

Industrial sand future markets

This factsheet provides an overview of UK industrial sand markets. It is one of a series on economically important minerals that are extracted in Britain and is primarily intended to inform the land-use planning process. It is not a statement of planning policy or guidance; nor does it imply Government approval of any existing or potential planning application in the UK administration.

November 2025

*Industrial sand
processing, Arclid
quarry. BGS © UKRI*

Industrial sand is an essential raw material for UK manufacturing with well-established markets for example in the glass, foundry sand and leisure sectors. Further detail can be found in the BGS [Mineral Planning Factsheet](#) for Silica Sand which gives a comprehensive overview of UK industrial sand industry, deposits and planning issues. However, the mineral planning factsheet does not consider how markets and demand may change as new applications develop and the downstream industries that consume industrial sand in the UK evolve. This industrial sand future markets factsheet aims to address this information gap by providing insights into the future trends of industrial sand markets and consumption in the UK.

Industrial sand is consumed in a wide variety of end uses in the UK (Figure 1). Some, such as glass sand, consume a large proportion of UK supply. However, there are also many other important uses that consume relatively small amounts. These include water filtration, sports pitches, use in fluidised bed boilers, ceramics, growing media, silica chemicals etc. These end uses are very different, but they all have two significant aspects in common:

- they support much larger, often high-value or strategically important, industrial sectors in the UK and;
- they have a requirement for particular physical and chemical characteristics of the sand which

often can only be met from a restricted number of quarries and geological formations.

For many of these uses, high demand combined with a limited number of producing sites has resulted in strained UK supply. If supply of industrial sand were to cease from UK operations, it would force consumers to source the same narrow specification of material from overseas at increased cost in terms of both time in developing new supply chains and transporting materials. Although industrial sand may represent a relatively small proportion of the cost of some higher value applications, it is nonetheless an essential component. Supply disruptions may have serious consequences for long term investment decisions or the viability of downstream industries and manufacturing sites.

Supply

A survey of silica sand production in Great Britain in 2023 was conducted by the BGS. The survey received a response rate of 81 per cent of all sites surveyed. Informed estimates have been used for missing sites. It is possible that some sites producing silica sand were not included in the survey, but the volumes are believed to be small. The results indicate that silica sand production in 2023 totalled 4.7 million tonnes, a small decrease of 4 per cent compared with a similar survey conducted in 2018 (4.9 million tonnes). The North West of England, with 1.6 million tonnes, was the largest producing region in 2023, accounting for 34 per cent of total production.

The Office for National Statistics (ONS) also conducts a survey of a sample of silica sand producing sites which is used to estimate annual production for all sites (PRODCOM data). The ONS report total production was 4.2 million tonnes in 2023 compared to 4.8 million tonnes in 2018.

The small decrease in production between 2018 and 2023 reflect broader economic trends in construction and industrial manufacture in the UK. Sand for bricks and tiles has seen the most significant decline; however, sand for other industrial uses (i.e., more specialist applications such as transport or water filtration) has seen an increase (Figure 2). This reflects the diversification of industrial sand into new and emerging markets, as is detailed in the sections on markets.



