

UK Composites Supply Chain Scoping Study – key findings

Prepared on behalf of UK Trade & Investment (UKTI) and
Department for Business, Innovation and Skills (BIS)

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Executive summary

Executive summary (p.1/2)

Executive Summary

Currently there are around 1,500 companies involved in the UK composites sector, of which more than 85% of activity is undertaken by the 38 largest companies. Annual production revenue amounts to £1.6 billion, or added value of £1.1 billion, almost half of which is exported, mainly on aerospace programmes. Composites activity is undertaken in all parts of the UK with many regional expert clusters, most notably the aerospace composites corridor in the South West of England.

Historically, the UK had a leading position in composites driven by early adoption of carbon-fibre composites in the defence and aerospace industries. However, several other nations have been targeting the composites sector and supporting development of capacity and new capabilities, particularly the US, Germany, Spain, Japan and Malaysia.

In composite component manufacture, traditionally a strength of UK industry, the competitive position continues to weaken as European competitors take a lead in manufacturing improvements, and lower labour cost countries invest, often with Government support, e.g., in Malaysia, to develop capability.

In both resins and fibres the global industry is already consolidated and led by Japanese and US companies. Many of these players maintain a UK presence to support their overall presence across Europe, and to participate in the UK composites industry itself.

Outside of the 38 largest companies, the UK supply chain is made up of smaller firms (with annual revenues of less than £5 million) supplying into end-use applications across a variety of industry sectors, and a small percentage produced for exports. These companies could benefit significantly from regional and national support, for example to identify existing and emerging export markets for their current products as well as upskilling to diversify their production techniques and product range to exploit a wider range of application areas.

Today, carbon-fibre and glass-fibre based materials constitute the greatest value in UK demand and supply of composite components and structures. New metal matrix and ceramic matrix composite materials are being researched in the UK aerospace industry in particular and, in the longer term, may be future growth areas where the UK can play a lead.

Executive summary (p.2/2)

In considering the growth potential of the sector, we found that there is a market-led opportunity over the next five years to step change the scale and global competitiveness of the UK composites industry.

- ▶ There is an upswing underway in the use of carbon fibre composites in new commercial and military aerospace programmes. This has traditionally been the largest area in value of composites production in the UK, and is set to grow by £0.4bn over the next five years.
- ▶ Development is ongoing in composite component manufacturing processes, to accelerate production rates and reduce unit costs. Making advances in this area, and sharing this around the UK composite component manufacturers, will be critical to retain work in the UK and to strengthen the platform for further growth in exports to existing European and American markets, as well as new markets in Brazil, Japan and China.
- ▶ The UK is leading a major development of offshore wind power generation that will give it a global lead in this sector over the next decade. The scale of the production requirement for composite turbine blades for UK installation, £0.4bn by 2015 and £0.6bn by 2020, plus the advances in composites technology needed to achieve longer, stiffer turbine blades, present a unique opportunity for the UK to develop world-leading composites capability in this sector.
- ▶ Composite capability in premium performance automotive is another strength of the UK composites industry. This segment is characterised by many smaller companies, including many who undertake composites work in-house. Promotion of the skills and export potential of this group of businesses, as well as greater sharing of expertise, would be beneficial for industry growth.
- ▶ Opportunities are available across a wide range of industry sectors and applications for composite including construction, marine and offshore oil and gas. In each of these areas there is growth potential as advanced in composite technology and a lowering of the cost of production creates new users – as well as demand recovery in some sectors.

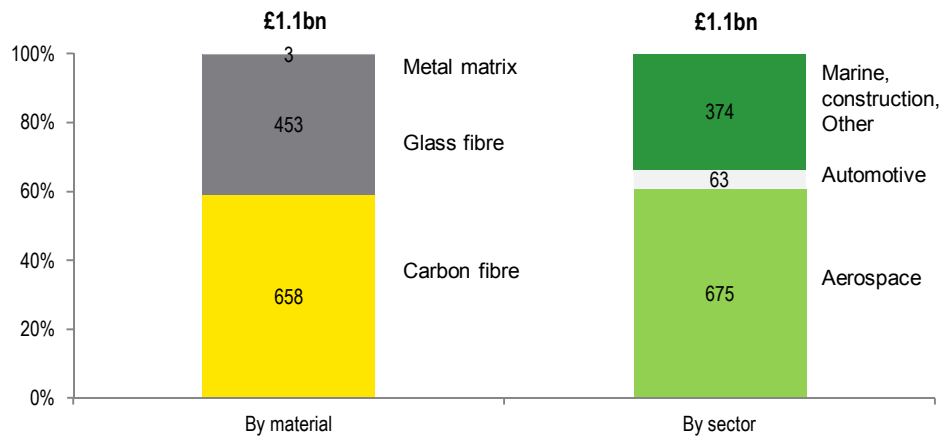
The global composite industry is becoming increasingly competitive. Many competitor countries have recognised the strategic importance of advanced composite materials and support their companies to develop capability to provide them with a global comparative advantage. In this environment, the UK is only likely to remain competitive by creating the conditions where companies can beneficially work together across sectors and supply chains to grasp the commercial opportunities provided by the increasing shift to lightweight composite materials. The National Composites Centre being created in Bristol will have a strategic role to play in this effort and in coordinating the work of other regional centres of composites excellence. Continuing to work on addressing the skills gaps will also benefit the UK. The UK has significant expertise and key building blocks to be a world class player in this fast growing strategically important market, and would benefit from co-ordination and support to best address the opportunities.

Overview of the UK Composites Industry

The UK produces about £1.1bn of composite components and structures. The aerospace sector is the biggest user of composites and the driver of high value carbon fibre composites

UK production value of composite components by material and sector, 2010 estimates

Source: Estimates based on prior research and interviews

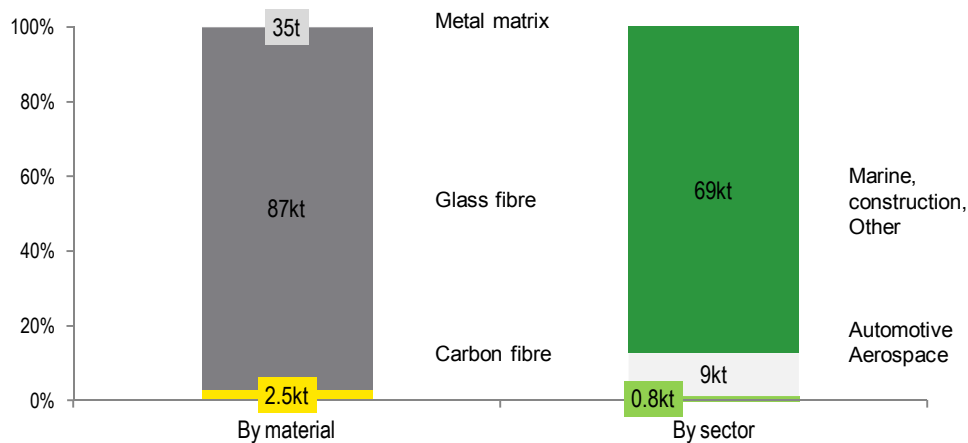


► This report has covered glass, carbon, metal matrix and ceramic matrix composite materials, with a focus on the key stages of the UK composites supply chain being resin and fibres, fabrics and prepreg and composite component manufacture and assembly.

- The size of the UK composites industry is between £1bn and £1.6bn depending on the point of view:
- Annual production revenue totals £1.6bn, but this double counts the supply of materials along the composites supply chain from resins and fibres to fabrics, prepreg, composite components and in some sectors, assembled composites structures.
- The estimate of industry value added is £1.1bn.
- UK domestic demand for composite components is £0.9bn, comprising UK production of £1.1bn less exports of £0.4bn (mostly aerospace) plus imports of £0.2bn (mostly wind turbine blades)

UK production volume of composite components by material and sector, 2010 estimates

Source: Estimates based on prior research and interviews
Note: Excludes waste

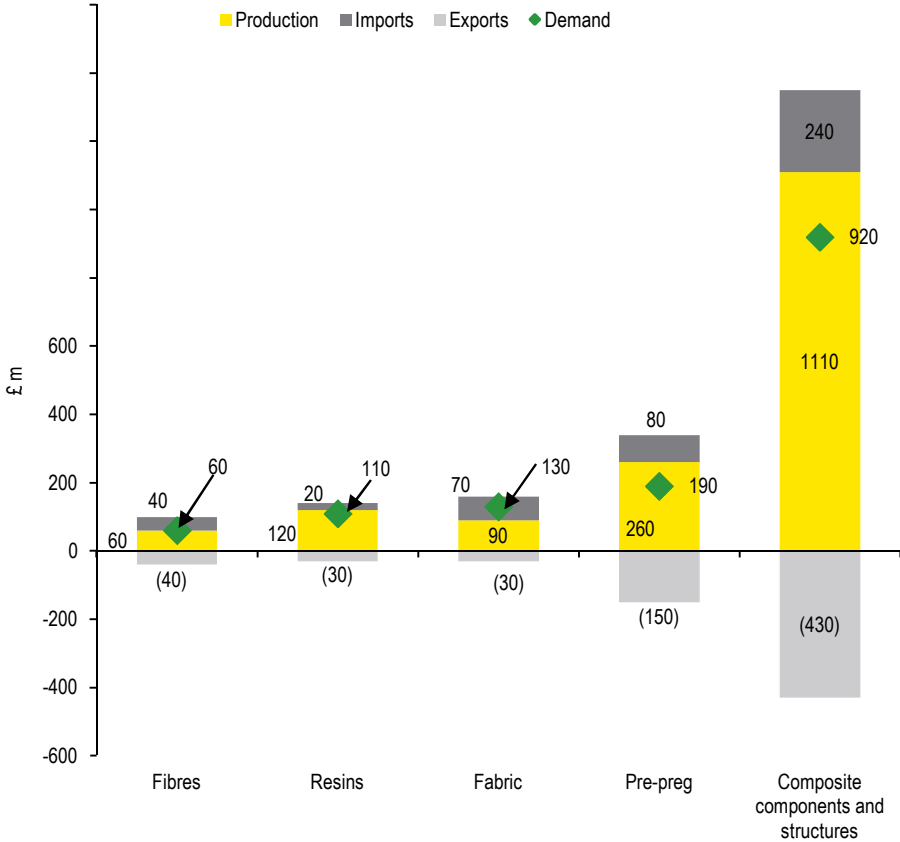


► By material, UK domestic demand is 65% carbon fibre and 35% glass fibre composites; by sector 65% aerospace, with wind, automotive and marine the other main sectors. There is widespread knowledge and use of composite components across UK industry given their long history of use. The benefits of carbon fibre composites relate to their high strength to weight ratio compared to metals, offset by a much higher unit cost. Glass fibre composites offer low unit cost and advantages in flexible moulding, but have a lower strength to weight ratio than metals and some other plastics. New metal matrix and ceramic matrix composite materials, that offer high temperature resistance, are being researched in the UK aerospace industry in particular and, in the longer term, may be major growth areas where the UK can play a lead.

