direction to take the industry; a seemingly overall lack of ambition within the sector; and most importantly, a lack of understanding of the sector within government.
- Shifting towards an industry-driven approach may require more regionalised policies and strategies: The UK's chemical industry is concentrated in six key hubs (Grangemouth, Teesside, Merseyside, Humberside, South Wales, and Southampton) each with its own unique context and specialisation, and these come with unique sets of needs and challenges. Consequently, a one-size-fits-all sector strategy may not be effective in harnessing the strengths and addressing the requirements of each hub. Moreover, echoing the findings from our deep dive with the CPI, tailored strategies and policies would not only benefit the local firms but also the communities around each industrial cluster.

Priority 2. Economic and business development

The aim of this theme is to ensure there is an enabling business environment to enhance the industry's GVA and grow its global competitiveness. Key areas for attention include:

- Mechanisms to improve the climate for investment in the industry, e.g., designed to provide greater stability and certainty over the pricing of essential raw material inputs and energy.
- Possible improvements to the planning process to support the development of new production and R&D facilities.
- Exploring the possibility of a supportive government procurement strategy for fine chemicals.
- Provision of support for incubating and commercialisation to help scale-up promising small fine chemical companies and innovative start-ups.

Priority 3. Regulation and policy

It is essential that there is a streamlined policy and regulatory environment for the fine chemicals industry. This requires actions to address the following:

- Harmonising UK's REACH system with the EU regulatory process is essential. After Brexit, the UK has implemented UK REACH, a chemical registration system largely aligned with EU REACH. This means that companies that export chemicals to the EU and the UK will need to register their substances separately under each regulation. While the UK REACH maintains the EU's regulatory framework, UK chemical regulation is now behind the EU due to gaps in capacity and expertise. This divergence from EU standards has raised concerns among manufacturers and environmental NGOs due to additional compliance overheads and dilution of protections, respectively. In terms of harmonisation, echoing the suggestions by the CPI, (a) UK and EU governments should implement the chemical annex in their trade and cooperation agreement, and (b) there should be a joint recognition of both frameworks within the UK and EU given the existing open supply chains and cross border trading. This harmonisation activity should be led by the UK's HSE in collaboration with chemicals industry associations.
- Simplifying carbon and/or sustainability reporting whilst ensuring consistency with international standards: There are at least 6 reporting schemes with differing metrics and focus. For example, Streamlined Energy and Carbon Reporting (SECR) primarily focuses on a company's greenhouse gas emissions, while the Energy Saving Opportunity Scheme (ESOS) concentrates solely on energy usage. There is a need to avoid duplicating efforts in carbon and/or sustainability reporting schemes, as the activities involved can be time-consuming and counterproductive for chemical firms. The simplification and/or streamlining of these schemes should be led by the His Majesty Revenue and Customs (HMRC) and the Department of Energy Security and Net Zero (DESNZ), while working together with the chemicals industry organisations.
- Expanding fine chemicals policy to include biodiversity and shifting from relative sustainability to absolute sustainability, to help foster industrial process innovation and create a competitive edge among peer countries.

Priority 4. Skills

This theme addresses current and future skills requirements in the fine chemicals industry. Actions will be needed in the following areas:

- Developing a skills roadmap that ensures there is balance between a sufficient supply of skilled workers via the UK education and apprenticeship system and reliance on migration of skilled workers from outside the UK.
- Ensuring a continuous supply of skilled workers via apprenticeships and training: Information dissemination about available opportunities must be improved by chemical firms and educational institutions so that they can attract new local apprentices and trainees to the chemicals industry.
- Exceeding minimum student numbers to make it worthwhile for educational institutions to offer apprenticeships and/or relevant courses by aggregating their demand with the demand of local chemical firms.
- Promoting Continuous Professional Development (CPD) courses and a culture of life-long learning within chemical firms as part of upskilling and reskilling of their existing workforce to new tools and digitals skills. This can be supported by chemicals industry associations (the CIA, SCI, and CPI) and professional development institutions like the Royal Society of Chemistry (RSC) and the Institute of Chemical Engineers (IChemE). Educational institutions must be also encouraged to offer CPD courses and/or massive online open courses (MOOCs) specifically targeted to the existing chemicals skills workforce's upskilling and reskilling.
- Encouraging chemical firms to be open with their succession planning and career development programs in order to retain their workforce, create their future leaders, and ultimately, address an ageing workforce.