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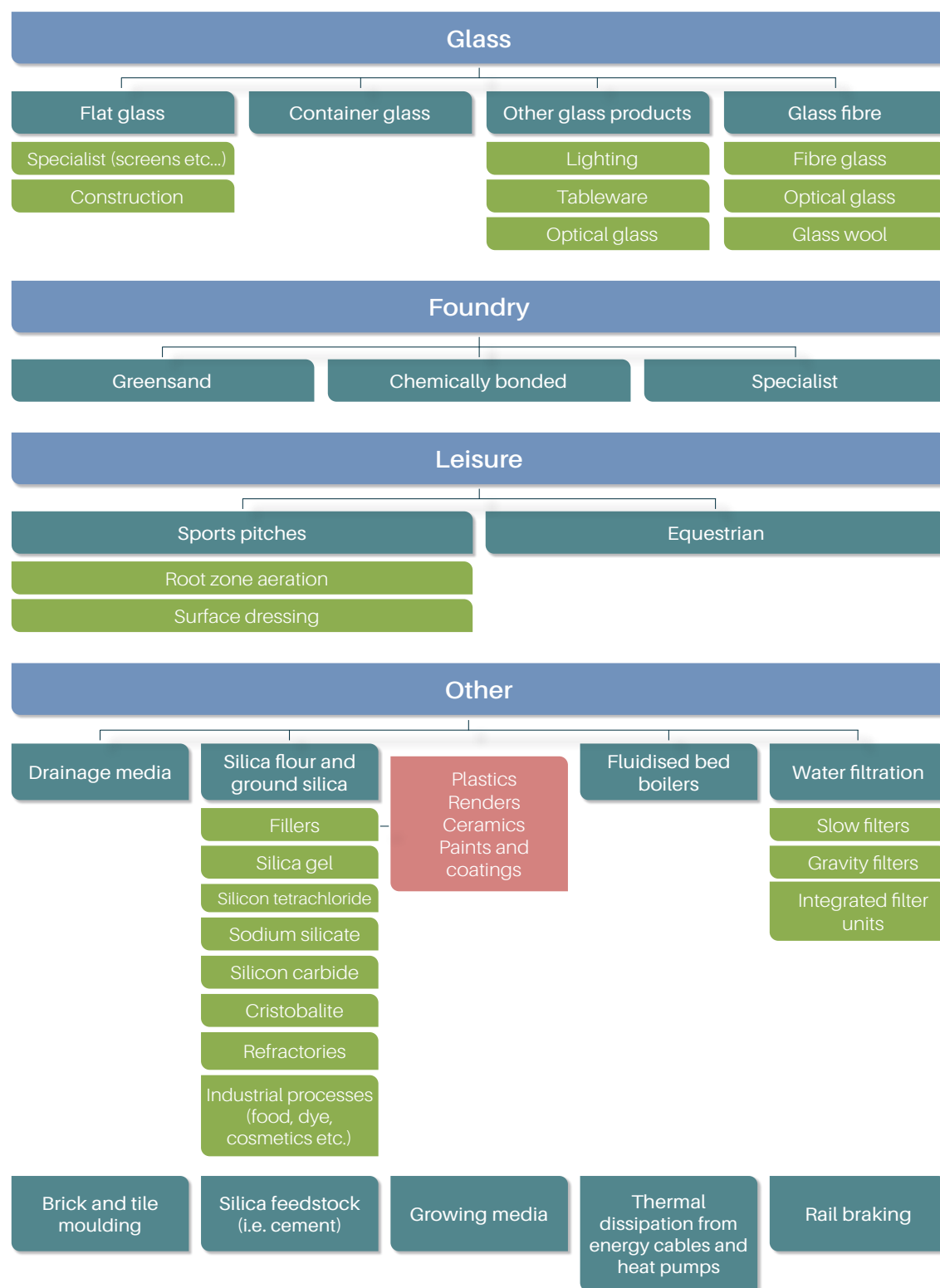


Figure 1 The main uses of industrial sand in the UK (some of which is imported as semi manufactured products).

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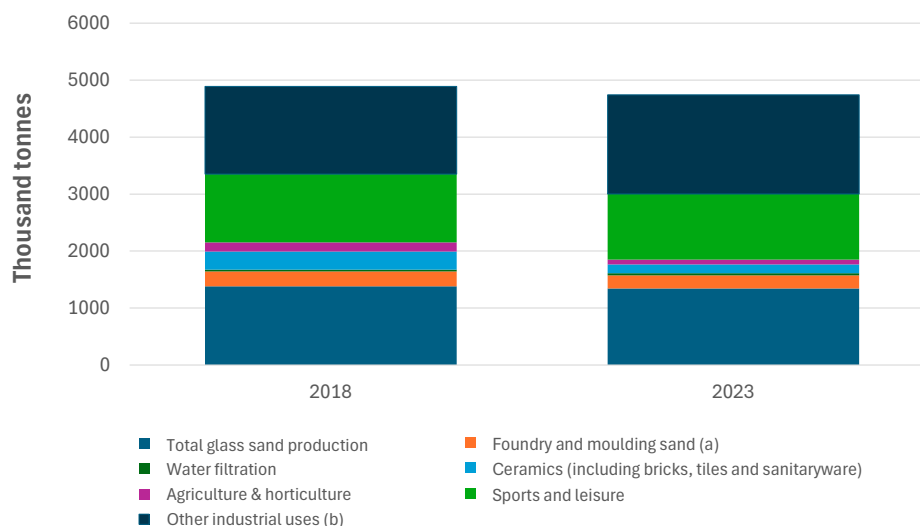


Figure 2 Industrial sand production by end use comparison between 2018 and 2023.
(a) Silica, resin-coated and naturally bonded. (b) Includes use in transport, energy, silica flour and cristobalite, sodium silicates/chemicals, adhesives, abrasives, paints, grouts and other prescribed industrial processes set out in the Aggregates Excise Notice.

Table 1 Production of silica sand in Great Britain by end use.

Silica sand production	Tonnes					
	England		Scotland		Great Britain	
	2018	2023	2018	2023	2018	2023
Glass sand						
Flat glass	C	C	C	C	400 448	386 927
Colourless containers	624 175	613 765	251 460	168 500	875 635	782 265
Coloured containers	C	C	C	C	C	C
Fibre glass	C	C	C	C	C	C
Total glass sand production	1 014 048	957 592	366 279	385 500	1 380 327	1 343 092
Foundry and moulding sand (a)	262 566	231 574	0	0	262 566	231 574
Other Industrial uses						
Water filtration	30 945	C	0	C	30 945	36 693
Ceramics (including bricks, tiles and sanitaryware)	C	C	C	C	318 834	154 316
Agriculture & horticulture	C	C	C	C	159 833	84 383
Sports and leisure	1 099 884	1 046 808	97 943	105 780	1 197 827	1 152 588
Other industrial uses (b)	C	1 550 177	C	188 070	1 540 158	1 738 247
Total other industrial uses	3 221 059	3 069 250	289 104	328 550	3 510 163	3 397 800
Total production	4 235 207	4 026 842	655 383	714 050	4 890 490	4 740 892

Table 2 Production of silica sand in Great Britain by region.