The UK composites industry is a large exporter in key areas of the supply chain; composite components and structures, pre-preg, and industrial grade carbon fibre

UK production, exports, imports and consumption of composites by supply chain, 2010

Source: Estimates based on prior research and interviews



- ▶ The UK composites industry is a large exporter in key areas of the supply chain. These include carbon fibre composite components and structures, predominantly to the aerospace industry, prepreg and woven fabrics for aerospace and industrial grade carbon fibres.
- ▶ Most value added is seen in the composite components and structures stage, reflecting the complexity of manufacturing processes and assembly activities. This is a key focus of technology development.
- ▶ Components and structures in the form of glass fibre composite wind turbine blades and carbon fibre composite components (from Asia and Europe) constitute the largest part by value of UK composite imports.

% of production exported	67%	25%	33%	58%	39%

The UK composites industry has annual production revenue of £1.6bn, of which close to half is exported. 85+% of industry activity is captured by the top 38 companies which include many global leaders

Size, value added, production and exports of UK composites industry, 2010

Source: Estimates based on prior research and interviews
 Note: *Cumulative production including the supply chain; ** Airbus UK not included in top 5 as it outsources most of its production

£ bn	Number of companies	Value added of UK composite production	Total revenue of UK composite production	Exports of as % of UK production	Composite material	Examples of leading UK composite companies
Top 5 (Top 5 companies by in-house production)	5	£ 0.4bn	£ 0.5bn	65%	Carbon fibre	<ul style="list-style-type: none"> ▶ GKN (commercial aerospace composite structures) ▶ BAE Systems (military aerospace composite structures) ▶ Hexcel (pre-preg materials) ▶ Bombardier (commercial aerospace composite structures, NP Aerospace (composite components))
6-38 (all >£5m of composite revenues)	33	£ 0.6bn	£ 0.9bn	45%	Carbon fibre, some glass fibre	<ul style="list-style-type: none"> ▶ Brookhouse (Aerospace component manufacturer) ▶ Lola (multi-sector component manufacturer) ▶ Cytec (semi finished product manufacturer) ▶ SGL (fibre manufacturer) ▶ Huntsman (resin manufacturer)
Others (<£5m composite revenues)	c.1,460	£ 0.1bn	£ 0.2bn	Small	Glass fibre, some carbon fibre	<ul style="list-style-type: none"> ▶ Specialist composites manufacturers with <£5m in revenues (eg. Formula 1 specialist Formtech Composites) ▶ In-house composite fabrication units (eg, Princess Yachts, Nissan), Tooling and moulding suppliers (eg. Rojac) ▶ Equipment manufacturers (e.g. Autoclaves Limited), ▶ Other firms with some revenue derived from composites.
Total	c.1,500	£ 1.1bn	£ 1.6bn	45%		

- ▶ More than 85% of UK composites industry activity is represented by the largest 38 companies identified in this research, who by and large have and will drive the future development of the UK composites industry. This group comprises a number of companies that are recognised global leaders, including GKN, BAE Systems, Hexcel, Bombardier, Lola, Cytec and SGL. Most of these players focus on carbon-fibre composites. In aggregate these companies export about half of their production, reflecting both the international nature of the aerospace and defence industries, as well as the European demand pool that the resin, fibre, fabric and prepreg companies supply in addition to domestic UK demand.
- ▶ Additionally there are over 1,000 SME companies involved in composites – those with composites revenue less than £5m or the in-house production of integrated manufacturers. These companies are typically more focused on glass fibre composites, and have a low level of exports.

GKN, Airbus UK, Hexcel, Bombardier and BAE Systems are the largest composite companies in the UK

Distribution of the UK composites supply chain, 2010

Source: Prior research, company accounts, interviews

Composite Structures

Design of structures including composite parts; mix of in-house and outsourced manufacture

Composite Components

Design and manufacture of composite components; focus on outsourced aerospace demand, also automotive and other niches

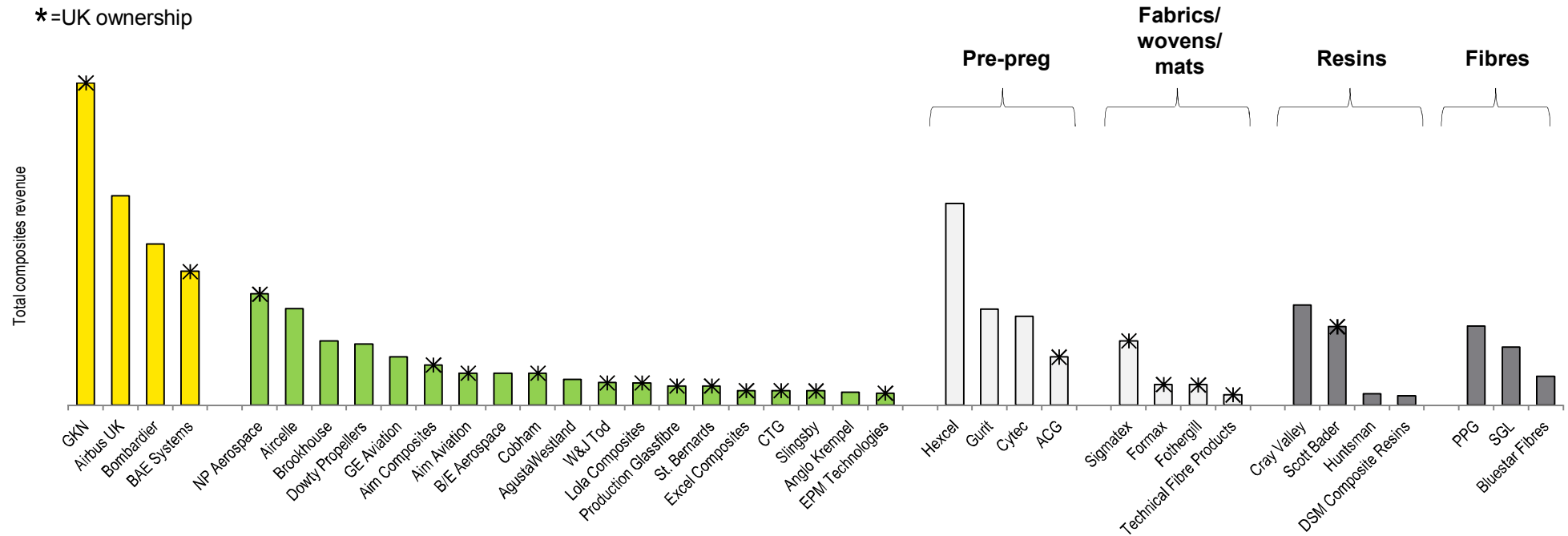
Semi-finished material

Production of pre-preg and woven fibres as input to composite component manufacture

Resins & fibres

Production of fibres and resins for semi-finished producers

*=UK ownership

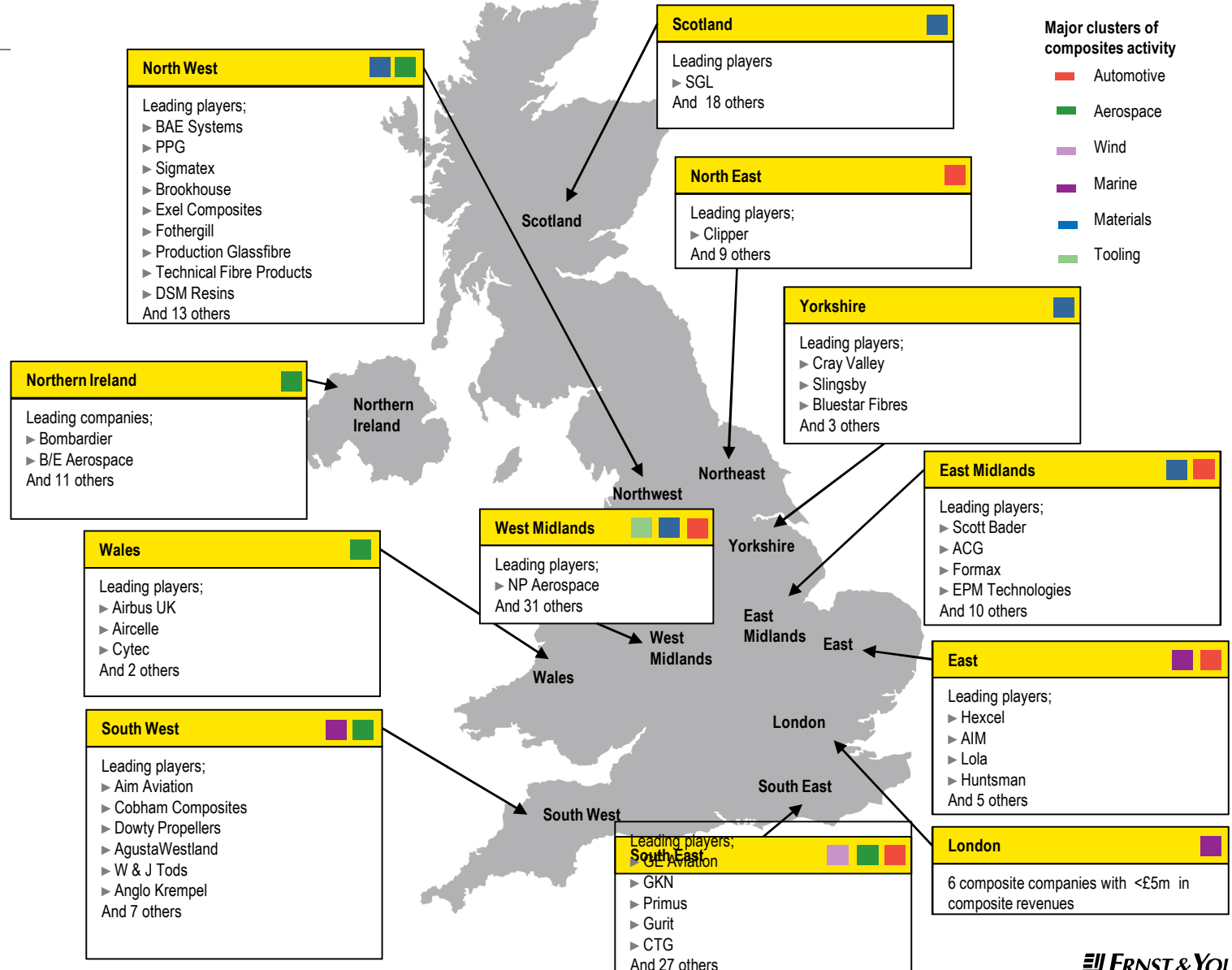


Note: *Excludes Vetrotex (glass fibre subsidiary of St Gobain), P D Interglas (glass fibre); Greene Tweed & Co. (component manufacture); imports of wind turbine blades, other composite producers with revenue <£5m

The composites industry is active in all regions of the UK with many regional clusters of expertise, for example in the Eastern regions in resin and materials supply and in the South West in aerospace composite components

