EU-Japan Centre
for Industrial Cooperation
日欧産業協力センター

THE JAPANESE COMPOSITE MATERIAL SECTOR

OPPORTUNITIES FOR EU COMPANIES

September 2016

Silke BROMANN

Table of Contents

Executive Summary

Because of the characteristics of composite materials – lightweight paired with a high degree of rigidity – and the demand for light weight and resource efficiency in nearly all industries, the market for composites has a high growth potential, especially in the Asia-Pacific region. Japan is not only home to large chemical companies that manufacture raw materials and composite materials, but also has a large market for composites in industries such as construction, aerospace or automobile manufacturing. As in all "high-tech" sectors, another typical characteristic is the high occurrence of inter-company R&D cooperation. For these reasons, Japan can be an interesting base for the composite materials business.

This report examines the market for plastic composites such as glass fibre-reinforced plastic (GFRP) or carbon fibre-reinforced plastic (CFRP). Following a short overview of the legal requirements (tariffs, import regulations, industry standards), it will discuss the market situation in Japan with a focus on application markets and future trends. In addition, recommendations will be given regarding distribution paths and business practices in Japan.

There are no further legal requirements regarding the import of most of the products dealt with in this report. In addition, only very few industrial standards apply to the materials themselves. However, they are subject to standardised testing methods. For some semi-finished and manufactured products made from composite materials such as water tanks or pipes, industrial standards have to be observed. Testing for compliance with Japanese industrial standards must be conducted by a third-party agency accredited by the government.

The main applications for composite materials are:

- Aerospace & defence
- Automotive
- Construction
- Wind energy
- Other sectors such as sporting goods, or electronics components

Industry experts estimate the global market volume of composites at 69.50 billion US$. [1] The worldwide production of composites in 2013 was about 8.5 million tons. Glass fibre-reinforced materials account for over 90% of production; the "high-tech material" CFRP has a share of less than 1% (global production in 2013: 64,000 tons). Other materials include aramid fibre-reinforced materials or materials using natural fibres. [2] The domestic production of fibre-reinforced plastic (FRP) in Japan amounted to 205,000 tons in 2015. [3] Manufacturers from Japan such as Toray Inc. are among the leading players in the field of carbon fibres and CFRP. The majority of domestic FRP production in Japan is destined for the construction sector, followed by automotive and other industries.

The aerospace, defence, automotive and wind energy sectors are regarded as further drivers of growth for the composite materials industry. If the issue of the high manufacturing cost of CFRP could be resolved, the use of this material in the mass production of automobiles could also be a growth factor. Another field of research is the use of natural fibres for reinforcement.

Compared to other regions, Japan is not a large-scale producer of aircraft and space technology. However, Japanese parts manufacturers supply OEMs such as Boeing or Airbus and are involved in joint development projects with overseas manufacturers. The production value of Japanese aerospace industry suppliers (including materials, parts

and attachments) amounted to 1,791.6 billion yen in fiscal year 2015 (approx. 15.6 billion euros[1]). [4] The domestic production value of aircrafts and engines for aircraft was 748.7 billion yen (2014 data, approx. 6.5 billion euros). [5] Turnover for space-related activities in the Japanese aerospace industry was 282 billion yen in 2013 (approx. 2.45 billion euros). [6]

The Japanese defence industry is the main supplier of the national Self Defence Forces (SDF). Since the ban on exporting defence equipment was lifted in 2014, Japan's arms manufacturers have been exploring new markets and seeking international cooperation. However, the industry is still not very export-oriented. [7]

Automobile and automotive parts manufacturing is one of Japan's leading export industries. Although the domestic market is showing signs of saturation, markets in emerging economies and in North America are expected to grow. In terms of models, global demand for small, basic cars is increasing. Japanese consumers tend to buy more compact vehicles, too. Due to regulations regarding fuel efficiency and emissions, weight is an issue. As a result, composite materials are increasingly replacing metals and other plastics.

