

Carbon fiber's changing global landscape

By Dr. Myriam Yagoubi / Manager, Future Materials Group (FMG)

» The carbon fiber industry, long seen as a niche market supplying high-tech and high-value applications, is undergoing significant transformation. Traditionally dominated by a few established players, this sector is now experiencing a surge in production capacity driven by demand for energy transition technologies and other high-growth applications.

In 2005, carbon fiber demand stood at around 25,000 tonnes. Today, it has grown to approximately 150,000 tonnes, and projections suggest that it could reach 450,000 tonnes per annum by 2030, especially as wind power demand continues to expand at an expected compound annual growth rate (CAGR) of nearly 30%. While still small compared to commodity materials like steel (with 1.9 billion tonnes produced in 2023 alone), the growth trajectory for carbon fiber clearly signals its transition into a fast-expanding industry.

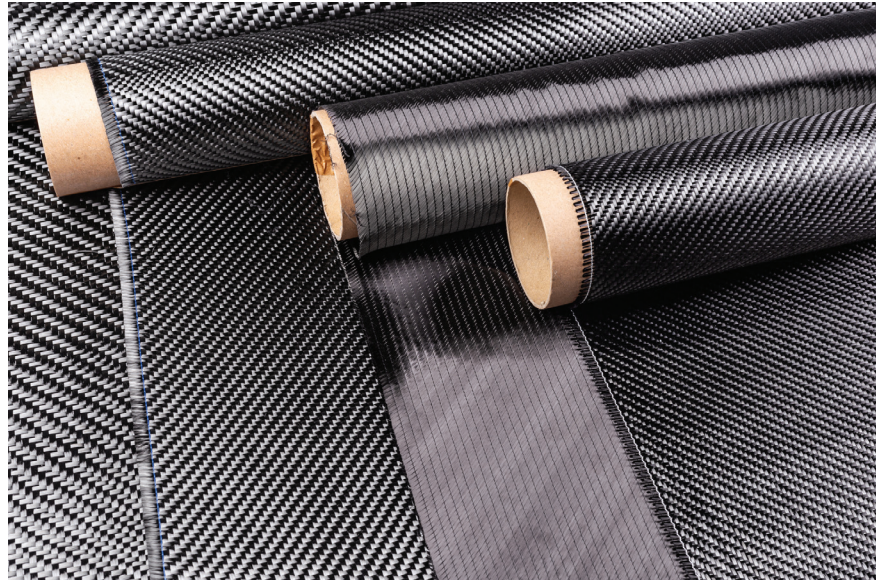
This raises two essential questions: How is the carbon fiber industry transforming, and can manufacturers remain profitable as the market grows and diversifies?

Three key market segments

Future Materials Group (FMG, Cambridge, U.K.) identifies three distinct segments emerging within the carbon fiber market, each presenting unique opportunities and challenges. Producers are adopting different strategies to position themselves effectively within these segments, either specializing in high-end niches, targeting large-volume applications or balancing both to focus on industrial niches.

1. AEROSPACE: HIGH-END APPLICATIONS

At the top end of the carbon fiber market, aerospace continues to be a cornerstone application. The industry structure has seen limited changes despite demand increasing, driven by the adoption of composite-intensive aircraft such as the Boeing 787 and Airbus A350. Only a handful of companies — such as Hexcel (Stamford, Conn., U.S.) and Toray (Tokyo, Japan) — continue to dominate this segment. These firms operate within a tightly controlled value chain to meet the aerospace sector's stringent requirements for safety, performance and durability.



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This value chain relies on a range of highly specialized carbon fiber materials, such as unidirectional pre-impregnated tapes, which are designed for the specific needs of aerospace manufacturers. The high entry barriers in this segment, including long material qualification processes and rigid customer requirements, make it difficult for new entrants to compete.

By focusing on high-value sectors like aerospace, established manufacturers protect their margins through customer lock-in, as switching suppliers within complex aerospace programs can be prohibitively expensive. Specialized manufacturers in this segment typically focus on continuous technological innovation and tailored services rather than competing on volume. This approach ensures that their position within the value chain remains secure, preserving profitability in the long term.

2. LARGE-VOLUME APPLICATIONS: WIND ENERGY'S GROWTH POTENTIAL

At the other end of the market spectrum, the demand for carbon fiber in wind turbine blades is driving significant growth. This demand is largely fueled by the energy transition, where carbon fiber is essential for building lighter, stronger blades that enhance

the efficiency of wind power generation. Carbon fiber demand for wind applications is expected to grow at a CAGR of 15-30% over the next 5 years.

In contrast to aerospace, buyers in this segment are highly cost-conscious, requiring consistent quality but with less emphasis on customization. The carbon fiber products they seek are more standardized, and services beyond the basic products are minimal. Price and scale are the key drivers in this market, making it attractive to players who can deliver large volumes efficiently.

Leading companies such as Zoltek (St. Louis, Mo., U.S.), a subsidiary of Toray, have invested heavily in scaling up production to serve this burgeoning demand. At the same time, new players have entered the market, particularly from China, such as Jilin Chemical Fiber (Jilin City, China) and Sinopec (Beijing, China). These companies are competing aggressively on price, adding pressure to established players.

To succeed in this segment, companies must adopt a comprehensive strategy focused on operational efficiency, competitive pricing and streamlined supply chain management. While innovation still plays a role, particularly in enhancing sustainability and reducing production costs, the primary challenge is achieving economies of scale. Firms that manage to optimize their operations will capture significant market share and profitability, while those that fail will struggle to remain competitive.