Region	Glass sand		Other industrial uses		Total	
	2018	2023	2018	2023	2018	2023
South East England	C	C	C	C	723 583	622 314
East of England	C	C	C	C	1 121 476	1 240 440
East Midlands, West Midlands and Yorkshire and the Humber (c)	C	C	C	C	545 543	569 532
North West England	C	C	C	C	1 844 505	1 594 556
England Total	1 014 048	957 592	3 221 059	3 069 250	4 235 107	4 026 842
Scotland	366 279	385 500	289 104	328 550	655 383	714 050
Great Britain Total	1 380 327	1 343 092	3 510 163	3 397 800	4 890 490	4 740 892

Footnotes to Table 1 and Table 2.

C indicates confidential.

(a) Silica, resin-coated and naturally bonded. (b) Includes use in transport, energy, silica flour and cristobalite, sodium silicates/chemicals, adhesives, abrasives, paints, grouts and other prescribed industrial processes set out in the Aggregates Excise Notice. (c) regions merged to protect confidentiality.

Reserves

In land use planning, the term 'reserves' or 'mineral reserves' refers to material that has a valid planning permission for mineral extraction. Without a valid planning permission, no mineral working can legally take place. A survey of permitted reserves of silica sand at operational sites in the UK on 31 December 2023 was undertaken. The results are presented in Table 3 and Table 4. Total reserves of silica sand in the UK at the end of 2023 were 59.8 million tonnes. Reserves have decreased by 2.9 Mt (5 per cent) since 2018 when total reserves were 62.7 Mt. It should also be noted that these figures contain a significant tonnage for the Lochaline mine in Scotland, which

supplies to market by sea transport, and therefore output is limited by capacity at its loading wharf. The significant increase in reserves of colourless glass sand between 2018 and 2023 is due to extensions at two sites in Cheshire being permitted during the period. A much larger decrease in reserves of other industrial sand, however, causes a decrease in overall reserves. Included within the reserve totals presented are smaller reserves of industrial sand that meet particular technical specifications required by specific end uses. Therefore, national reserves totals may mask more limited reserves of industrial sand suitable for specialist end uses or markets.

Table 3 Permitted reserves of silica sand, by end use.

Permitted reserves	Tonnes	
	31 December 2018	31 December 2023
Colourless glass sand	21 102 517	27 409 936
Other glass sand (coloured and fibre)	1 155 100	555 675
Other industrial uses	40 400 008	31 817 825
Total	62 657 625	59 783 436

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Table 4 Permitted reserves of silica sand, by region.

Region	Glass sand		Other industrial uses		Total	
	2018	2023	2018	2023	2018	2023
South East England (a)	C	C	C	C	5 089 537	5 731 588
East of England	C	C	C	C	9 540 000	5 810 000
East Midlands, West Midlands and Yorkshire and the Humber (b)	C	C	C	C	12 585 146	13 689 482
North West England	646 288	152 136	11 734 154	14 362 221	12 380 442	14 514 357
England Total	1 787 617	7 115 612	37 807 508	31 025 575	39 595 125	36 955 186
Scotland	20 470 000	20 850 000	2 592 500	1 978 250	23 062 500	22 828 250
Great Britain Total	22 257 617	27 965 612	40 400 008	33 003 825	62 657 625	59 783 436

(a) includes a small amount in the South West, (b) regions merged to preserve confidentiality, C indicates confidential.

Major markets

Glass

Glass is a significant market for industrial sand in the UK. It is a major industry that produces over 3 million tonnes of glass per year and contributed £3.5 billion to the UK economy in 2023. Container glass, mainly consisting of bottles and jars, accounts for around 60 per cent of all UK glass production (by value), whilst flat glass for the construction and automotive industries is 30 per cent. The remaining 10 per cent consists of fibreglass and speciality glasses (lighting, oven hobs, optical, medical and scientific uses) (BEIS-British Glass, 2017). The emergence of new applications for glass, particularly those integral to the energy transition, is likely to continue as the UK economy moves towards net zero.

Container glass

Container glass is the largest sector of the UK glass industry with a value of £1.52 billion to the UK economy in 2023. There are six container glass manufacturers in the UK operating 12 plants in total. Nine plants are in England, with two plants in Scotland and one in Northern Ireland. The high levels of production capacity ensures anticipated demand can be met in the short term.

Sales of sand for container glass declined by 11 per cent between 2018 and 2023. In recent years

changing consumer preferences along with policy and consumer drivers around decarbonisation has led to an increasing trend to replace glass containers with aluminium containers. Aluminium containers can be packaged more readily for transport and weigh less than glass containers. Counterbalancing this trend is the use of glass as a replacement for plastic. Glass is infinitely recyclable and is an excellent material for reusable containers. This makes glass a more sustainable packaging material compared to plastic.