Industry experts estimate investments in construction projects at 49,610 billion yen for fiscal year 2016. Some 46% of construction investments in 2014 were government-funded projects. The number of these public projects has risen recently due the economic policy to spur economic growth through government spending. [8] Urban development programmes in particular will contribute to this expected growth. As in the automotive industry, "smart cities" in which elements of the infrastructure are connected and communicate with each other, are at the focus of current R&D projects. [9]

Wind energy still plays a minor role in Japan; in 2014, a mere 0.5% of electric power supply came from wind turbines. [10] The installed wind power capacity at the end of 2015 in Japan was 3,038 megawatts. In the same year, 245 megawatts (8% of capacity) was newly installed in Japan. [11] Japanese manufacturers of wind turbines are catching up in their domestic market.

Possible distribution paths are either supplying directly to end product manufacturers or via general or specialised trading firms. Although Japanese corporate and public customers prefer Japanese suppliers, cooperation in R&D could open the door to the Japanese market in the field of composite materials. Therefore, a high level of experience and quality is a must.

Generally speaking, the Japanese business culture is rather long-term-oriented. It takes time for both sides to get to know each other and to build trust. For this reason, patience is very important.

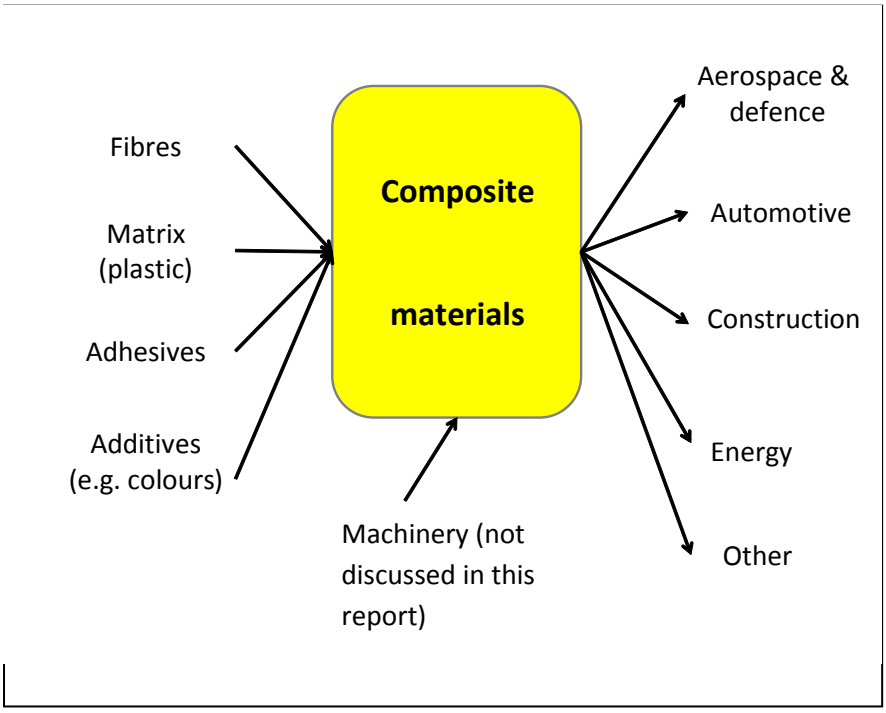
[1] Exchange rate 1 euro = 115 yen (September 2016)

Definitions, Scope of Coverage

This report examines the Japanese market for composite materials that use plastic raw materials such as carbon and glass fibre-reinforced composites. Materials such as concrete, ceramic or metal composites are not included in this report.

What is a composite? Put simply, it is a manufactured material that combines two or more different materials (phases). The earliest composite used by humans was a mixture of mud and straw used as building material. Another example is ferro-concrete – concrete reinforced with steel bars – which allows more stable buildings and structures that are not possible using concrete alone. The most common method for manufacturing reinforced composite materials is to embed fibres (e.g. the straw in the above-mentioned example) into a matrix made up of another material (e.g. mud). The first composite material using plastic polymer as a matrix was glass fibre-reinforced plastic, which came into use during the 1930s.