Regional distribution of the UK composites supply chain, 2010

Source: Company websites, interviews



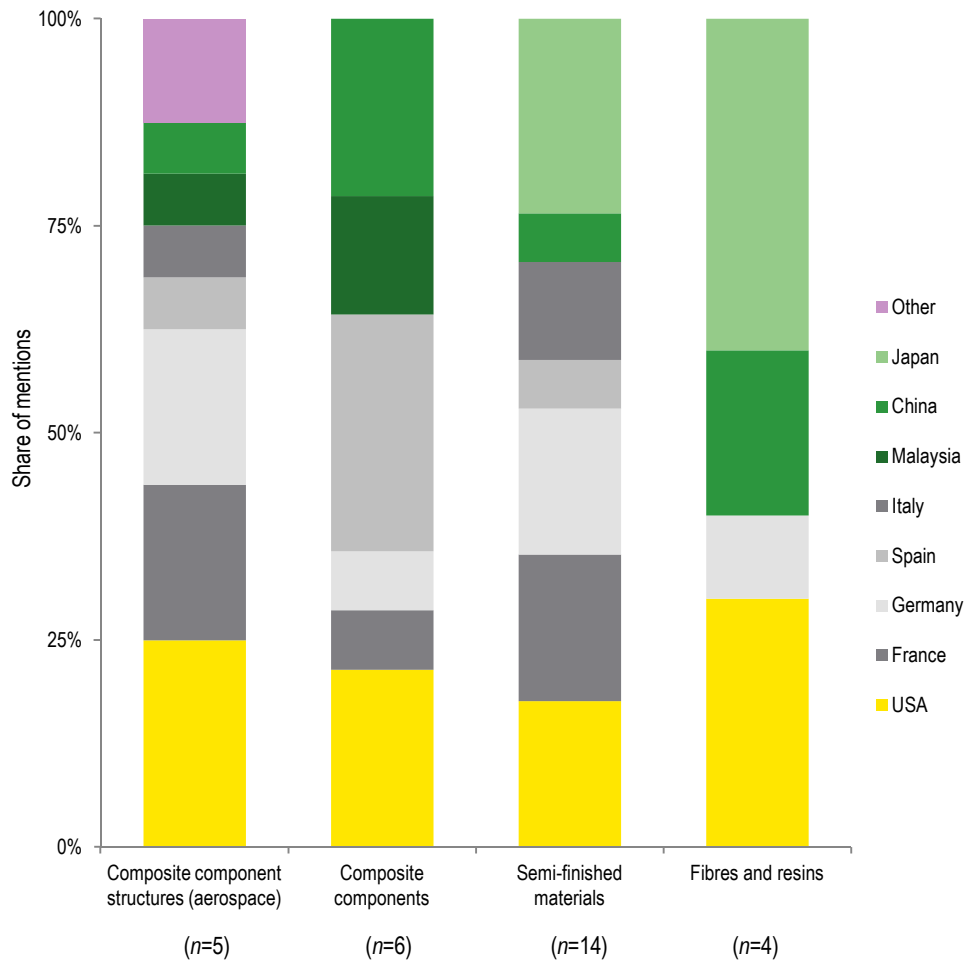
The map shows 39 companies with >£5m in composites revenues by their main composite locations, and a further 142 that were identified by RDA's and by this study. These companies derive all or a substantial part of their revenue from production of composite products, components or participate in the related supply chain. There are a further c. 1,300 companies active in composites sector that have not been mapped.

Competitiveness of the UK Composites Industry

The UK competes against American, European and Asian composites industries

Industry views on key sources of international competition (indicative)

Source: Interviews



- ▶ Given the relatively high degree of exports and imports, particularly in carbon-fibre-based composites, UK industry competes with American, European and Asian composites industries. Historically, the UK had a leading position in composites driven by early adoption of carbon-fibre composites in the defence and aerospace industries. However, several other nations have been targeting the composites sector and supporting development of capacity and new capabilities, examples include Spain, Japan and Malaysia. In some cases, direct Government intervention has led to corporate investments being located in competitor countries.
- ▶ The source of international competition varies by industry segment:
 - Composite component structures producers in aerospace face most competition from the USA, France and Germany – reflecting the primary location of the aerospace primes
 - Composite component manufacturers perceive greater competition from Spain and Malaysia, given their targeted investments in this area, and a growing threat from China
 - Fabrics and prepreg manufacturers experience competition from the USA, Europe and also Japan
 - In resins and fibres, the main competition comes from the USA, Germany, Japan and China

The following pages highlight some examples of international development.

International competitors are investing to develop their composites industries (1 of 3)

Country	Key strengths	Drivers of composite industry development	Mapping to UK composite industry
US	Aerospace, defence, wind, raw materials	<ul style="list-style-type: none"> ▶ US industry is a leader in composites innovation and benefits from a significant presence in all the key industry sectors considered in this report. ▶ Composites innovation has benefited from the US defence industry, which has fostered growth of leading-edge applications as well as large volume programmes. The country's leadership in civil aviation programmes has also driven advances in the composites industry, most notably with the B787 programme. ▶ The US composites industry is also supporting the growth onshore and increasingly offshore wind energy. ▶ The US has a well developed supply chain producing resins, fibres and pre-preg, with a number of global leaders such as Hexcel, Cytec, PPG, and Zoltek. ▶ Direct government investment benefits the industry, such as recent initiatives in low-cost carbon fibre manufacturing at Oakridge Laboratories sponsored by the Department of Energy. 	<ul style="list-style-type: none"> ▶ The key sectors in which UK companies face competition from the US are in the military and civil aerospace sector, from a strong base of composite structure manufacturers and composite component manufacturers. However, government-driven purchasing patterns and in particular restrictions on technology derived from the defence industry limits some of the cross-border competition, including higher-end exports out of the US. ▶ Raw materials are imported into the UK from the US, however these compete to a limited degree with domestic supply, as these products are either supplied by the local plants of international players (e.g. Cytec, Hexcel, PPG) and/or there is no significant domestic capability (e.g. limited overlap in industrial grade fibres).
France	Aerospace, fabrics	<ul style="list-style-type: none"> ▶ The French composites industry benefits from the country's stake in Airbus, which has supported the growth of the sector as composites penetration into airframes increases. ▶ Additionally, France has a strong position overall in aerospace and defence, with leading firms such as Dassault, Thales, and several EADS subsidiaries lead by Eurocopter driving composites demand. ▶ The French government has made direct grants to composite companies to support the establishment of production bases in the country, such as those granted to Hexcel for positioning its fabric manufacturing plant in France. 	<ul style="list-style-type: none"> ▶ The growth in aerospace composites use, and France's share of Airbus programmes, has fostered a similar industry structure to that in the UK, with a number of composite structure and composite component manufacturers such as Composites Aquitaine, Duqueine, and several others all having revenue exceeding £20m. Although competitors to UK suppliers on the French and European field, these firms do not export into the UK to any scale. ▶ France also houses a number of subsidiaries of internationally leading players, for both raw materials and semi-finished materials (e.g. Saint Gobain subsidiary Vetrotex, Hexcel, and Toray's Sofirac) which export some of their output to the UK.

International competitors are investing to develop their composites industries (2 of 3)

Country	Key strengths	Drivers of composite industry development	Mapping to UK composites industry
Germany	Aerospace, Wind, Automotive	<ul style="list-style-type: none"> ▶ Germany's large industrial base is driving demand for composites across a number of sectors, fostering a sizeable composites supply base (albeit generally quite fragmented and predominated by SMEs). German composites activity is clustered around industry hubs in Augsburg and the CFK-Valley in Stade near Hamburg. ▶ Germany is a leading participant in the EADS conglomerate which, in particular via Airbus, has driven composites supply into the aerospace sector. ▶ Germany has been one of the two largest European markets for onshore wind, with several leading turbine manufacturers located in the country to supply domestic and regional markets. The country is now also increasingly benefitting from growing demand in offshore wind. ▶ The German government has provided direct aid to both attract composite players to establish manufacturing bases in the country, as well as support the establishment of manufacturing facilities in end-user industries such as wind. 	<ul style="list-style-type: none"> ▶ In aerospace, the German industry is encroaching on the UK's core competency of wing manufacture, evidenced by parts of the A350 wing skins being made in Germany. ▶ With established scale and significant experience, German wind turbine blade manufacturing poses a competitive threat to the establishment of a UK manufacturing base in the sector. ▶ Exports from composites companies serving the German automotive industry into the UK is limited.
Spain	Aerospace, Wind	<ul style="list-style-type: none"> ▶ The Spanish government has focused on composites as a high growth sector since the late 1990's, working to attract international composite players, and to support investment in building a domestic supply chain. ▶ The Spanish outsourced component manufacturing industry is believed to benefit somewhat from its ownership by leading Spanish banks. ▶ Leading equipment manufacturer MTorres has also been instrumental in stimulating the Spanish aerospace industry by spearheading automation technology. ▶ Spain is also attracting investment in materials processing with grants and a strong demand base, such as the new Hexcel precursor plant. 	<ul style="list-style-type: none"> ▶ Spain is believed to have a competitive advantage over the UK in the component manufacture segment and poses a significant competitive threat in aerospace in particular. This is supported by Spain winning the manufacture of composite wing panels for the A350. ▶ Spain has positioned itself as a manufacturing base specialising in composites, compared to UK manufacturers who are built around particular applications (e.g, wings or nacelles).
Italy	Aerospace, Marine	<ul style="list-style-type: none"> ▶ The Italian aerospace industry has close links with Boeing, as evidenced by Alenia Aeronautica manufacturing B787 composite fuselage barrel and horizontal stabiliser sections for Boeing. ▶ Italian government stakes in key aerospace majors has also allowed access to investment capital. ▶ The Italian leisure boat building industry has gone through a period of consolidation and is investing in pushing the boundaries of marine sector composites use and production. 	<ul style="list-style-type: none"> ▶ Italy competes with the UK in manufacturing of large aerospace structures, and is a threat due to its access to US manufacturers such as Boeing. ▶ The Italian boat building sector is recognised as being more progressive than the UK and is beginning to leverage its composites expertise as a source of competitive advantage over the UK.