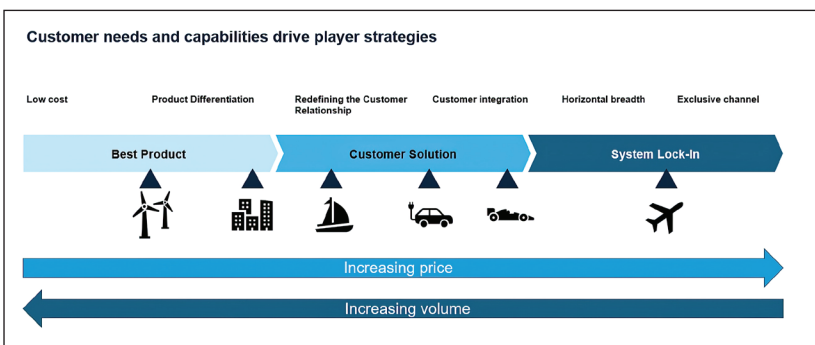
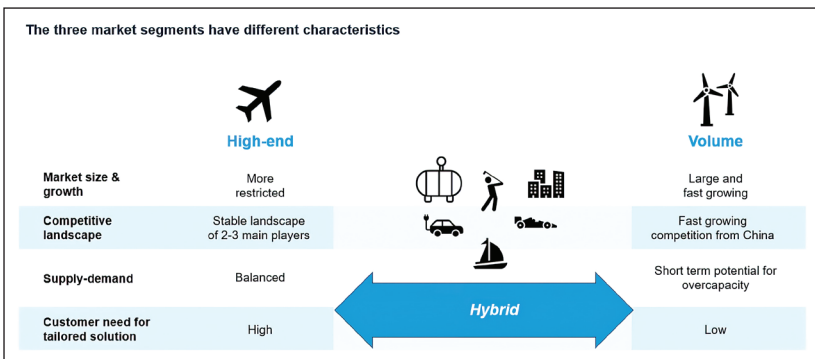
3. MIDDLE GROUND: BALANCING NICHE AND SCALE

Between the aerospace and large-volume wind energy segments lies a diverse range of industrial and consumer applications. In these markets, carbon fiber plays an important but often niche role. Applications range from high-performance automotive parts and pressure vessels to sports equipment. In these cases, carbon fiber's combination of strength and light weight is critical to performance.

Unlike aerospace, where customer loyalty is strong, industrial and consumer markets are more fluid. Buyers in these segments often require tailored products but are willing to switch suppliers to find a better balance between cost and service. As a result, manufacturers serving these markets must be more flexible in their approach.

Companies in this middle ground have adopted a hybrid business model that blends elements of both specialty and volume strategies. Mitsubishi Chemical Group (MCG, Tokyo, Japan and Sacramento, Calif., U.S.), for example, offers a wide variety of carbon fiber grades to target different industrial niches. However, despite this broad approach, the company has faced difficulties in establishing dominance in any one segment. Similar challenges have faced other international players who entered this market over the last decade.

The key challenge for firms in this segment is maintaining flexibility while ensuring profitability. They need to balance the demands of high-end, customized applications with the efficiency needed for larger volume industrial orders. To achieve this, »



Carbon fiber market segments (top) and player strategies (bottom). Source | Future Materials Group

companies should segment their operations into distinct business units, each focused on a specific market segment. For example, Toray has pursued this strategy with varying degrees of success. The ability to balance this dual focus is crucial for players aiming to succeed in the middle market.

Global perspective: New, growing carbon fiber markets

Traditionally, carbon fiber demand has been focused on North America, Europe and Japan, with these regions also responsible for most of the global carbon fiber supply.

Increasingly, however, the demand for carbon fiber is becoming truly global. The use of carbon fiber in new, rapidly growing economies was initially driven by the low-cost production of what we termed “middle ground applications” including consumer and sport goods, then by the needs of large-volume industrial applications such as wind energy, pressure vessels and construction.

To satisfy this local demand, countries such as China, South Korea or Turkey have established their own production over the past

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15 years. Other fast-growing economies are also planning their own entry into this market. In India, flagship company Reliance Industries (Mumbai) is said to be progressing its plans to install its own production in the near future.

In addition to addressing the needs of local markets, these new entrants will no doubt participate in the carbon fiber markets globally. China alone has announced that it will provide nearly half of the global nameplate capacity by 2030.

Future outlook

On one hand, the carbon fiber industry has recently faced some strong headwinds. The lack of maturity and volatility of end markets as well as the successive global economic and political crises have disrupted the complex carbon fiber supply chains, evidence of the industry’s lack of resilience. These short-term instabilities, however, are inherent to a rapidly evolving industry and carbon fiber’s long-term growth prospects remain very attractive.

The carbon fiber industry is at a critical juncture, with rapid growth and diversification reshaping the competitive landscape.

Companies must carefully choose their strategic positioning, deciding whether to focus on high-end, low-volume sectors like aerospace, pursue large-volume applications such as wind energy or straddle the central span through a hybrid approach.

Each strategy presents its own risks and opportunities. High-end players must continue investing in technology and innovation to maintain their margins, while volume-driven companies must remain vigilant about costs and operational efficiency. Meanwhile, firms targeting both high-end and industrial niches face the dual challenge of flexibility and focus.

Ultimately, the future of the carbon fiber industry will depend on how well companies can adapt their business models to meet the changing needs of their target markets. The demand for carbon fiber is set to continue rising, driven by the global energy transition and an increasing emphasis on lightweight, high-performance materials. Those companies that can align their strategies with the evolving market dynamics will not only survive but thrive in this rapidly transforming industry. **cw**



ABOUT THE AUTHOR

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