Figure 1: Material flows and applications covered in this report



Source: Author

Figure 1 shows the material flows and applications covered in this report. The market players covered by the yellow rectangle “Composite Materials” use the raw materials in the left hand column to manufacture parts and products used by the application industries in the right hand column. Most composite materials use adhesives to blend the matrix with the fibres. Additives provide further characteristics, for example, colours or greater UV resistance.

Regulations for Import and Sale in Japan

Generally speaking, the steps shown below apply when importing goods to Japan.

Figure 2: Procedure for importing goods to Japan

Prior consultation and research regarding import regulations

Preparation of necessary documents

Arrival of goods in Japan at designated customs area

- Customs procedure:
  - Import declaration
  - Payment of customs duty
  - Payment of consumption tax
  - Payment of taxes other than consumption tax, payment of customs handling charges (if applicable)
  - Issue of import permit by Japanese customs

Distribution in Japan

When the goods arrive in the designated customs area (Hozei area 保税地域), an import declaration has to be made. The import declaration must be submitted by the importer or another qualified institution, e.g. a customs agent. The following documents have to be submitted:

- Import declaration form
- Commercial invoice
- Bill of lading/air waybill
- Certificate of origin
- Certificate of origin for preferential origins (e.g. form A) (if applicable)
- Other certificates or licences required by laws other than Customs Law, e.g. Food Sanitation Law
- Insurance certificates, packing lists (if applicable)

Becoming an authorised economic operator (AEO) for the exporter or importer, as long as they have not commissioned a customs agent, could speed up customs procedures. The authorisation is issued by the local customs office in Japan.[2]

[2] Japan Customs provides more information on its homepage: http://www.customs.go.jp/english/aeo/.

Please refer to the MADB databases of the European Commission (http://madb.europa.eu/madb/indexPubli.htm) regarding requirements for specific products.

Legal Requirements at the Time of Import

There are no further legal requirements regarding the import of most of the products dealt with in this report. The following are exceptions:

In the case of **used or waste products that are imported into Japan**, **regulations on hazardous waste** apply: If hazardous waste is shipped to Japan for disposal or recovery, the goods must be accompanied by a notification of the transboundary movements of hazardous waste and the corresponding document for transboundary movements of hazardous waste. Both documents must be obtained by the exporter from the authorities in the exporting country. They include information that enables the Japanese authorities to assess whether these goods are permitted to be imported and further processed in Japan.

Legal Requirements at the Time of Sale

Japan has a system of standards and norms for manufactured goods and related testing procedures (Japan Industrial Standard, abbreviated JIS). While very few industrial standards apply to the materials themselves, there are standardised testing methods for the materials, e.g. testing for bending fatigue (JIS K 7082:1993) or exposure to natural weathering (JIS K 7081:1993) for carbon fibre-reinforced plastic. Industrial standards apply for some semi-finished and manufactured products made from composite materials, such as water tanks, pipes or other items used in construction. Items certified as complying with the JIS can be labelled with the JIS mark (see below).

Testing for compliance with JIS standards must be conducted by a third-party agency accredited by the government. Manufacturers are free in their choice of testing agency.[3]

Japan aims to harmonise its standards with international (ISO) standards. However, some Japanese industrial norms deviate from ISO ones. Japan uses ISO standards for some testing methods for FRP materials (e.g. ISO 30012:2016 specifies methods for measuring the size and aspect of crushed CFRP for recycling purposes), while other methods are subject to specific JIS norms. Therefore it is recommended to find out about the local standards that apply to your product.

For more information on Japanese industrial standards, see the materials on the relevant JIS and ISO standards provided by the Japan Standards Association on its website. These materials can be ordered online.