A UK-wide Deposit Return Scheme (DRS) is planned for October 2027 for drinks purchased in a single-use container (Defra, 2024). All four nations of the UK will include plastic bottles and aluminium cans, but only Wales will include glass bottles. England, Scotland and Northern Ireland have not included glass in the DRS due to the required storage and handling costs and the lower proportion of glass in litter when compared with that for plastic and metal containers. If the scope of the DRS is extended to include glass across the UK, it is not clear exactly how this may affect glass markets. The scheme requires packaging to be recycled, rather than reused, therefore it is likely that glass will be crushed on-site. If this recycled glass is not separated by colour, the resulting mixed cullet is likely to be exported. Future policies for Deposit Return Schemes may specify the reuse of containers, rather than their recycling. This may

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Container glass	
Main control on specification	High chemical purity.
Current market trend	➔ Stable/slight decrease (due to increased use of aluminium drinks containers).
Potential future drivers	➔ The impact of circular economy policies e.g. Extended Producer Responsibility for packaging or deposit return schemes will depend on the specifics of policies implemented (these could increase sand consumption if glass is favoured over aluminium, or decrease sand consumption due to increased recycling of glass). ➔
Importance to UK economy	12 plants of glass. Container glass sales were worth £1.52 billion in 2023.

lead to an increased demand for glass containers and influence the design of the bottles, for example the use of thicker glass. Such schemes are difficult to implement as they require new supply chains of glass to be developed in response. Any changes in demand for raw materials for glass may be balanced by an increase in recycling rates. The glass industry is currently targeting a recycling rate of 90 per cent by 2030 (of all glass collected for recycling). Another important factor regarding

UK recycling capacity is industry effort to decrease exports of unprocessed cullet, ensuring this material stays within the UK.

Container glass specification for industrial sand:

Industrial sand must conform to very closely defined specifications dependent on end use. The ability of any sand to meet these specifications is defined by both geological properties and the degree



Container glass production. © Beatson Clark Ltd

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of processing undertaken following extraction. Particular uses require different combinations of properties and attributes, and different grades of sand are not usually interchangeable. Container glass requires a silica content between 98.5 to 99 per cent SiO_2 . Colourless glass: Iron <0.035 per cent Fe_2O_3 ; Alumina 0.5 per cent maximum Al_2O_3 ; Coloured (Amber & green) glass: Iron 0.25 per cent - 0.3 per cent Fe_2O_3 ; Alumina 0.2–1.6 per cent Al_2O_3 . Limits on alkalis (Na_2O & K_2O), colourants (Ni, Cu, Co), refractory minerals (such as chromite, ilmenite, zircon, rutile, and corundum), and the particle size to be between 0.1 and 0.6mm (100 to 600 microns) (Mitchell, 2012).

Flat glass

The main market for flat glass in the UK is the construction sector. The automotive sector is a smaller, yet significant, consumer, however this market is served through imports as no automotive glass is produced in the UK.

The construction sector has struggled in recent years to meet the aspirations of UK Government in terms of house building and infrastructure development. The demand for construction materials in the UK, a useful indicator for construction activity, has been on a declining trend over the last 5 years (with a modest increase during 2024) (e.g. a 22 per cent decrease for sand and gravel, 10 per cent for cement, 30 per cent for bricks) (DBT, 2025). During the same period, sales of flat glass have decreased by 3 per cent. The Government is reforming the planning system in order to address

current housing shortages. Increases in the average number of houses built annually in the future will result in increased demand for flat glass.

Policies around decarbonisation may also result in an increased demand for flat glass. The Future Homes and Buildings Standard (FHBS) is due to become legislation in late 2025. This requires all new homes to produce 75–80 per cent less carbon emissions than homes built under the current Building Regulations. The current UK Building Regulations require new and replacement windows to have a Window Energy Rating (WER, the overall energy efficiency of a window) of B or better (HM Government, 2023). In order to meet the FHBS, triple glazing is one of the potential routes to improving WER. According to the latest English Housing Survey, 88 per cent of all dwellings in England had double glazing in 2022 (MHCLG, 2024); the proportion of new builds with triple glazing is reported to be as low as 2–3 per cent (Mills, 2022). Use of triple glazing could potentially lead to a 50 per cent increase in flat glass required for UK new build housing.

The UK automotive sector is affected by numerous complex external drivers, however multinational companies continue to invest in UK vehicle construction plants and demand for automotive glass is not expected to significantly change in the near term. Any changes are likely not to affect the UK sand market as all automotive glass used in the UK is imported.

Flat glass specification for industrial sand:

Silica content between 98.5 to 99 per cent SiO_2 , Iron content 0.04–0.1 per cent Fe_2O_3 , Alumina content

Flat glass	
Main control on specification	High chemical purity.
Current market trend	➡ Stable/slight increase (due to changes in construction industry).
Potential future drivers	➡ Increase in housebuilding.
	➡ Triple glazing becoming standard due to energy efficiency targets.
	➡ Increased recycling.
Importance to UK economy	Three plants, essential for the construction sector (one of the most significant economic sectors for the UK). Sales of flat glass were worth £261 million in 2022. If processed flat glass (flat glass that has undergone additional treatment to meet specific functional, aesthetic or scientific requirements) is included, this rises to over £1.5 billion.