Priority 5. Innovation

It is essential that the fine chemicals industry increase its capacity for innovation, by aiming to be on par with the success of the Swiss fine chemicals industry, if it is to remain globally competitive. The following areas need attention:

- R&D to advance and commercialise home-grown flexible manufacturing and process intensification technologies: Echoing our deep dive with the CPI, the UK should not aim for large-scale facilities but for more cost-effective and value-retaining "Goldilocks" scale facilities, which could be achieved with modular and process-intensified technologies.
- R&D is especially needed in chemical technologies to meet the UK's carbon reduction agenda, along with other environmental objectives (e.g. reducing waste from processes and efficient use of resources).
- R&D to support greater integration between industrial biotechnology and synthetic biology.
- Prioritising IP ownership and exploitation within the UK: As an area of future detailed work, it will be necessary to review the innovation capabilities of the 'long-tail' of companies and the extent to which innovative start-ups and small companies are purchased by non-UK companies and investors.
- Identifying the funding requirements of fine chemical companies with promising innovations: This could include any funding gap or 'valley of death' problems, and exploring what mechanisms need to be introduced to ensure an appropriate funding environment for incubation and commercialisation.
- Reviewing the current funding availability and structure for basic science and early-stage R&D.

Priority 6. Mindset change

Underpinning these actions, we believe there is a need for greater recognition of the chemicals industry in terms of its importance and role in the everyday life of UK citizens.

- The fine chemicals industry underpins key UK manufacturing sectors: is the chemicals industry is needed to provide the raw materials for many key manufacturing sectors. However, understanding of the sector is limited, both on the part of the general population and government.
- The recent closure of chemistry departments of some UK universities is concerning. Losing our capacity to educate future chemists and inventors would mean lost opportunities for our industry as fine chemicals innovation comes from a strong base of scientific and technological know-how and a constant supply of skilled workforce.
- We believe that a programme, led by fine chemicals industry associations (the CIA, SCI, and CPI) and professional development institutions (the RSC and IChemE), is needed to provide education and transparency to achieve the mindset change that will help to improve the standing of the industry.

- We will also need people with skills to oversee the rebranding of the chemicals industry. Organisations such as ChemTalent, The Alliance of Chemical Associations (ACA), The Society of Chemical Manufacturers and Affiliates (SOCSA), the UK Chemical Stakeholder Forum, the Royal Society of Chemistry (RSC), and the Alliance for Sustainable Chemicals and Materials (ASCM) could all have a role to play. However, timing will be critical for this endeavour.

13. Future work and detailed studies

- Building upon this sectoral review and analysis, we will create in collaboration with stakeholders **a sector strategy for the fine chemicals industry:**

- The primary objective of this future work is to create a detailed and actionable strategy that outlines specific measures for supporting the sustainable growth of the fine chemicals sector.

The key expected outcomes are:

- A strategic framework that aligns industry and government efforts to enhance innovation, competitiveness and investment.
- A clear roadmap and policy recommendations to streamline regulatory processes, improve planning mechanisms, and enhance government support.
- An investment and funding strategy to boost the scaling of SMEs and start-ups within the fine chemicals industry.
- Stronger regional and global positioning for the UK's fine chemicals sector within international markets.

Areas that might be addressed in the strategy and based on findings from the Sector Review include:

- Alignment between industry stakeholders to agree the strategy's scope, timescales, actions and deliverables.
- Improving the climate for investment in the industry.
- Mechanisms for supporting incubation and scale-up of promising small fine chemical companies and innovative start-ups.
- Policies to support funding and investment and retention and exploitation of IP within the UK.
- The role of government procurement in supporting the fine chemicals sector.
- Streamlining and harmonising key regulations.
- Simplifying carbon and/or sustainability reporting whilst ensuring consistency with international standards.
- Developing a skills roadmap and ensuring a continuous supply of skilled workers.
- The role of the planning process in supporting or constraining the development of new production and R&D facilities.
- The regional and wider value chain aspects of a fine chemicals sector strategy.
- The vision of this sector strategy is to increase revenue of the fine chemicals sector, which translates to greater GVA and, consequently, more economic growth for the UK. Hence, this strategy will concentrate on two key areas: 1) the needs and objectives of the fine chemicals industry to foster growth and sustain it, and 2) the policy environment that is necessary to support these needs and objectives.
- It was highlighted in the Roundtable Discussion with stakeholders from the fine chemicals industry we held last 10 March 2025 that the creation process of this sector study must have some prioritisation, to avoid becoming a long 'wish list' (i.e., to focus on around 3 priority themes). In developing this sector strategy, the role of procurement was also highlighted as a big driver, but will require some horizon scanning (i.e., a) What are the demands?; b) What products will be procured?; and c) Which markets, import or export?).