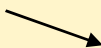

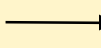
International competitors are investing to develop their composites industries (3 of 3)

Country	Key strengths	Drivers of composite industry development	Mapping to UK composite industry
Japan	Materials, Automotive, Aerospace	<ul style="list-style-type: none"> ▶ The Japanese government has a long-standing composites strategy based on building composites material technology, and leveraging it to build expertise in composite component production. This has led to Japanese companies leading the manufacture of carbon fibre globally. ▶ Japan won a significant role on the B787 programme, partly leveraging its large order as the launch customer for the programme to win this. 	<ul style="list-style-type: none"> ▶ Japan has a competitive advantage over UK carbon fibre manufacturers, with the leading firms manufacturing their products across the globe, reaching virtually all export markets. ▶ Japan is unlikely to be an imminent threat to the UK aerospace composites industry due to limitations imposed upon Japanese partners by Boeing on the export of its technology.
China	Multi sector, low cost production	<ul style="list-style-type: none"> ▶ Although a recent entrant into the composites sector, Chinese industry is becoming a competitive manufacturer of low cost high volume components, by leveraging cheap labour and investing in large dedicated composite manufacturing plants. China also has a growing supply base feeding industrial grade fibre into a number of key markets globally. ▶ The Chinese composites industry has been pursuing a strategy of inward investment, in particular acquiring composites expertise through partnerships with leading global composites players. 	<ul style="list-style-type: none"> ▶ In the near term China will be a threat to low end volume component manufacturers in the UK, leveraging the country's lower cost of labour. ▶ As Chinese industry develops, higher end component manufacturers and composite structure manufacturers are expected to face increasing competition from Chinese companies.
Malaysia	Aerospace, low cost production	<ul style="list-style-type: none"> ▶ CTRM has been the flagship composite manufacturer in South East Asia to date, established with extensive government launch aid as part of a local push in the composites sector. ▶ The Malaysian government has also been able to leverage its position as a key growth market for Western aircraft manufacturers in order to acquire expertise and know-how, shortening the time required to acquire fully fledged composites capability. ▶ Malaysian companies have access to, and utilise, a strong composites knowledge base, through engineers educated in the UK and other centres of composites research. 	<ul style="list-style-type: none"> ▶ Malaysia is already a direct competitor or outsourcing partner to the larger UK composite component manufacturers. This trend is expected to continue. ▶ Malaysian composites expertise combined with low cost manufacturing capability pose an on-going threat to UK industry.
Turkey	Marine	<ul style="list-style-type: none"> ▶ Turkey has recently been gaining share in large recreational yacht building, supported by easy access to Europe, comparatively cheap labour and investment in new technology. 	<ul style="list-style-type: none"> ▶ Turkey is becoming very competitive in the cost effective manufacture of recreational yachts, a sector that is the mainstay of the UK marine composites industry and therefore poses a threat to the UK demand for composites in this sector.
Canada	Aerospace	<ul style="list-style-type: none"> ▶ The Canadian aerospace industry has been developed through a sustained series of government initiatives. Examples of composites-related government initiatives include granting free access to CADIA (design software) to SMEs, grants to assist with training and R&D grants. 	<ul style="list-style-type: none"> ▶ Canada does not compete directly with the UK to any significant extent but is an important trading partner (notably Bombardier) for the UK composites industry

The UK composites industry has competitive advantage in the design and manufacture of composite structures, and in semi-finished composite products (1 of 2)

Summary assessment of the competitive position of the UK composites industry by segment

Source: Interviews and EY analysis

Industry segment / factors affecting competitiveness	Composite structure manufacture	Composite component manufacture	Semi-finished products: Fabrics and Pre-preg	Resins and Fibre
Overall assessment of competitive position	Strong and increasing: competitively positioned for international growth	Competitive but facing growing pressure: local and export opportunities in areas of expertise	Well positioned in key areas: export opportunities and inward investment	Limited in areas of highest value: opportunities in domestic market
Number of companies with >£5m of UK composite revenue	4	19	8	7
Relative scale compared to international competitors	Medium	Medium	Medium	Low
Technical differentiation in core areas of composite expertise	High	Medium	High	Medium
Relative cost position, ie, unit cost of production	Medium	Low	Medium	Low
Trend in competitiveness				
Key drivers of future competitive position	Role on future programmes, low cost manufacturing	Design capability, low cost manufacturing	Qualification of UK plants for key growth programmes, capacity investment	

The UK composites industry has competitive advantage in the design and manufacture of composite structures, and in semi-finished composite products (2 of 2)

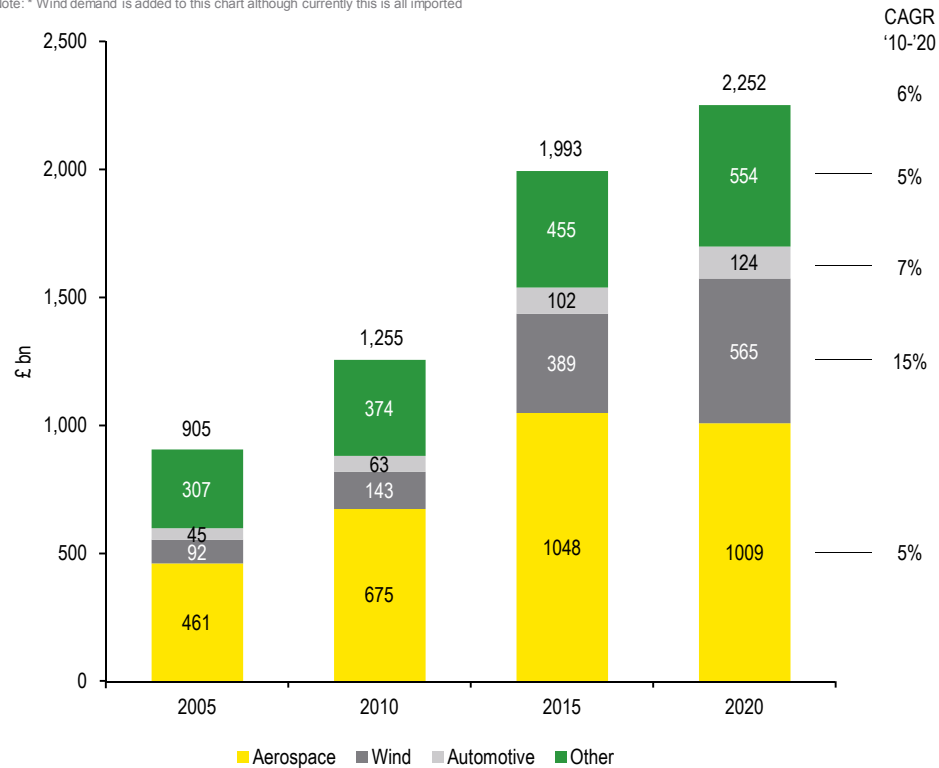
- ▶ Benchmarking the competitive strength of the UK composites industry by segment also produces differential results. These views reflect specific consideration of relative scale, technical differentiation and cost position by segment against specific international competition, as well as consideration of industry views on historical and forecast trends in competitiveness.
 - The UK has a strong and improving position in the design and manufacture of composite structures, notably in aerospace due to its role on key new programmes. This is based on a high degree of technical differentiation in aerostructures and composites design and engineering, as well as comparable relative scale and cost position to other major players.
 - The UK also has a strong competitive position in prepreg production and fabric weaving. This again reflects the views of industry and competitive advantage based on technical differentiation and comparable scale and cost.
 - In composite component manufacture, historically a strength of UK industry, the competitive position continues to weaken as European competitors take a lead in manufacturing improvements, and lower labour cost countries invest in capability. While the UK industry retains comparable scale, it has lost its lead in technology and has a higher cost position. Industry participants expect this sector of the industry to continue to see a weakening of its competitive position internationally.
 - In both resins and fibres the global industry is already consolidated and lead by Japanese and US companies. Many of these players maintain a UK presence to support their overall presence across Europe, and to participate in the UK composites industry itself.
- ▶ A key challenge facing the UK industry is improvement in its cost position of composite components manufacture. This may be achieved through research and development into process and materials improvement, e.g., the National Composites Centre initiative; TSB-led solutions focused competitions. It may also benefit from UK-led technology transfer to lower labour cost countries.

**UK demand for Composites and
Opportunities for UK Industry**

UK demand for composites is forecast to grow due to increasing use in aerospace and wind applications

Estimated UK production demand for composites by sector*

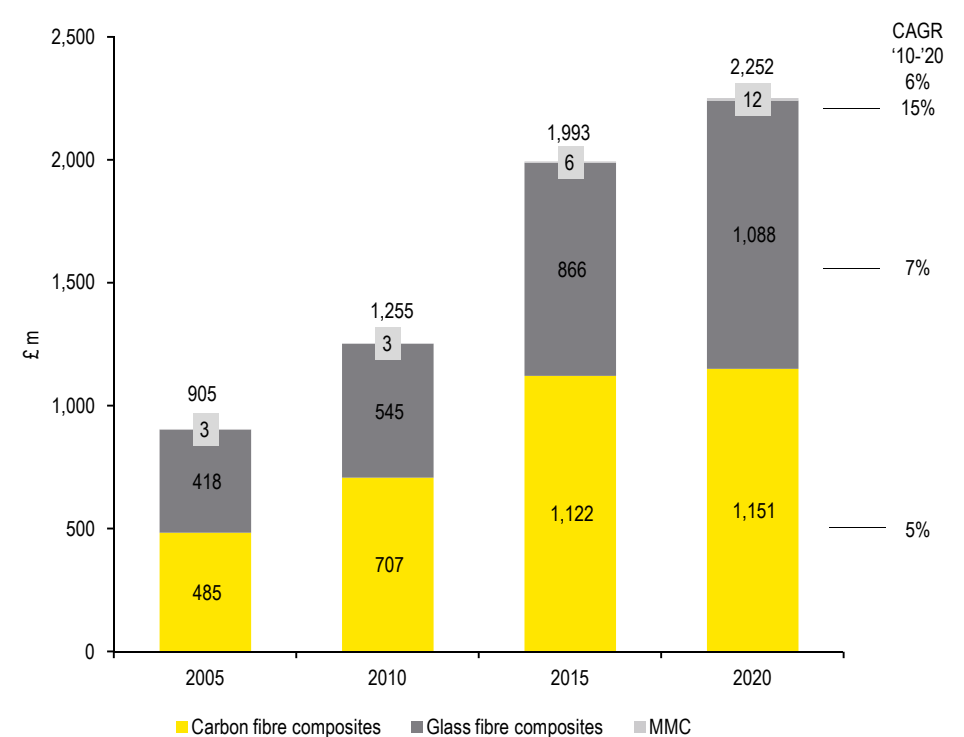
Source: EY Analysis
 Note: * Wind demand is added to this chart although currently this is all imported



CAGR	2005-2010	2010-2015	2015-2020
Aerospace	8%	9%	-1%*
Wind	9%	22%	8%
Automotive	7%	10%	4%
Other	4%	4%	4%
Total	7%	10%	2%