0.03 per cent maximum Al_2O_3 . Limits on alkalis (Na_2O & K_2O), colourants (Ni, Cu, Co), refractory minerals (such as chromite, ilmenite, zircon, rutile, and corundum), and the particle size to be between 0.1 and 0.6mm (100 to 600 microns) (Mitchell, 2012).

Fibre

Glass fibre (or glass fiber) is manufactured by the extrusion of molten glass to form continuous filament fibres or spun out into fine filaments that

form glass wool. These two products require different processing facilities and serve different markets. Albeit a small component of the UK glass sector, glass fibre is a critical feedstock material for various manufacturing sectors.

Continuous filament fibre is estimated to comprise around 20 per cent of the UK fibre glass market by value in 2023. Extruded glass fibres are either chopped into strands, wound to create 'roving', processed into fabric or milled to a coarse powder

Fibre	
Main control on specification	High chemical purity.
Current market trend	 Flat due to slowdown in construction sector (glass wool). Possibly a slow increase (continuous filament fibre) due to use of reinforced plastics. The wind energy market is currently flat but new policies around expanding UK wind energy capacity could be a major driver.
Potential future drivers	 Increased focus on home insulation may increase the use of glass wool, although such products have high recycling rates, of around 80 per cent. New policies around expanding UK wind energy capacity could be a major driver for continuous filament fibre.
Importance to UK economy	Four major UK plants supply essential raw materials to many manufacturing sectors, including automotive, aerospace, green energy and construction sectors. Sales of fibre glass were worth £480 million in 2023.



Fibre glass turbine blades. BGS © UKRI

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Case Study: Glass fibre reinforced plastic wind turbine blades

An example of how industrial sand underpins a growing UK manufacturing sector is the use of glass fibre reinforced plastic in wind turbine blades. Sand, after being processed and milled to a powder is transported in tankers to fibre glass manufacturers. It is mixed with clay and limestone plus a boron source. The resultant mix is melted in a highly controlled furnace and extruded and treated to allow the glass fibres to be packaged into bundles. These are then transported to wind turbine manufacturing sites around the UK where glass fibres are set in polyester based resins. An average turbine blade will weigh around 30 tonnes, and this will contain around 50 per cent glass fibre (which will be around 60 per cent sand). Therefore 30 per cent of the blade will be composed of industrial sand. Unlike other glass products there are currently no processes to recycle glass used in this way, so demand for virgin raw materials is unlikely to decrease.

(with a particle size between 80 and 150 microns). With the closure of the UK's only continuous filament fibre manufacturing site in June 2025, it has become reliant on imports.

Chopped strands coated with high-performance resins are used in Fibre Reinforced Plastics and Fibre Reinforced Thermoplastics as reinforcing materials in automobiles, electronics and concrete. Plastic reinforced with roving is used in housing equipment, automobiles, as synthetic wood, exterior wall panels and flat boards in the architectural and civil engineering markets, and in wind turbine blades. Glass fibre is used as an additive to plasterboard to provide strength and act as a fire retardant. Milled glass fibre is used in thermoplastic and speciality paint.

Strong, lightweight glass fibre reinforced plastic is currently used in electric vehicles (EVs), with potential growth in aerospace applications. Lightweight glass fibre reinforced plastic is used in EVs to reduce the overall weight of vehicles to help preserve battery life and is also used for integrated EV battery casings. Another application is for chopped strands to be mixed with resin, pelletised and used in the injection moulding and 3D printing of precision engineering components.

Glass wool represented approximately 80 per cent of the UK glass fibre market, by value in 2023. It is used as thermal insulation and soundproofing and is produced at four sites in the UK. Future demand will depend on rates of new construction, this is buffered to an extent however by the very high recycling rates (80 per cent) of glass wool.

Foundry sand

Foundry sand was once a major consumer of UK industrial sand. This historically declined with the decline of the UK's foundry sector. However, demand has been stable for the last 10 years with around 200 000 tonnes of industrial foundry sand consumed per year. Additionally, 12 000 tonnes of prepared binders (mixture of sand and binding agents for foundry moulds) are manufactured per year, the main component of which is sand. Sales of foundry sand have dropped by 12 per cent over the last 5 years, reflecting wider economic conditions rather than structural changes to the casting industry. There are around 400 active foundries in the UK, employing 17 000 people, ranging from small specialist operations to major industrial infrastructure. These foundries cover a range of sectors from basic tools through to jewellery or the manufacture of advanced aerospace and medical components as well as military applications (Cast Metal Federation 2024). As such the foundry sector still constitutes a significant consumer for high value applications, but often with requirements for a very narrow range of sand specifications. Specialist casting, such as investment casting for detailed components and jewellery also consumes ground silica, derived from UK sourced high purity sands. Casting uses sand-based moulds as the only practical method for applications working with ferrous metals (due to the temperature of the process) or large casts where die-casts are impractical. Foundry sands have high recycling rates, with between 70 to 90 per cent being reused after cleaning and reprocessing (i.e. sands coated in resin will need the resin removed via attrition). However, the quality of sand degrades as

