

In addition to commercializing innovative materials, Toray recognizes the critical need to put forward proposals that dramatically increase the value of customers' products. With this in mind, Toray Group moves beyond the simple supply of materials, and works diligently to advance solutions that address customers' issues on the back of commonly shared visions.

Toray began the full-fledged production of commercial carbon fiber in 1971. Given the absence of carbon fiber market when we started, it was imperative that we take steps to create the market from scratch, while developing processing and molding methods, either on our own or in collaboration with customers. At the outset, we focused on the sporting and leisure fields, where a certain level of demand could be expected if the performance of products was high even when materials were a little expensive. As a result, we were successful in creating the market in the fields of fishing rods, golf clubs, and tennis rackets.

In contrast aircrafts, an area Toray Group targeted for carbon fiber sales in the long run, was hit by the first oil crisis in 1973. This set off the ongoing search for lighter weight, energy efficient materials by aircraft manufacturers, demand for carbon fiber reinforced plastic (CFRP) gradually increased for the use in the secondary structures of aircrafts, such as rudders. Based on the track record, The Boeing Company adopted plans to apply CFRP as a primary structural material (for structural parts where damage is directly linked to a crash) in its Boeing 777 in 1980,

## Sharing Visions with Customers while Creating Markets

Toray's Strengths

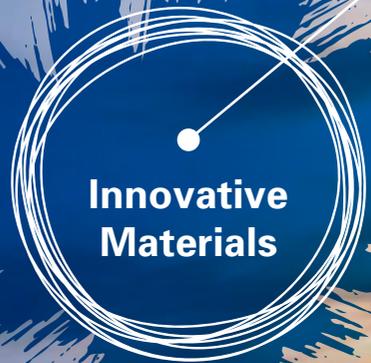
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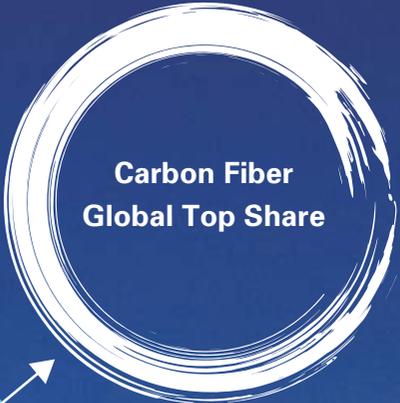
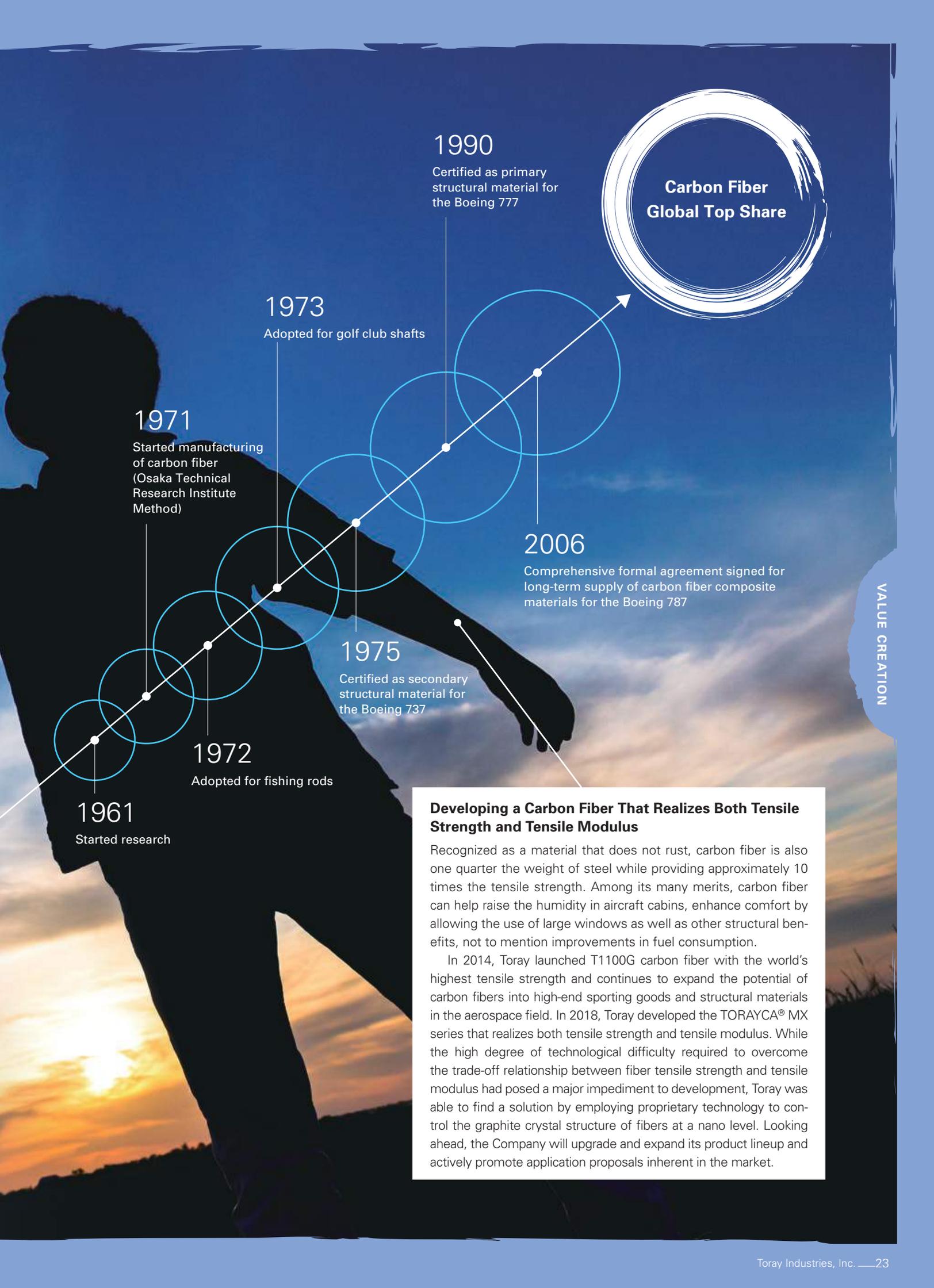
Marketing