Estimated UK production demand for composites by material

Source: EY analysis



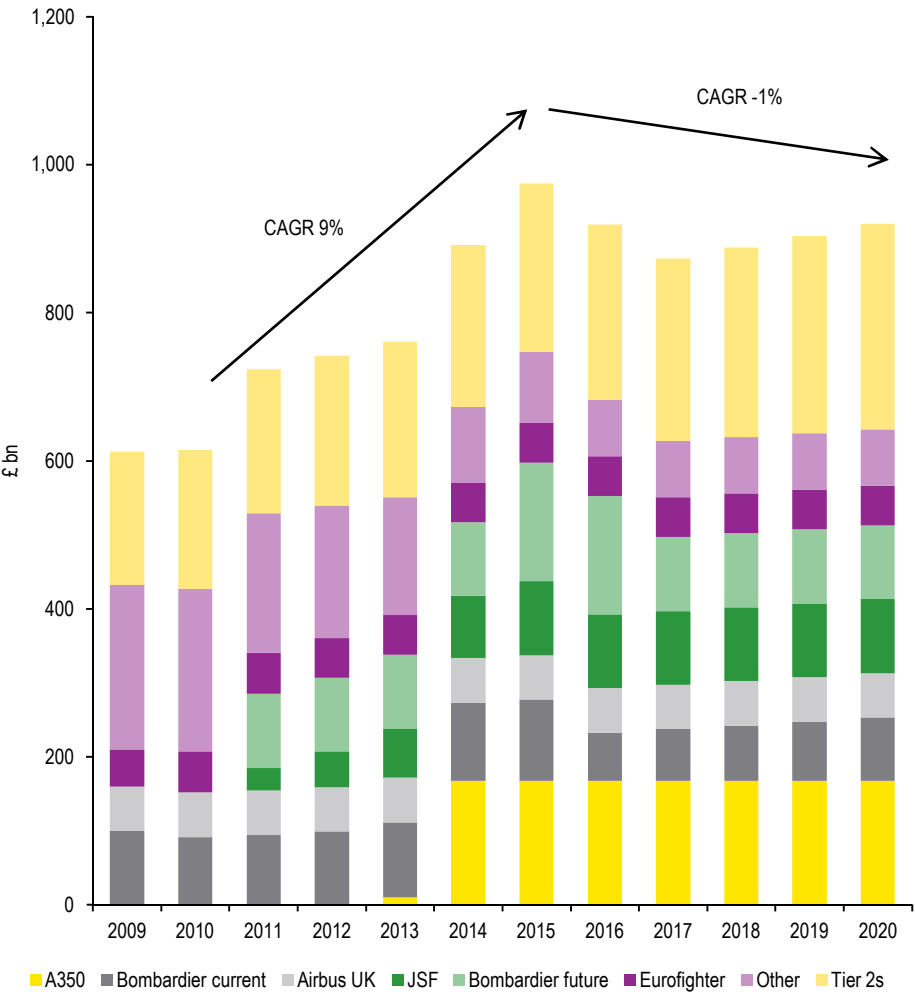
CAGR	2005-2010	2010-2015	2015-2020
Glass fibre composites	5%	10%	5%
Carbon fibre composites	8%	10%	1%
MMC	0%	15%	15%
Total	7%	10%	2%

► UK demand for composites is expected to grow rapidly over the next five years due to increasing demand from aerospace and wind applications, from £1.2bn in 2010 to £2bn in 2015. The UK growth rates for both glass fibre (9% pa) and carbon fibre (17% pa) composites are faster than those forecast for the US and rest of Europe, and match or exceed those of emerging markets. Exploiting this growth is a huge opportunity for the UK composites industry.

Aerospace – the UK aerospace composite demand will grow at 9% pa over the next five years to c. £1.1bn as the A350, JSF and Bombardier programmes achieve full production

UK Aerospace composite demand by aircraft platform

Source: EY analysis

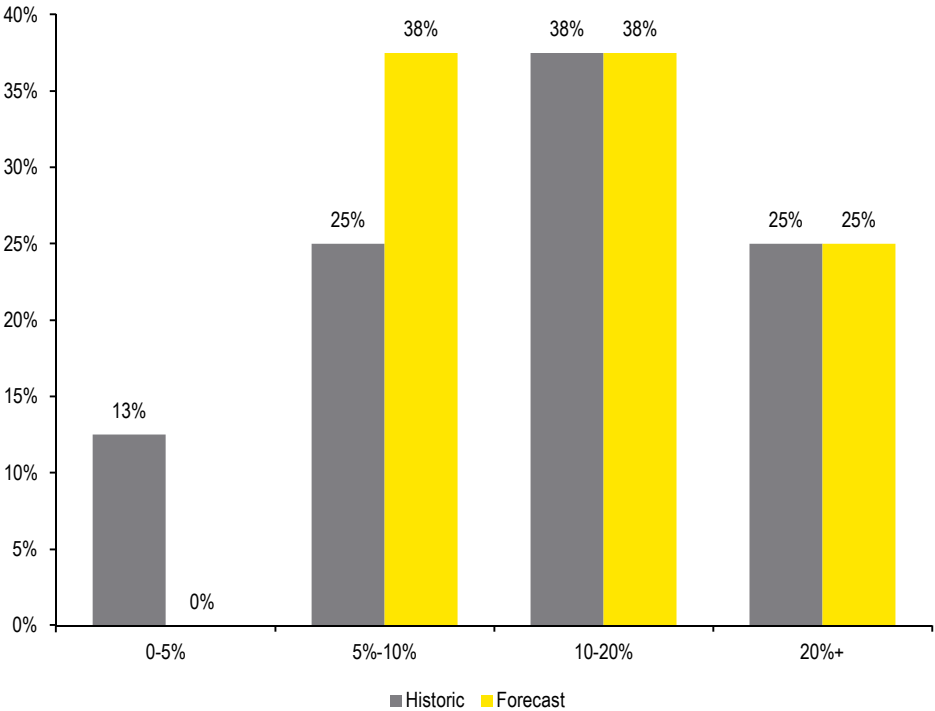


- ▶ In aerospace this stems from work-share already won on key new programmes with a high composites content in the airframe, particularly the Joint Strike Fighter, the Airbus A350 and Bombardier C series. The major players in the aerospace supply chain have already invested to meet this growth in demand. The critical issue going forward is to retain the composite component manufacturing work in the UK, versus outsourcing to lower labour cost countries. This will require improvement in production processes and / or UK industry taking the lead in establishing lower cost operations.
- ▶ Longer term, the priority is maximising UK benefit from demand growth arising from new high composite airframe programmes. Technological development is a key driver to this, both in terms of component complexity and reduction in cost to manufacture, but this development also will require complementary development of the supply chain. The UK's role of the next generation of single aisle aircraft is also critical to maintain competitiveness, both in commercial aerospace and overall in composites.

Aerospace - industry expects growth in aerospace, with higher growth at the larger players manufacturing composite structures

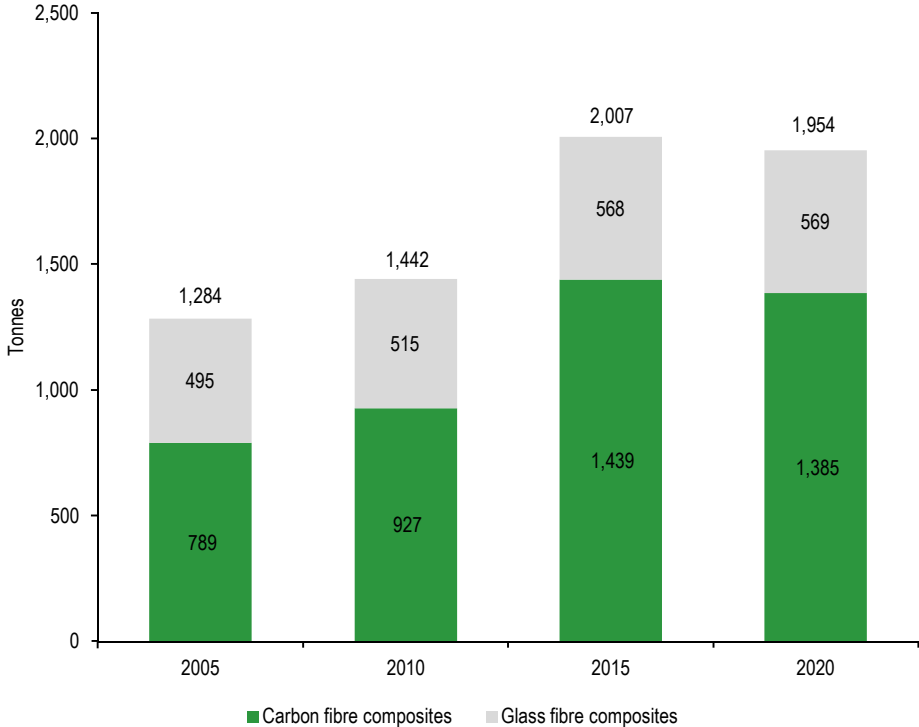
Aerospace composite industry views on growth of their composites revenues

Source: Interviews (n=8)



Forecast volume demand for aerospace composite suppliers by material

Source: EY analysis



CAGR	2005-2010	2010-2015	2015-2020
Carbon fibre composites	4%	9%	-1%
Glass fibre composites	1%	2%	0%
Total	3%	7%	-1%

► Overall UK aerospace composite manufacturers anticipate growth in the range of 10-15% in the near term. UK manufacturers of aerospace structures and assemblies were highly optimistic of future growth in their composite revenues. This reflects the respective manufacturers' exposure to high growth programmes such as the A350, JSF and Bombardier C-Series. There is also the expectation of growth from increased outsourcing by aerospace OEMs.

Aerospace - potential BIS / UKTI / RDA opportunities to support the UK aerospace composites industry in meeting domestic demand growth (1 of 2)

- ▶ UK component manufacturers are on the whole expecting their business to grow in line with historic growth of 10%. Limited ability to invest in expansion is limiting growth. Several UK component manufacturers have already lost out on places on major programmes due to capacity limitations. Investment in facilities and equipment will be required by SMEs if they are to participate further in the growth in wider aerospace composites demand. However access to funding was noted to be difficult as banks require confirmed orders to lend against, and orders could not be obtained without demonstrating investment into capacity.
- ▶ UK prepreg manufacturers and carbon fabric weavers will benefit from aerospace composite demand growth; investments have been made to satisfy increased volume. However the majority of aerospace grade resins are imported and the UK does not have an indigenous manufacturer of small tow carbon fibre suitable for aerospace applications.
- ▶ Aerospace components are c. 90% made from prepreg. This is expected to remain the case in the near term as these systems have been qualified for use in key programmes. However market participants have expressed interest in and some have already started using, alternative processes such as resin infusion. The most significant barrier to widespread adoption is the investment already made in prepreg based technology (such as automated tape laying machines). The overhaul of an entire facility built around prepreg processing is often cost prohibitive. Additionally the aerospace industry has limited experience in alternative processing techniques, and requires a shift in design all the way through to re-training of shop floor staff. However over time there will be an increase in resin infusion/transfer processing in the aerospace industry, and potentially a step change if adopted on future large programme for which infrastructure has not yet been put in place. UK SMEs would be more likely to adopt non prepreg technologies as the investment required to smaller scale manufacturing is comparatively smaller.
- ▶ Developments in manufacturing processes will continue across the composites components industry. Lower production costs and increased throughput rates will help to minimise investment in additional capital and labour capacity to meet the increases in composite demand. This will be essential to secure and maintain composites work in the UK over the duration of these programmes.

Actions to potentially help meet domestic demand growth:

- ▶ Encourage development of lower cost component manufacturing. The National Composites Centre and other initiatives provide platforms for further investment, e.g. automation, resin infusion.
- ▶ Support domestic technology development and manufacturing.
- ▶ Leverage National Aerospace Technology Strategy to further inform UK supply chain of opportunities.