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Foundry sand	
Main control on specification	Consistent grain size and shape. Different applications will have strict requirement on grain size, clay content and impurities.
Current market trend	➡ Stable.
Potential future drivers	↗ Increased use of casting for high-tech applications and specialist manufacturing in the UK.
Importance to UK economy	Around 400 foundries in the UK, underpins significant high value manufacturing sector, the UK casting industry is valued at over £2.2 billion annually, sales of prepared binders had an average value of £19 million over the last 5 years.

repeated cleaning and reprocessing affects the grain size leading to a requirement for virgin raw materials. More intricate specialist moulding processes require tighter specifications for sand and therefore have lower recycling rates. It is possible that demand may increase due to the new developments in foundry technology. For example, the adoption of 3D printing techniques can speed up the manufacture of moulds and make moulds more complex, combined with increased demand for modern consumer electronic goods.

Foundry sand specification for industrial sand:

Silica content 98 per cent minimum (SiO_2). Limits on CaO and MgO (to reduce the acid demand value and minimise binder demand). Particle-size range between 0.1 and 0.5mm (100 to 500 microns). Narrow particle-size distribution improves permeability. Particle shape specification includes a preference for rounded to sub-angular grains with reasonable sphericity. This will reduce binder demand and improve compaction and mould strength.

Leisure

Industrial sand for leisure applications is a major market, consuming more than glass and foundry sand combined. Leisure-related end uses, such as top dressing for sports pitches, or use in bunker sand for golf courses or surfaces for equestrian events, require strict controls on sand colour, grain size and grain shape, combinations of which are often unique to specific quarries or geological formations. Although some aspects, such as colour, may be more a function of consumer preference rather than an essential physical property, there is very little flexibility around specifications for many applications of industrial sand. Although sales have decreased by 3 per cent over the past 5 years (mirroring total industrial sand), demand for sand for leisure applications is now expected to remain level in the near-term. Longer-term trends are less clear, the pattern of the replacement of grass sports pitches by artificial ones due to ease of maintenance and all-weather capabilities, may be slowed due to concerns

Leisure	
Main control on specification	Narrow particle-size range. High sand particle roundness required for sports pitches, but angular for golf bunkers and equestrian uses. Low fines content, low iron content (to avoid staining).
Current market trend	➡ Stable.
Potential future drivers	↗ Continued demand for all-weather sports surfaces and requirement to maintain existing ones, however concerns over contaminants from microplastics and rubber crumb in 3G sports pitches.
Importance to UK economy	Several thousands of 3G sports pitches, golf bunkers and equestrian facilities. The economic and social benefit they generate is significant, e.g. the Premier League, which relies on high volumes of industrial sand for pitch maintenance, contributed £8 billion to the UK economy in 2022.

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Sand used in sports pitch construction. © Holcim UK

around environmental impacts of microplastics from rubber crumb (a component of synthetic sports pitches). In September 2023, the EU banned the sale of rubber crumb (due to come into force in 2031). Whether the UK will follow this ban is under review by DEFRA, devolved government and national sports associations. Implications on future demand of industrial sand will depend on any change in the method of construction of such pitches.

Other markets

In addition to the above major markets, a range of other end uses (or intermediate products) exist

which require comparatively small, but essential, volumes of industrial sand. Sales to these markets have risen by 13 per cent over the past five years.

Fluidised bed boilers

A significant market, which has largely taken up the supply shortfall left from the decline in demand for foundry sand, is for use in fluidised bed boilers. The amount of waste sent to incineration plants with energy recovery in the UK rose by over 30 per cent between 2016–2020 (Smith, 2025). Only a subset of incinerators utilise fluidised bed technology but the rise is expected to be proportionate. Within fluidised

Fluidised bed boilers

Main control on specification	Grain sizes typically between 0.5 and 1mm (although this can be coarser), low fines, SiO ₂ greater than 96 per cent, high angularity.
Current market trend	↗ Rising.
Potential future drivers	↗ Decarbonisation increasing the use of biomass for energy and heating.
Importance to UK economy	Controls on the use of fossil fuels as well as the rise in the use of incineration for waste management mean these types of boilers will continue to be an important part of the UK's energy mix.

bed boilers sand acts as inert particles, allowing an airflow for combustion, effectively 'fluidising' the fuel and air mix. These biomass boilers, or energy from waste boilers, continue to be a growing market due to decarbonisation policies, for example to replace supply from coal powered electricity generation, which ceased in the UK 2024 (Department of Energy Security and Net Zero 2024). Biomass power generation is currently favoured as a green alternative to fossil fuels. Fluidised bed boilers are also used in energy from waste generation and community heating schemes. They are currently favoured for low carbon heat generation as outlined in the Government's heat and building strategy (Department of Energy Security and Net Zero 2023). It is likely that the consumption of sand for fluidised bed boilers will continue to rise. Recent studies from Sweden highlight how national scarcity of suitable sand for that country has the potential to inhibit the use of such boilers (Storner et al., 2021).