Labelling Requirements

Generally speaking, labelling must provide users of a product with accurate and understandable information regarding its characteristics and safe handling.

Labelling not only has the function of providing users or trading partners with information about the product's characteristics and handling. It is also a means of advertising. The **Act Against Unjustifiable Premiums and Misleading Representations** regulates the general information and advertising on the label.

In general, for most products, the label must provide the following information:[4]

[3] Accredited testing laboratories can be found on the website of the Japanese Industrial Standards Committee (https://www.jisc.go.jp/eng/jis-mark/designated.html).

- Product name
- Materials
- In case of imported products: country of origin
- Name and address of the manufacturer (in the case of imported goods: name and address of the importer)
- Advice on safe handling
- If applicable: warning notices, e.g. for electric devices
- If applicable: marks indicating conformity with Japanese standards [5]

In the case of imported goods, the country of origin must be stated. Instead of the name and address of the manufacturer, the name and address of the importer must be written on the label.

All labelling has to be in Japanese.

The JIS mark (Figure 3) that certifies compliance with Japanese industrial standards is voluntary. However, as most mandatory standards are based on the JIS standards (e.g. for testing procedures), it is strongly advised to undergo testing for these standards. For information on Japanese industrial standards, please refer to the Japanese Industrial Standards Committee.

Figure 3: JIS mark

Source: Japanese Industrial Standards Committee

The **BL label** is a voluntary label for **construction items** such as bathroom units or doors. It is awarded by the Center for Better Living and shows that these items meet a high level of quality and performance. Materials bearing this label are covered by warranty and indemnity insurance. [12]

The **Eco mark** is another voluntary label that attests to the environmental friendliness of a product. For example, plastic products are eligible to carry this label if they contain a high percentage of recycled material. It is supervised by the Japan Environment Association.[5]

According to the **Act on the Promotion of Effective Utilisation of Resources**, Japan has a differentiated system of waste separation. Therefore the **packaging material of the products** must be marked with labels indicating what materials they consist of.

[4] The Consumer Affairs Agency and the Manufactured Imports and Investment Promotion Organisation (MIPRO) provide general information on labelling requirements.

[5] For recycling FRP products, see chapter “Market Analysis”.

Tariffs and Taxes

Tariffs

Table 1 shows some examples of tariffs for different raw materials and products. For the tariffs for individual products, please refer to the respective databases of the European Commission (*http://madb.europa.eu/madb/indexPubli.htm*) or Japanese customs (*http://www.customs.go.jp/english/tariff/2016_6/index.htm*). Japan uses the Harmonized Commodity Description and Coding System.

Table 1: Tariffs for composite materials and products thereof (examples)

HS code	Description	General tariff rate	WTO[6]
6815	Carbon fibre, articles made of carbon fibre such as woven fabrics	free	free
7019	Glass fibre, articles made of glass fibre such as glass wool, woven fabrics	free	free
3922	Bathtubs, washbasins, toilet seats etc. made of plastic	5.8%	4.8%
3925	Reservoirs, tanks, vats and similar containers, of a capacity exceeding 300 l	5.8%	3.9%

The table shows the tariff rates that apply to each HS code, depending on the type of product. For details, please refer to the respective databases.

Source: Japan Customs

Consumption Tax

When importing products, Japanese consumption tax has to be paid. In June 2016, the sales tax was 8%. A sales tax rise to 10% has been postponed until October 2019.

Market Analysis

Products and Applications Covered by this Analysis

Composite materials incorporate the advantages of their individual components. For example, fibre-reinforced plastics (FRP) are more robust than non-reinforced materials. FRP components are as stable as metal materials, but much lighter than metal and more robust than aluminium. This characteristic makes them attractive for manufacturing aircraft and automobiles. They are also less corrodible than metals.