Aerospace - potential BIS / UKTI / RDA opportunities to support the UK aerospace composites industry in meeting domestic demand growth (2 of 2)

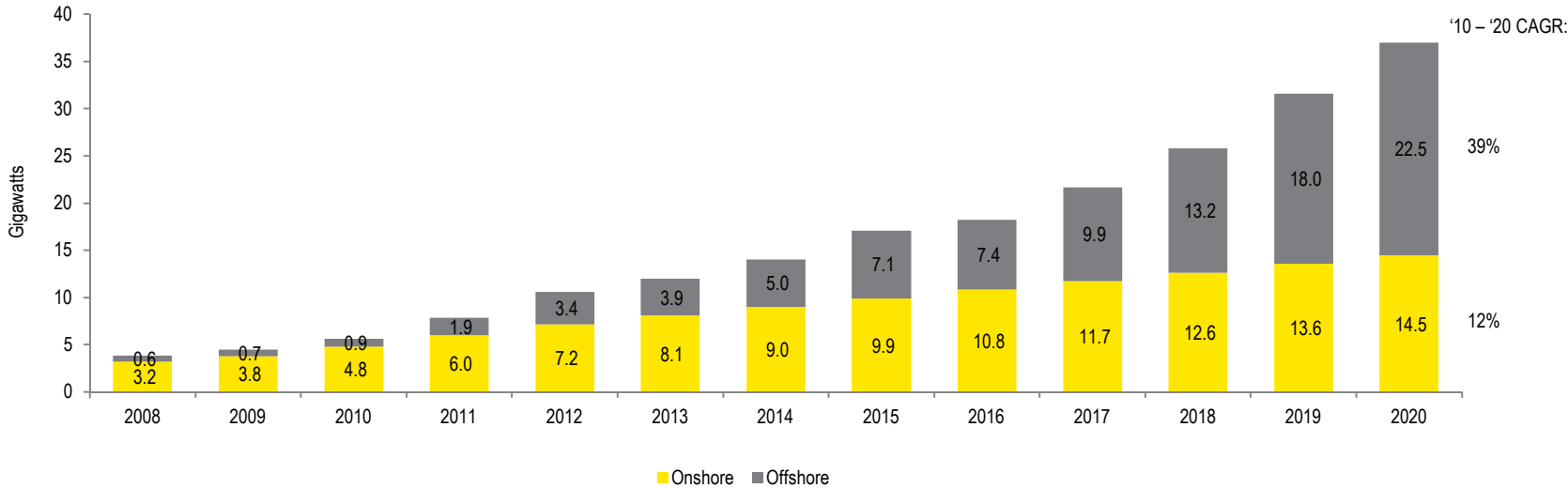
- ▶ Support and foster aerospace composites SME growth:
 - Regional networks to help identify UK SME challenges (e.g. lack of access to growth capital, insufficient investment capability for new technologies, skilled labour shortage).
 - Other possible steps to overcome SME challenges:
 - Grants/low interest loans for investment in equipment, facilities and training.
 - Encourage resource pooling to bid for large programmes.
 - Facilitate easier access to public development/production facilities, such as the NCC.
 - Promote the use of the National Composites Certification and Evaluation Facility to qualify new suppliers.
- ▶ Increase communication and visibility of the UK commitment to NGSA. This would provide the composites supply chain (as well as many other parties) with confidence to maintain investment.

Wind turbines – the UK is planning a significant increase in the installation of wind energy farms over the next decade that will drive demand for composite wind turbine blades

- ▶ The sector experiencing the largest growth in demand is composite wind turbine blades, where demand is forecast to grow from around £0.1bn to £0.4bn by 2015 and to continue to grow thereafter to £0.6bn by 2020. Underpinning this demand are the plans to grow offshore wind power generation in the UK, focused on the North Sea, with around 4,000 turbines installed by 2020. While there is uncertainty around precise forecasts of scale and timeframe, the UK Government is driving the development of offshore wind, and the commitment by three wind turbine manufacturers to invest in the UK is evidence of success.
- ▶ The development of new offshore wind turbines with greater power output requires longer and hence stiffer blades – which is leading to change in design and use of composites materials, notably an increase in the use of carbon-fibre composites. The number and weight of blades translates into a large volume of composites demand – particularly for carbon-fibre relative to current UK demand levels in other sectors.
- ▶ Currently c. 65% of wind turbine blades is manufactured using resin transfer technology with the remaining 35% made with prepreg. The UK is exporting both prepreg and resins to the European wind industry and has domestic resin, fabric and fibre supply, but all of these will require capacity and capability development to take advantage of this opportunity.

Cumulative installed capacity of renewable wind power in the UK to 2020

Source: Renewables UK, European Wind Energy Association, EY analysis

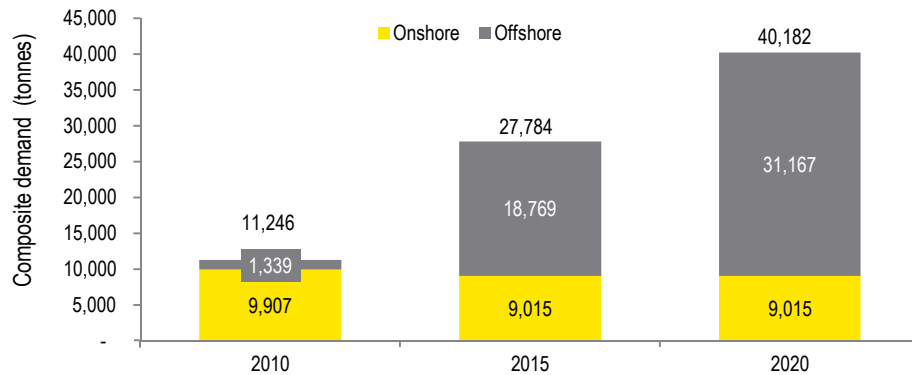


Annual new turbine installations (estimate)	Offshore	25	50	223	343	97	232	420	44	462	542	807	754
	Onshore	262	480	480	364	364	364	364	364	364	364	364	364

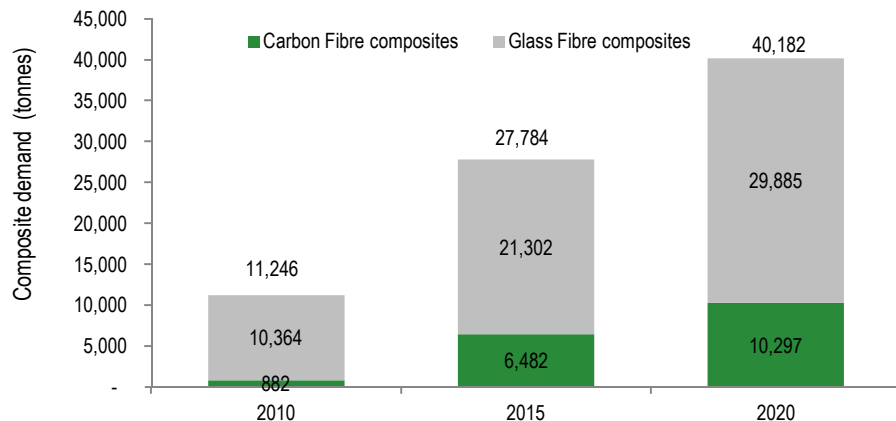
Wind turbines – driven by the planned significant increase in offshore wind generation, the volume of composites demand for turbine blades installed in the UK is forecast to grow at 14% pa over the next decade

Forecast demand for composites from the UK wind energy sector

Source: Renewables UK, European Wind Energy Association, EY analysis



CAGR	2010-2015	2015-2020
Onshore	-2%	0%
Offshore	70%	11%
Total	20%	8%



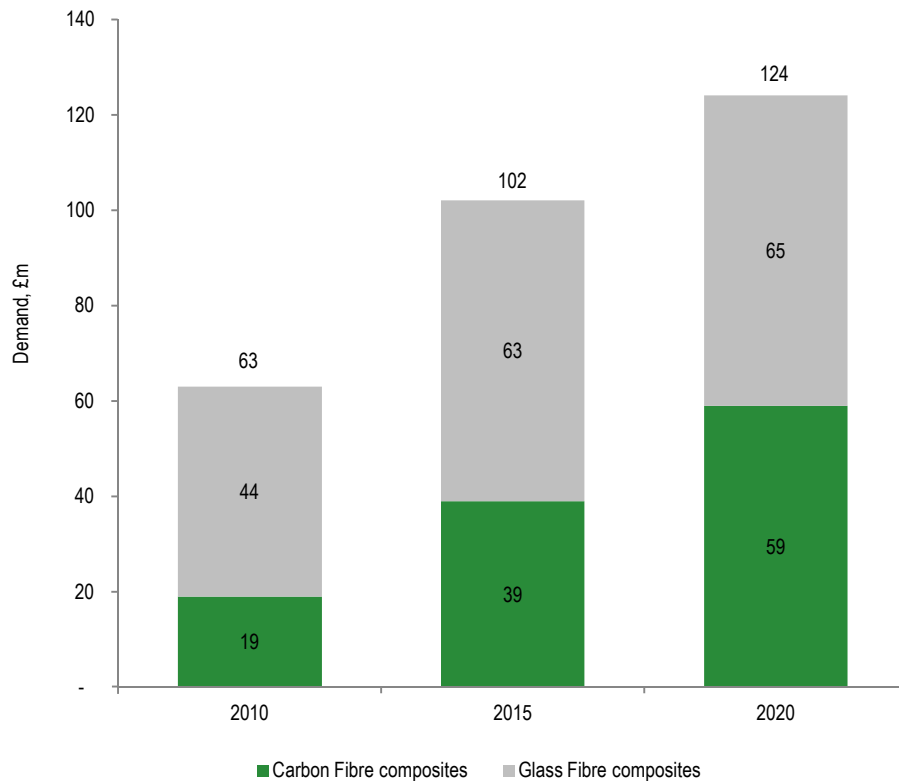
CAGR	2010-2015	2015-2020
Carbon fibre composites	49%	10%
Glass fibre composites	16%	7%
Total	20%	8%

- ▶ Although the UK is poised to become the leading installer of offshore wind, the UK composites industry is not ready to meet this demand. Our industry research did not identify a high degree of preparedness and detailed planning to meet this growth, in part reflecting inherent uncertainties at this stage of the development. Building out the composites supply chain in the UK to meet this growth in demand is an achievable, albeit challenging, goal. The facts that the domestic demand opportunity is worth £0.5bn by 2020 (excluding export potential) and that this is a unique opportunity to establish the UK as a global leader in offshore wind power generation and large composite structure manufacturing, surely provide enough of an incentive to ensure that maximising the UK benefit from growth in offshore wind energy composites is a priority for policy and resource.
- ▶ The key growth catalyst for the composite supply chain serving the wind industry is domestic wind turbine production. One of the major challenges is that blade manufacturing is moving in-house into turbine manufacturers; therefore attracting these manufacturers to the UK is a key first step (e.g. recent Siemens and GE announcements). Work is then needed to ensure that turbine blades are manufactured in the UK and not shipped from facilities overseas.
- ▶ Actions to support growth in offshore wind energy composites:
 - Encourage and support establishment of turbine blade design and manufacturing, as part of or in addition to turbine manufacturers locating in the UK.
 - Establish investment requirements for supply chain.
 - Identify international supply chain and promote investment.
 - Support entry of UK-based suppliers into the wind sector.
 - Identify clusters that may facilitate development blade manufacture.
 - Leverage the NCC to develop manufacturing processes for turbine blade components and structures.