On the other hand, the following are the areas of future detailed studies:

- We recommend the examination of the alternative measures of productivity for the UK's fine chemicals sector, such as capital productivity, energy productivity, and material productivity. Measuring the capital productivity of the sector could reveal how efficient the existing physical assets of the sector are and what would be needed to increase their productivity. Measuring the energy productivity could reveal how energy-efficient the sector is in its energy use and what would be needed to increase efficiency while protecting the climate. Measuring the material productivity could reveal how resource-efficient the sector is and what would be needed to achieve circularity.
- We recommend examining the closer integration between pharmaceuticals, biotechnology, MedTech and the fine chemicals sector. Currently, there seems to be a lack of connectivity between the UK's pharmaceutical industry and its fine chemicals industry. Moreover, with the increasing influence of biotechnology on chemicals and, consequently, manufacturing, there is a need to examine the opportunities for synergy and threats for trade-offs resulting from the integration. A horizon scan could be conducted as part of this study. We also think that the NHS is an anchor end-user with resulting closer integration of these sectors.
- We recommend a detailed review of the innovation capabilities of the 'long-tail' of companies, which would determine how innovative they are, how many are intending to stay small versus try to scale-up, and how much value-add they bring to the economy. Moreover, this review should determine the extent to which innovative start-ups and small companies are being purchased by non-UK companies and investors (i.e., Are there many that have been acquired by US companies similar to the biopharmaceuticals sector?).