To maximise the components' strengths and at the same time minimise their specific weaknesses, adequate material design and production methods are crucial (e.g. long fibres vs. short fibres, unidirectional layout of the fibres vs. multidirectional layout, thermoset matrix vs. thermoplastic matrix).

[6] Tariff rate for WTO members applies to exports from the EU.

One drawback, especially in the case of carbon fibre-reinforced plastic (CFRP), is the high cost. Both material and production costs are higher than for comparable metal components. In addition, these materials are difficult and costly to recycle, as they are a compound of several raw materials.

The most common reinforced plastics are:

- Glass fibre-reinforced plastic (GFRP), used e.g. for cover panels, vehicle body panels, bathtubs, tanks, bath-room units
- Carbon fibre-reinforced plastic (CFRP): used e.g. for parts of automobiles or aircrafts, sporting goods such as fishing rods, golf clubs or bicycle frames
- Aramid fibre-reinforced plastic, used e.g. for body armour, construction materials, jet engine casings
- Reinforced plastic materials using other materials (wood, cotton and other plant fibres), used e.g. in auto-mobile parts or construction materials

Semi-finished and manufactured products made from composite materials are used, among others, for the following applications:

- Aerospace & defence: e.g. structural parts of aircraft, bulletproof gear
- Automotive: e.g. automobile body parts, gas tanks
- Construction: e.g. panels, tanks, bathtubs, bath/kitchen units
- Energy: battery/fuel cell parts, wind generator blades
- Others: sports/leisure (fishing rods, bicycle frames), parts for electronic devices and machinery

Another (marginal) application is everyday goods and decorative items made of CFRP, such as mobile phone cases, furniture or ball pens.

Market Size, Trends and Profitability

By Product

Global and Domestic Production of FRP

The global production of composites in 2013 was about 8.5 million tons. Glass fibre-reinforced materials accounted for over 90% of production, while the more “high-tech” material CFRP had a share of less than 1% (global production in 2013: 64,000 tons). Other materials include aramid fibre-reinforced materials or materials using natural fibres. [2]

The largest producer and consumer of GFRP is currently China. The Asia-Pacific and North America regions occupy two-thirds of the global GFRP market. Wind energy and aerospace are the growth drivers in this segment due to rising demand in emerging economies. [13]

Global demand for CFRP in 2014 was 83,000 tons (corresponding to a growth rate of 15% compared to 2013), while worldwide sales amounted to 10.6 billion US$. [14] Experts project the market volume in 2020 at 152,600 tons and global turnover at 35.75 billion US$. [15]

Demand for carbon composite materials is distributed regionally as follows: North America: 38%, Europe 35%, Asia-Pacific 23%. [14] The share of Asia-Pacific is expected to grow further not only due to the increased efforts of China and India in aircraft manufacturing, but also the growing automotive industry in these two economies. [16]

The domestic production of FRP in Japan in 2015 was 205,000 tons [3], corresponding to 2.6% of global production.[7] Imported FRP materials accounted for a share of 12.1%. [3] Industry association and public data did not differentiate further between product categories. However, we assume that the share of FRP materials used for different applications (over 70% in construction and for different kinds of tanks, mainly made from GFRP, see following chapter) reflects the global situation (GFRP over 90%, CFRP approx. 1%).

Domestic production of FRP in 2015 was down by 3.3% compared with the previous year. Glass fibre-reinforced plastic accounts for the majority of production. This is used mainly in construction and manufacturing transport equipment. The construction sector in particular is highly dependent on the general economic situation. China and other emerging economies are gaining market share globally. However, some growth is recorded in materials for the automotive sector.