Automotive – carbon fibre composite demand is forecast to grow at over 10% per annum to equal glass fibre demand by 2020; however both relatively small versus other industry sectors

Forecast revenue demand for automotive composites suppliers by material

Source: Interviews and EY analysis



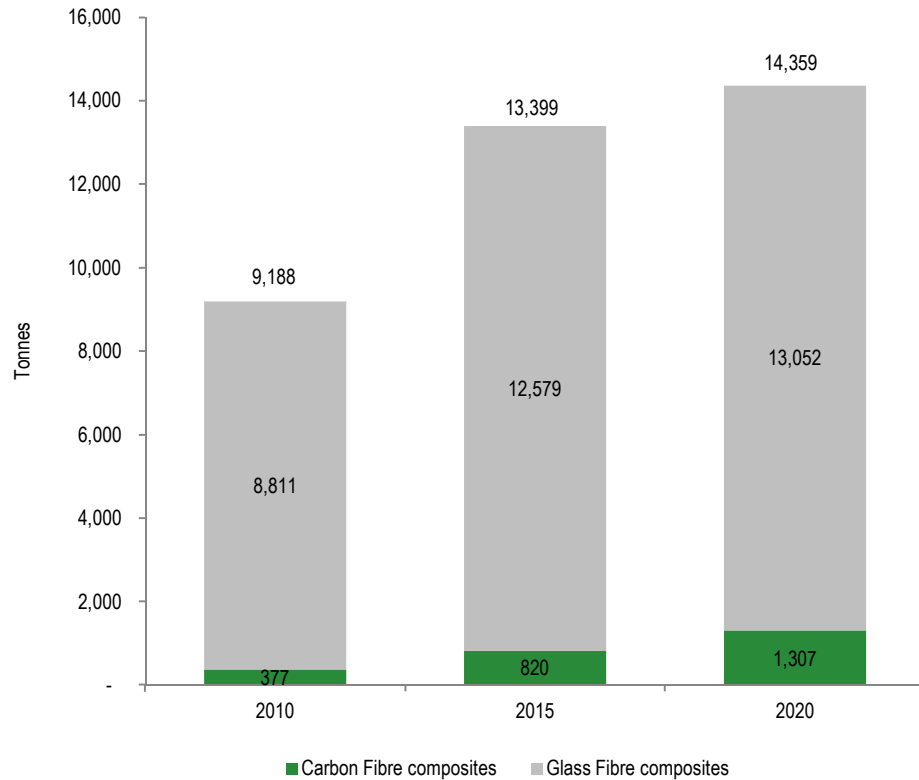
CAGR	2010-2015	2015-2020
Carbon fibre composites	15%	9%
Glass fibre composites	7%	1%
Total	10%	4%

- ▶ The production growth rates of vehicles built by volume manufacturers (which comprise the vast majority of UK automobile production) are the key driver for glass fibre composite applications. On average the content of glass fibre composites in mainstream passenger cars is not higher than it was twenty years ago and this is not expected to change materially in terms of weight or value per vehicle in the period to 2020. Growth in glass fibre composite demand is expected to continue broadly in line with overall UK vehicle production rates.
- ▶ With strong links to its motorsport heritage and industry, the UK has over the past decade regained its position as one of the leading centres for high-end performance cars, which are the key vehicle types for carbon fibre use. Manufacturers such as Aston Martin, Bentley, McLaren and Jaguar expect to continue growing sales worldwide. Overall carbon fibre composites demand for automotive applications is forecast to grow at over 10% per annum, although total volume remains low relative to other sectors. UK composite suppliers are well located to work with these companies to support design and manufacture of carbon fibre components and structures.
- ▶ To generate use of carbon fibre composites in higher production vehicles, production techniques will have to undergo radical change. The biggest challenge is for composite component manufacturing processes to attain speeds that are fast enough to keep up with vehicle production rates. Without the ability to incorporate carbon fibre composite component manufacture directly into the car production process, the cost of carbon fibre composites will be too high for adoption by volume manufacturers.

Automotive – the automotive sector offers additional volume growth to the UK’s carbon fibre composite supply chain

Forecast volume demand for automotive composites by material

Source: EYanalysis



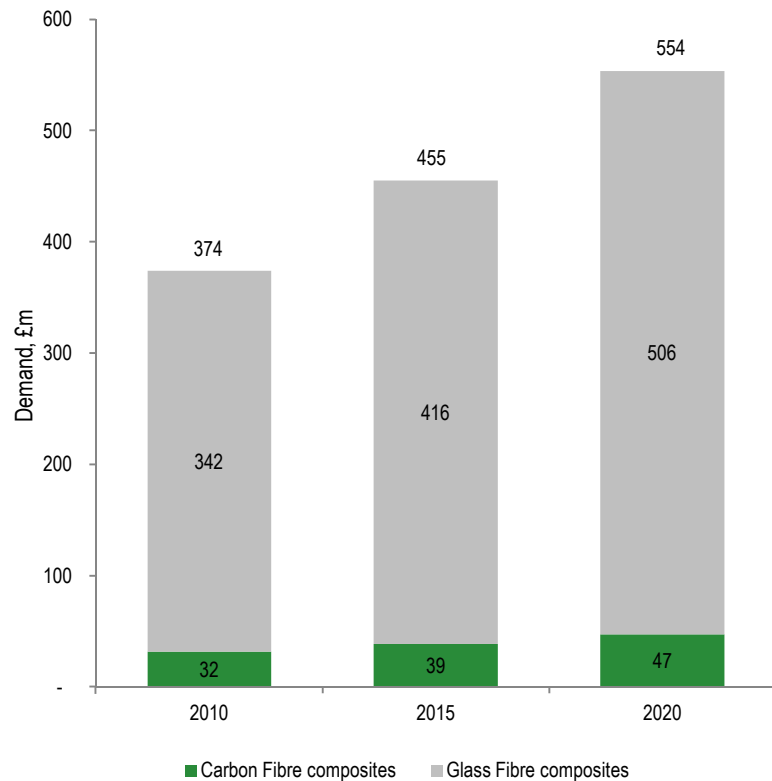
CAGR	2010-2015	2015-2020
Carbon fibre composites	17%	10%
Glass fibre composites	7%	1%
Total	8%	1%

- ▶ Major composite and automotive companies are researching the development of such processes and recent announcement by companies such as BMW and SGL demonstrate that significant progress is being made outside the UK. The UK automotive composites sector needs to focus on and speed up the rate of reaction to these challenges if it is not to fall significantly behind international competition.
- ▶ Actions to support growth in automotive composites:
 - Foster support for research into composite production techniques.
 - Ensure close involvement of the automotive sector (Automotive Council) in the NCC and similar initiatives.
 - Facilitate demonstrator projects for the new technologies developed.
 - Encourage R&D programmes addressing recyclability and reuse of composite materials, including players from across the supply chain.
 - Ensure the supply chain grows to support changes in this sector.
 - Ensure availability of materials.
 - Explore possibility of independent moulding facilities where appropriate.

Other sectors – most composite applications are driven by growth in end-user volumes

Forecast revenue demand for other sectors composites suppliers by material

Source: Interviews, EY analysis



The average growth rate for the use of composites in other sectors is 4%.

- ▶ **The marine sector** comprises approximately one third of composite demand outside the top three sectors. The UK boating industry is focused on the manufacture of small to medium sized pleasure craft. Within the industry, there are three large boat builders of scale, with circa 100 smaller firms producing a limited number of craft. Total boat manufacturing totals approximately 6000 units.
- ▶ Marine composites have historically focussed on the use of large volumes of glass fibre, which has been used for pleasure craft hulls over a number of decades. A sizeable proportion of composite work for the marine sector is undertaken in-house by the boat builders using a mixture of raw and semi-finished materials, with only limited outsourcing of component manufacture.
- ▶ Carbon fibre composites are being used in small amounts for a handful of marine superstructure elements and some hulls in larger and performance-oriented craft manufactured in the UK. However, volumes for these are expected to remain limited and very small compared to glass fibre composite volumes. Some applications do occur in defence marine. These are often large in volume per vessel, but with a smaller number of vessels produced.
- ▶ The Italian boat building sector is focussing considerable resource on greater use of composite materials for high-end boats. In the small to medium sized segment, which is the main focus of UK manufacturers, competition is increased from Turkey. Technology such as that developed by Gurit UK has focused on faster and more efficient production techniques. This has supported increased uptake of UK-made material.
- ▶ Overall the use of composite material per boat is expected to remain broadly constant for UK boat manufacturers in the period to 2020. UK boat build rates are expected to recover to pre-recession rates of 6% annually by 2012 or 2013.
- ▶ **The UK Construction industry** uses glass fibre composites in applications ranging from roofing, through to doors, windows and bathroom applications. Less structural applications for glass fibre composites include trim and decorative components such as canopies and panelling. The use of glass fibre composites in construction applications will continue largely in line with house building and general construction activity in the UK. This is expected to recover from current low levels due to the recession. Some higher uptake from more modular components may occur for large projects, such as the London Olympics.