Appendices

A.1. Fine chemicals global market trends in terms of market volume

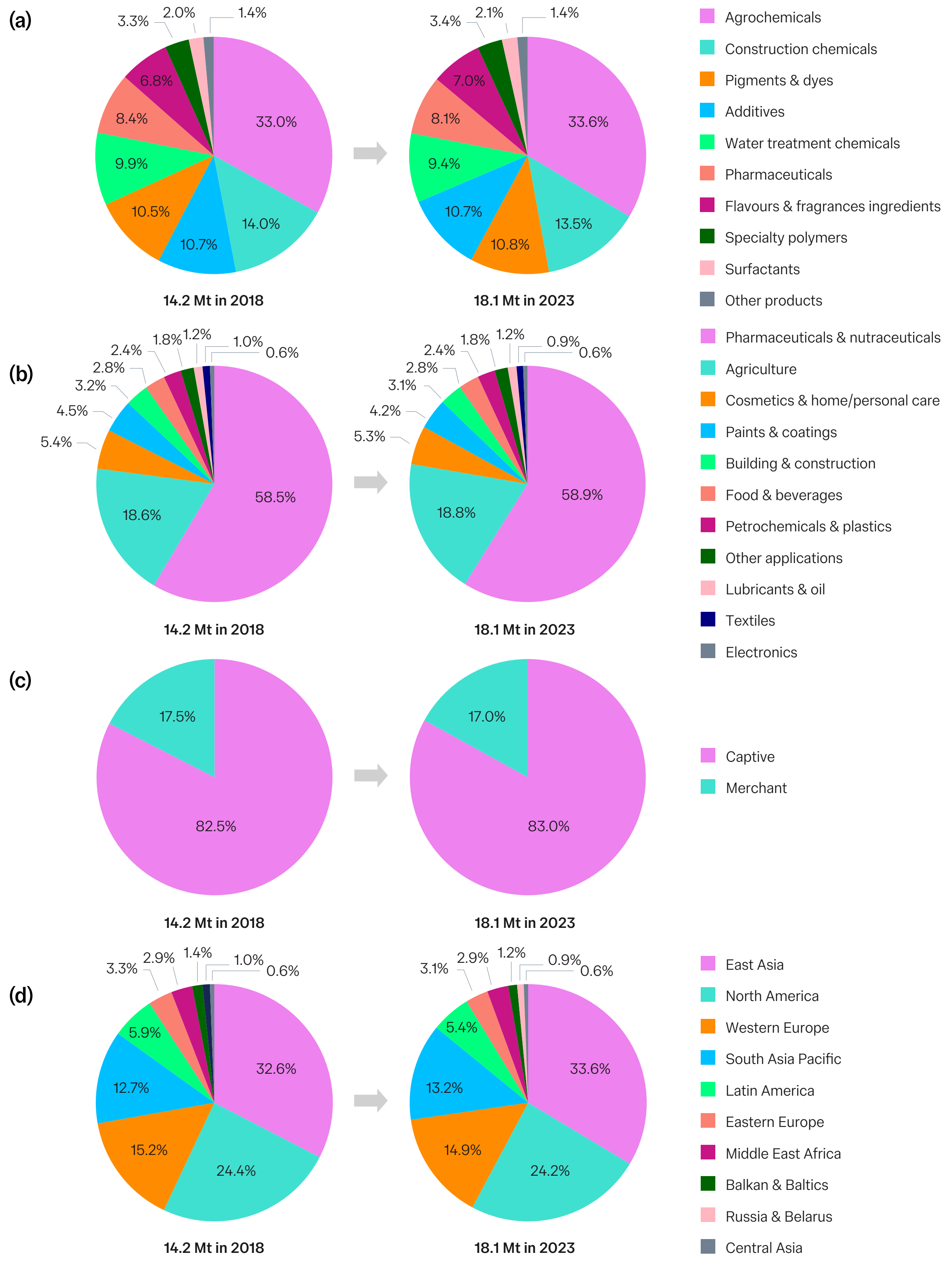


Figure A - 1. Global fine chemicals market volume share by product type (a), application type (b), business type (c) and region (d) in 2018 and 2023, plotted from FMI[8] data.

A.2. Methods and data for productivity measure

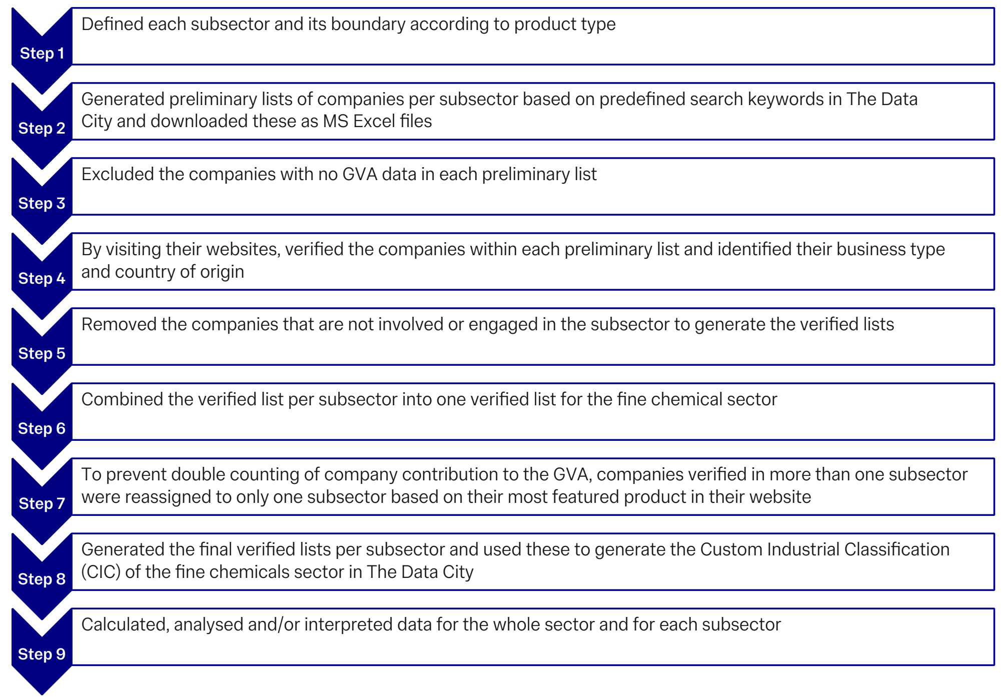


Figure A - 2. Schematic diagram of the determining company-level labour productivity based on the methodology we developed while taking some inspiration from the methodology of Moore and Kutlu[84] for their review and analysis of the MedTech sector.