Water filtration

Another use, essential for UK utilities infrastructure, is sand for water filtration. Sand is used either in 'slow' applications where water naturally flows through large sand beds, or gravity driven filters where water is pumped through at greater rates. Sand can also be used in small volume applications, such as swimming pool filtration units where it is combined with other materials, such as carbon. The sand essentially acts as a physical blocker for contaminants. Sand used in slow and gravity fed filtration beds can be dug out and re-used. However, periodically the sand in these filtration systems is completely replaced. This requires a large volume of sand. Although overall annual volumes required are small compared to other uses, this end use has seen a rise in sales of nearly 20 per cent over the past 5 years.

Water filtration specification for industrial sand:

This is set out in BS EN 12904. The main control is the uniformity of the grain size to ensure good flow. Therefore, the grain size tolerances will be very low, with very little under or oversized material being required. Slow filtration requires finer sizes (0.15 to 0.35 mm) compared to rapid filtration, where coarse sands is used (over 0.5 mm). Sphericity is high to ensure good permeability. The required chemical composition varies based on the use, but the minimum specification is 80 per cent SiO₂, maximum acid soluble material 10 per cent, and less than 2 per cent Fe₂O₃ (as well as limits on Al₂O₃, CaO, K₂O and Na₂O).

New, developing and emerging markets

- Sand for use as a growing media. Sand of the correct grain size and porosity allows both air and water to flow through root zones. This use is essential in hydroponic and vertical 'urban' farms. These types of operations are increasing due to opportunities from re-development of vacant brownfield sites in urban areas as well as rising concerns around distance of transport for food and security of supply.
- Sand for heat dissipation in cable laying. High power electricity cables and infrastructure for ground source heat pumps can generate significant amounts of heat when buried. Unless this is efficiently dissipated it can damage the cables and pipes. To mitigate this, cables and pipes are bedded in sand where it has a higher thermal conductivity compared to soil or air.
- Sand for rail braking. Sand is used as a braking agent or to increase traction in wet or icy conditions, adding friction between track and locomotives and trams.

Water filtration	
Main control on specification	Uniform grain size, high sphericity, low fines.
Current market trend	↗ Expected to rise.
Potential future drivers	↗ Increased housebuilding and rising population requiring infrastructure. Increased pressure and legislation on water companies to improve infrastructure.
Importance to UK economy	Water supply is a fundamental part of the UK utilities infrastructure.

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Sand used for growing media. © Holcim UK

One use that has previously been predicted to consume large volumes of industrial sand was for enhanced hydrocarbon recovery and geothermal energy. There continues to be a small market for this. However, due to declining UK oil and gas production it is unlikely to be a significant future market.

Silica chemicals

An important use of industrial sand is as a raw material for a range of silica-based chemical products and feedstocks. The importance of silica chemicals could easily be overlooked as the volumes are small and the supply chains are complex, often involving multiple processing stages carried out by several different companies. However, if a product contains silica or silicon there is a significant chance it originated from sand. Although it should be noted that some high purity forms, such as silicon metal or silicon chips require feedstocks derived from hard rocks (not sand) due to the requirements of the physical processes used in refining.

Industrial sand can be ground or milled to a flour, where, due to its high purity and chemical inertness it can be used as structural component or filler in applications such as renders, ceramics, paints and coatings. Ground silica or silica flour can be processed further into products such as silicon tetrachloride, sodium silicate, silicon carbides or cristobalite. These all have a high range of applications, from use as a feedstock for high purity silica based chemicals, used in specialty glass, abrasives, optical fibre, or to increase whiteness in pigments. Uses for sand-based silica derivatives are numerous and diverse. Examples range from thickeners and absorbents in cosmetics to enamel coatings on mugs. As a result, the supply of sand-based silica derivatives underpins a significant range of manufacturing sectors in the UK (and in some cases overseas manufacturer of such chemicals due to exports). The UK imports around 30 000 tonnes of SiO_2 (a mixture of varying grades of ground silica and derivative products) a year and exports a similar amount with a value around £80 million from exports and £60 million from imports.

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Sodium Silicate.

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Alternatives

As with many industrial raw materials, industrial sand is used in established markets based on highly constrained physical and chemical properties. Often the specifications for industrial sand reflect the nature of the available sand resources. In a unique positive feedback loop, the industrial processes have been designed to accommodate the properties of the sand that was available. Following this premise, new sources of sand need to meet the tightly constrained properties of the original industrial sand. As geological variability makes it highly unlikely that any two sand deposits are the same, new sources of sand are placed at a distinct disadvantage. The properties of the original sand may be unique to certain geological processes in geographically constrained areas that would be difficult to replicate in the same country and possibly anywhere else on the planet. This also means that the original industrial sand source is placed under increasing pressure as it is the sought after raw material. In extreme cases this can lead to resources being effectively worked out.