CAGR	2010-2015	2015-2020
Carbon fibre composites	4%	4%
Glass fibre composites	4%	4%
Total	4%	4%

Other sectors – potential BIS / UKTI / RDA actions to support the use of composites in other industries

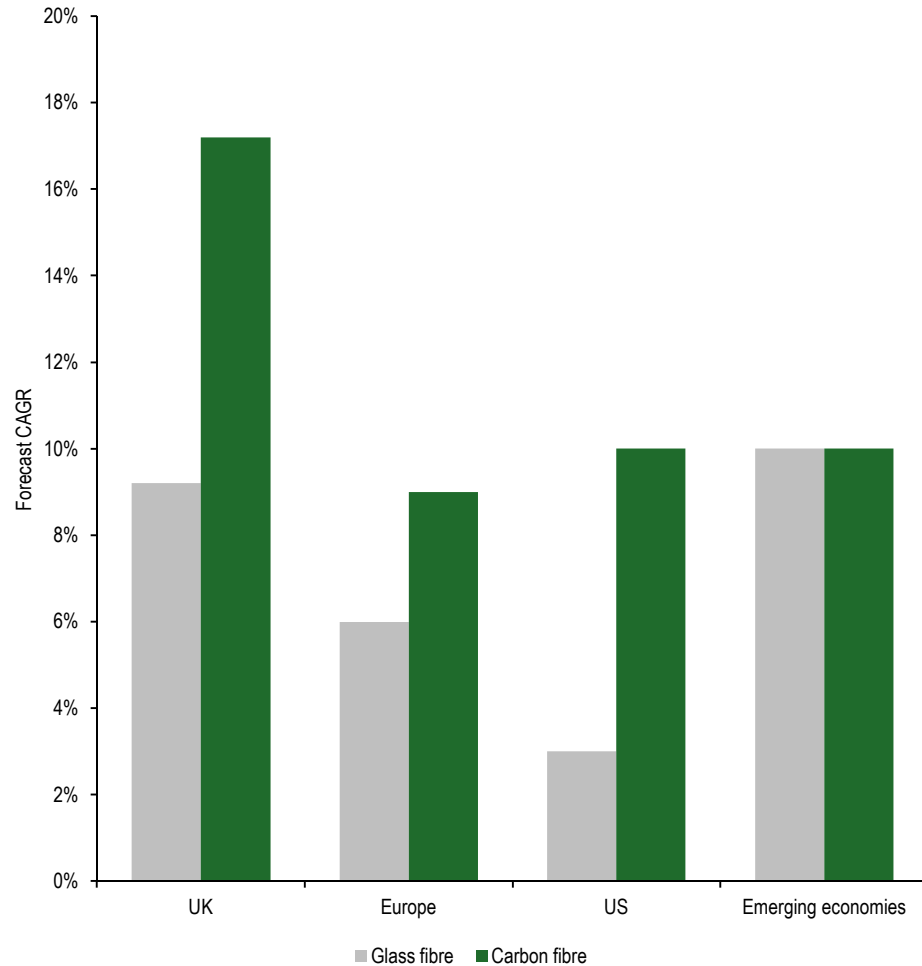
- ▶ Carbon fibre composites are used in newer, higher growth applications, such as the reinforcement of both new build and existing concrete structures. Isolated projects in the manufacture and reinforcement of smaller bridges have also taken place. Volumes are much lower than glass fibre composites and uptake is much more disaggregated, with usage being project specific. No major growth trends for series production or increased penetration were identified.
- ▶ In the **Consumer and Sporting Goods sectors** the uptake of carbon fibre composites has accelerated considerably in the recent past as more and more applications enter mainstream use (e.g. golf clubs, bicycles). However, the vast majority of production of these goods is based in Asia, with limited production in the UK. Proportionately this sector comprises a much higher share of the global carbon fibre composites market (possibly up to 40%) than it does in the UK market. Similarly glass fibre composite applications are prevalent in leisure and other consumer markets (e.g. kayaks), however applications of this material have not evolved or grown materially in the recent past.
- ▶ Sporting goods applications have been hit hard by the macroeconomic downturn, due to its exposure to discretionary spending. Demand is expected to recover, but beyond this, composite penetration is already high and production is outside the UK.
- ▶ The **Oil and Gas sector** is a relatively nascent area of application currently undergoing further research and development. The exploration and extraction of oil is pushing operations into ever more extreme environments and is therefore requiring more sophisticated materials to cope. Carbon fibre composites are being developed for use in risers as potential alternatives to other materials and could lead to growth of use in this sector. The UK's strong off-shore oil industry lends itself well towards exploiting opportunities for composites uptake. Promotion and communication of the benefits of composites and design expertise within the sector, ensuring increased exposure to potential partners or customers in the sector, is likely to assist in driving development. Early uptake of suitable production solutions is likely to give UK users a competitive advantage.
- ▶ It has been shown that the UK composite industry is represented across a wide range of end user sectors. Establishing a mechanism for cross sector knowledge transfer could provide the UK with a significant technological competitive advantage. Examples could include:
 - Transfer of expertise and experience between fixed wing and rotary aircraft in the aerospace sector.
 - Transfer of knowledge about blade manufacture between the aerospace and wind turbine industries.
 - Initiatives such as the National Composites Centre and future Technology Strategy Board calls should be used to provide mechanisms and frameworks for companies to share knowledge and expertise in a non-competitive environment.
 - The international shortage of skills in the composites sector was also highlighted during research for this report. Industry views on possible remedies within the UK include:
 - Assisting smaller companies with training of apprentices and retraining staff.
 - Improving access to vocational training.
 - Encouraging academics to work with industry and increased access to university expertise to SMEs.
 - Maintaining government funding for composites-related research/teaching at universities.

**International demand for Composites
and Opportunities for UK Industry**

Composites demand in the UK is forecast to grow faster than international markets

Forecast growth of composite demand in key international markets

Source: AVK, Lucintel, Freedonia, EY analysis
 *Note UK growth represents growth in the 2010-20 period and includes off-shore wind demand; European growth represents sustainable growth rate estimated by AVK; US growth is for the 2009-2014 period.



- ▶ Composites demand growth in the UK is forecast to exceed growth in international markets, largely driven by the growth in offshore wind and aerospace sectors. This market leading growth rate should enable UK companies to continue developing composite capability, and to apply this know-how to develop further export markets.

In Europe:

- ▶ Growth in carbon fibre demand is forecast from the aerospace sector.
- ▶ In volume terms the construction industry is the largest segment, with a strong automotive and wind energy cluster in Germany.

In the USA:

- ▶ Carbon fibre demand is forecast to grow in aerospace and green energy segments.
- ▶ The US has a large glass fibre composite manufacturing industry focused on the construction and automotive sectors, accounting for c. 63% of production. Limited growth in these mature markets is expected.

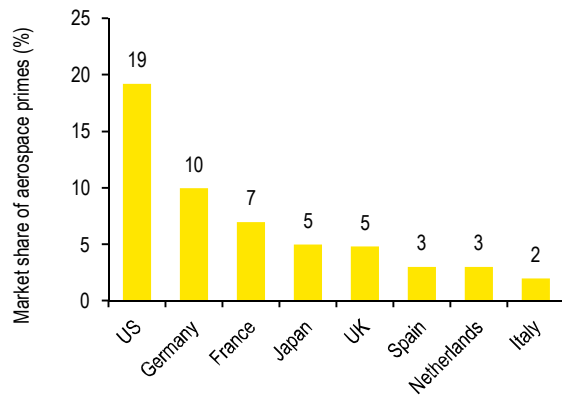
In emerging economies:

- ▶ Strong domestic growth in construction, consumer goods and automotive industries, is driving fastest global growth for glass fibre demand.

In aerospace, the UK composites industry is already export oriented as aircraft assembly is largely carried out in Europe and the USA. These markets, and new markets in Asia, offer long term export growth potential

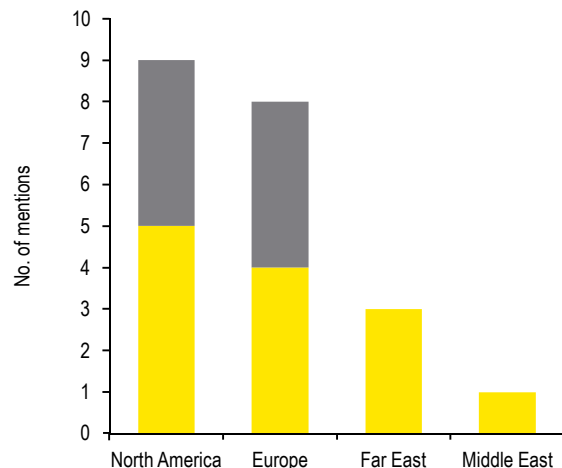
Estimated market share of composite aero structure manufacturers by country

Source: Counterpoint
 * Note - based on market share of 15 largest aerospace primes



Industry views on key export geographies

Source: Interviews



Target export markets

- ▶ The UK composites industry is successful in international markets, particularly in Europe and North America and on major aerospace programmes. For the composites players already focused on the international aerospace sector, there are a number of opportunities to grow as the global aerospace industry increases the use of composite materials. These opportunities include:

USA

- ▶ The most accessible market for UK aerospace composite manufacturers is the US, which is both relatively open and large. Historical co-operation between US and UK defence industries also allows UK companies easier access to US defence contracts than most other market participants.
- ▶ US and Canadian regional, business jet and general aviation industries are also a key growth sector. Composite use in smaller civil aircraft is still in early stages of development and presents a substantial opportunity for UK exports.

Europe

- ▶ The European aerospace composite market is relatively closed, largely as a majority of composites work for Airbus Europe is carried out in-house or by captive manufacturers. For example Airbus Europe outsources c. 10% of composite production by value, of which only 1% was imported. Most UK suppliers gain access to Airbus programmes through Airbus UK and thus are largely limited to wing related applications.

Asia

- ▶ In the longer term, UK industry could seek export opportunities to the embryonic Chinese and Indian aerospace industries.
- ▶ Whilst Japanese companies have a strong presence in production of aircraft components and benefit from technology transfer from Boeing, it is thought that they will be prevented from using Boeing technology on domestic programmes. UK companies could potentially work in partnership with their Japanese peers to develop composites capability for domestic Japanese programmes such as the Mitsubishi Regional Jet (MRJ).

South America

- ▶ Brazil is fast becoming a centre for regional jet production, but does not feature prominently in the global composites industry. Supporting manufacturers such as Embraer in technology development, outsourced component manufacture and supply of aerospace materials could potentially open up a lucrative market for the UK composites industry.

Middle East

- ▶ Governments in the Middle East are seeking to establish an aerospace composites industry. Supporting this with UK technology is a significant export opportunity for the UK, although technology sales will need to be balanced against the prospect of creating future competitors.

There are opportunities for international promotion of the UK composites industry in sectors outside of aerospace

- ▶ The UK composite component manufacturers are expected to see a continued decline in their international competitiveness. As a result, this group may benefit most from actions to increase their international sales, which are currently very low. Opportunities may include:
 - Support in targeting export sales in the core markets of the USA and Europe, if these markets are not currently being targeted. This could include aerospace, defence and other niche applications.
 - Expansion in the Middle East region, whose governments are seeking to establish aerospace composites capability and where the UK could play a role in technology transfer and development. Political/diplomatic support will be necessary if this opportunity is to be pursued.
 - Investment in China with composites technology, through direct exports or new sites.
- ▶ In the wind sector, exports currently represent all of the UK composite industry's sales. This sector will grow with wind power generation across Europe. If the UK creates a sizeable offshore wind turbine blade composites supply chain over the next five years, then this will lead to substantial future export opportunities, for example:
 - German, Danish and North Sea offshore wind farms will be able to leverage the existing UK supply chain.
 - Technology transfer packages to other parts of the world
- ▶ Outside the aerospace sector, the UK composite industry is characterised by many small companies and low levels of exports. A number of companies with revenue <£5m are active across a range of market niches, just one example being motorsport, often with a high degree of technical design and manufacturing capability. These companies illustrate the strength of the sector outside aerospace, but many do not export to any significant extent. Additionally there are many smaller companies that are being tracked on a regional level. Both of these groups may benefit from support to increase their export sales.
- ▶ In the resin and fibres segments of the UK composites supply chain, there is already a high degree of exports principally to European countries. Most of these companies are UK subsidiaries of global players who are managing supply against regional pools of demand. Growing UK exports will be largely driven by attracting inward investment to increase UK share of their overall production.