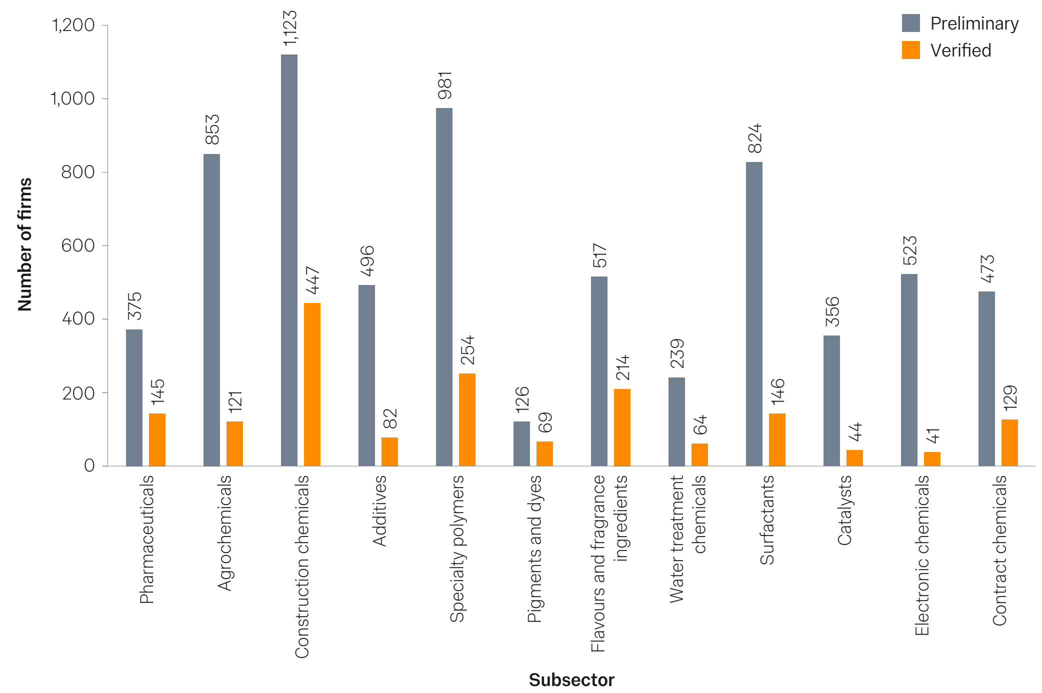


Figure A - 3. A total of 6,886 preliminary companies across 12 subsectors of the UK's fine chemicals sector were found through The Data City[65], and only 1,756 companies were verified as involved in the fine chemicals industry in 2024.

A.3. Supporting data for technology scaling-up

Table A - 1. Typical investment cost for a cGMP multipurpose plant in the US. Retabulated from Wikipedia[13].

Cost elements			Details	Share (%)
Raw materials cost			Inclusive solvent	30
Conversion cost	Plant specific	Utilities and energy	Electric power, steam, brine	4 – 5
		Plant labour	Shift and daytime work	10 – 15
		Capital cost	Depreciation and interest on capital	15
		Plant overheard	Quality control, maintenance, waste disposal	10
		Research & development	Inclusive pilot plant	8
	Marketing & sales		Inclusive promotion	5
	General overhead		Administrative services	15

Table A - 2. Indicative operating cost breakdown of a fine chemical company. Retabulated from Wikipedia[13].

Equipment / Investment	Quantity/Amount
Description of a main equipment	
Production trains	2
Reactor vessels (volume = 4 m^3)	6
(Total reactor volume)	(24 m^3)
Filtration units	2
Dryers	2
Capital investment	
Total capital investment	**$21 million**
• Investment per production train	$11.5 million
• Investment per piece of main equipment	$2.1 million
• Investment per m^3 reactor volume	$0.9 million

A.4. Typical deep dive interview questions

1. What are your thoughts on current fine chemicals market trends (Global or UK)?
2. What are the strength(s), weakness(es), opportunity(ies), and threat(s) of the UK FC sector?
3. Being a subsector within the chemicals sector, who do you consider the leading fine chemical companies in the UK?
4. Who do you consider peer countries in this sector?
5. What are your thoughts on the labour productivity (i.e., GVA per employee) of the UK's fine chemicals industry?
6. Aside from labour, what is/are measures of productivity of the fine chemicals industry?
7. What do you think is/are key(s) to unlocking higher productivity and global competitiveness of the UK's fine chemicals industry?
8. What do you are the competitive advantages of our international competitors or what are they doing differently?
9. What do you think are the skills requirement for the fine chemicals industry? Follow up on T-levels
10. How is Brexit impacting, either positively, or negatively, if at all, the UK's fine chemicals industry or the entire chemicals industry?
11. How is implementation of UK REACH impacting, either positively, or negatively, if at all, the UK's fine chemicals industry or the entire chemicals industry?
12. In what ways is your organisation supporting the fine chemical companies navigating the complexities of Brexit and UK REACH?
13. What support should the government provide to improve the competitiveness of the fine chemicals industry? What should be the overall ask?

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