and requested global manufacturers to step up their development of high-performance carbon fibers as well as CFRP. Against the backdrop of an increasingly competitive environment in the development of new technologies by each company, our product was certified as the world's first and only product which cleared the specification requirements put forward by The Boeing Company in 1990.

Our product has been recognized for its reliability as a material used in the manufacture of aircrafts, as well as for its stable supply and cost performance. Through a process of interactive technology exchange, Toray and The Boeing Company have continued to engage in the development of next-generation aircrafts, while nurturing strong ties of mutual trust. In 2003, both companies commenced the joint development of a CFRP for use in the next-generation medium-sized passenger aircraft the Boeing 787. After executing a fundamental agreement for the supply of materials in 2004, the companies concluded a long-term 16-year comprehensive supply contract in 2006. Spurred by the hope that carbon fiber would be adopted as a core material in the manufacture of all aircrafts, Toray has continued to engage in development. In a major step toward crystalizing visions of Toray Group and The Boeing Company, the Boeing 787, for the first time in the world, entered service across domestic flights in Japan in 2011. Over the ensuing period, the Boeing 787 operations have been expanded to service routes around the world.

Indicative of the widespread growth of the carbon fiber market, and our strong belief that materials have the power to bring about fundamental transformations in society, we are sharing visions with customers while providing broad solutions that help realize those visions as our inherent strength. As a result of these endeavors, we are expanding manufacturing markets in which materials play a leading role.





1990

Certified as primary structural material for the Boeing 777

1973

Adopted for golf club shafts

1971

Started manufacturing of carbon fiber (Osaka Technical Research Institute Method)

2006

Comprehensive formal agreement signed for long-term supply of carbon fiber composite materials for the Boeing 787

1975

Certified as secondary structural material for the Boeing 737

1972

Adopted for fishing rods

1961

Started research

VALUE CREATION

**Developing a Carbon Fiber That Realizes Both Tensile Strength and Tensile Modulus**

Recognized as a material that does not rust, carbon fiber is also one quarter the weight of steel while providing approximately 10 times the tensile strength. Among its many merits, carbon fiber can help raise the humidity in aircraft cabins, enhance comfort by allowing the use of large windows as well as other structural benefits, not to mention improvements in fuel consumption.

In 2014, Toray launched T1100G carbon fiber with the world's highest tensile strength and continues to expand the potential of carbon fibers into high-end sporting goods and structural materials in the aerospace field. In 2018, Toray developed the TORAYCA® MX series that realizes both tensile strength and tensile modulus. While the high degree of technological difficulty required to overcome the trade-off relationship between fiber tensile strength and tensile modulus had posed a major impediment to development, Toray was able to find a solution by employing proprietary technology to control the graphite crystal structure of fibers at a nano level. Looking ahead, the Company will upgrade and expand its product lineup and actively promote application proposals inherent in the market.