These factors in the industrial sand market make finding alternative sources of industrial sand difficult. Consumers which have adapted their manufacturing processes to accommodate the properties of the industrial sand currently available are sensitive to any changes which may cause issues for complex

industrial processes. As a result, they may invest significant resources to test sources of sand before establishing supply chains. Such consumers, therefore, face risks if supply chains are disrupted, often leading to the need for significant capital investments to adapt their manufacturing processes to accommodate new industrial sand feedstock from an alternative source.

Technically, it is possible to process industrial sand to meet the required physical and chemical properties of most major applications. Such processes include acid leaching (hot or cold) and other chemical treatments; attrition scrubbing and washing; classification using elutriators and hydrocyclones; drying; gravity separation using spirals and dense media cyclones; and magnetic separation (wet or dry) are all used in certain sites in the UK. Economically, the viability of such processing is often limited due to high energy costs and those associated with the necessary treatment of waste. Nevertheless, many UK industrial sand quarries have some level of advanced processing capacity and there are indications of continued investment in such plant. For example, a recent application for a drying plant at Martell's quarry, Essex. Such investment decisions indicate high demand for industrial sand products and their value in UK supply chains.

Industrial sand, and derived materials, are imported into the UK. There is scope to import increased volumes, especially for high value, small volume applications (i.e. for silica chemicals) where the transport costs represent a smaller proportion of the overall cost of getting the product to the consumer. However, there is a risk that the UK industry becomes more reliant on overseas suppliers of which it has little influence over. Additionally, the development of overseas supply chains in the UK requires significant investment in freight transportation, which needs access to port infrastructure. Overseas supply chain development has a higher transportation cost and an overall higher carbon footprint.

Higher recycling rates, as currently being pursued by the glass sector, may relieve some pressure on the need for new sources of industrial sand. There are already high rates of recycling in many industrial sand sectors. Filtration sands are dug out and cleaned many times before they need to be replaced. Foundry sand has a recycling rate of

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approximately 80 per cent. The recovery and re-use of industrial sand is driven by the tight markets for virgin raw materials, as well as the benefits of cost savings and meeting decarbonisation targets. However, for many applications, e.g. glass fibre, there are limited effective recycling technologies currently available. Additionally, increased rates of recycling are likely to increase demand for higher quality virgin raw materials to compensate for deleterious properties in secondary sources thereby exacerbating supply issues.

Demand for industrial sand is likely to increase in the near future particularly if there is a significant rise in house building. Current production may not be able to provide the sand required to meet the demand. Unless there is a significant increase in recycling rates it is unlikely that recycled sand will be able to meet any shortfall. An alternative solution is to examine the specifications of industrial sand and consider a move away from tightly controlled material properties to performance specifications. These focus more on the properties of the end products and less on what goes into making it. This may enable the use of industrial sand resources which have hitherto been ruled out as they do not meet the strict property-based specifications of the different sand types required by consumers. It may also enable the use of recycled sand for industrial processes that have up until now purely been supplied by primary industrial sand resources. The downside is that development of performance specifications would require many years to establish, an extensive testing of alternative sources of sand, increased processing costs in terms of both financial and environmental consequences, consumers accepting products that may be more variable in appearance and contention with the perception that only the highest quality industrial sand can be used for specific end uses.

Conclusions

Industrial sand remains an essential raw material in well-established sectors of the UK economy, notably the glass, foundry, and leisure industries. In addition, industrial sand underpins numerous high value manufacturing industries. The importance of industrial sand in these smaller markets is often overlooked due to the smaller volumes of sand consumed, intermediate processing steps, or limited awareness of supply chains. Industries that rely on silica-based chemicals, high technology

manufacturing using advanced materials such as reinforced glass fibre, and advanced component manufacture using casting, all rely on UK sourced industrial sand. For many applications strict consumer specifications limit the sand used to a handful of sites nationally that can supply the required material. Many sands can be 'upgraded' to meet a wider range of consumer specifications through energy intensive processing, but this requires significant investment in plant equipment at sites and has associated carbon costs.

Whilst trends in increased recycling may reduce pressure on virgin raw materials there are significant drivers that would suggest demand for primary industrial sand is likely to increase in the short to medium term. Most notably:

- Decarbonisation policies, which increase demand for raw materials used, for example, in triple glazing, insulation, fluidized bed boilers, horticulture, heat pumps, and turbine blades for wind energy.
- Government targets for an increase in house-building and related infrastructure (glass and water filtration).

In the medium to long term, recycling of both end products and sand along with circular economy practices may reduce the demand for industrial sand. However, the demand for the highest quality sand is likely to remain high due to the need to counterbalance the lower quality of recycled materials. Regardless of future trends, maintaining the current level of supply will still require development of new sites and extension of existing ones as existing reserves are depleted.

The combination of high demand and the limited number of quarries capable of meeting stringent sand specifications may increase the risk of supply shortages and associated price increases. Such risks impact downstream industries and associated UK manufacturing capacity.

Well-established consumers of industrial sand, such as glass manufacturers, along with users in low-volume, high-value sectors such as precision casting, fibre-reinforced plastics and silica-based chemicals, play a significant role in the UK's industrial landscape. These applications depend on a stable and locally sourced supply of industrial sand.

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