Trends

As FRP is a chemical product, there are concerns regarding its environmental impact. Because it is a compound of several components, the recycling process for these materials is complex. However, ongoing R&D efforts are aimed at achieving more effective recycling processes. Industry initiatives are looking at recycling fibre-reinforced plastic materials. The Japan Reinforced Plastics Society promotes the recycling of glass fibre-reinforced plastic items used, e.g. in construction. After recycling, one possibility is to use them in the production of cement. [17] There are several methods for recycling carbon fibre-reinforced plastic. Public entities such as the Japanese New Energy and Industrial Technology Development Organisation (NEDO) and private companies are conducting research in this field. [18] FRP made with natural fibres is used in automobile manufacturing, construction and everyday goods. However, due to the high requirements regarding robustness and durability, they are of limited use in the fields of aerospace and wind energy.

Similar to other high-tech components, composites are often manufactured according to customers' specifications (e.g. manufacturers of aircraft or automobiles). Users, parts suppliers and research institutes work together to develop new materials and applications. For example, the German Fraunhofer Institute for Chemical Technology and the plastics business unit of Sumitomo Bakelite Co. Ltd. from Japan are cooperating to develop automobile engine parts made of FRP. [19]

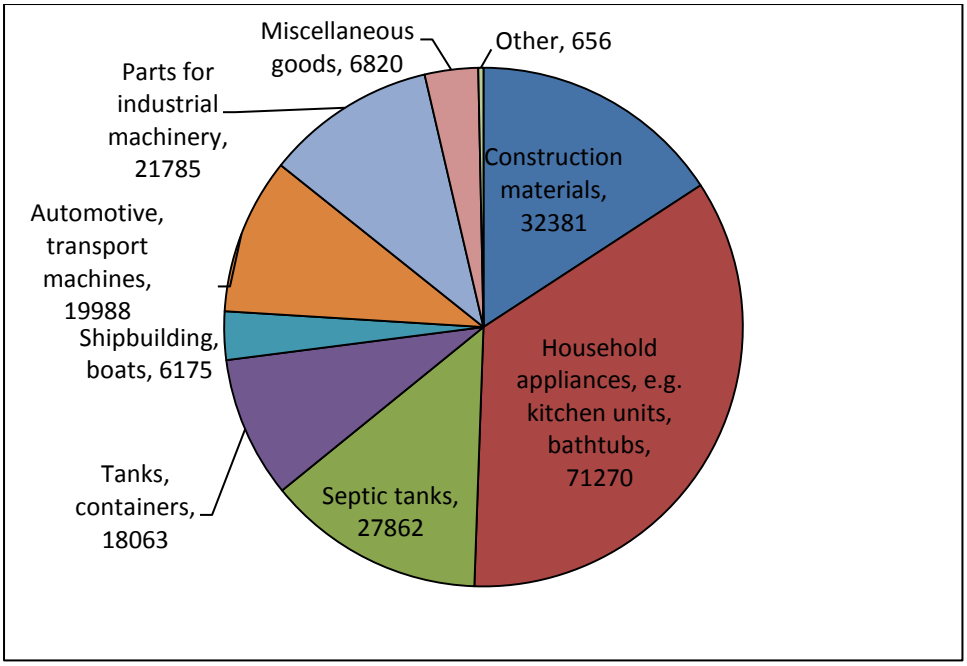
The Japanese FRP industry is concerned that transferring production abroad could result in a decline in domestic production capacities. Other current issues include waste management and cooperation in R&D between public and private entities. [20]

As a recent trend, Japanese chemical companies have started to enhance their international competitiveness and are expanding to international markets through exports as well as overseas investments and international alliances. [21] This is also true for manufacturers of FRP products and raw materials. This is one reason why domestic production of FRP materials is declining.

[7] 2013 data.

By Application

Figure 4: Composites in Japan: Share of domestic production by application (in tons, 2015 data)



Source: Japan Reinforced Plastics Society (2016): Heisei 26, 27 (2014, 15)-nen FRP yōtobetsu, seikeihōbetsu tōkei (FRP statistics 2014, 2015, by application and manufacturing method), Tokyo: Japan Reinforced Plastics Society.

Figure 4 shows the different applications for FRP made by Japanese manufacturers. More than half of production is used in construction, 22% is used in different kinds of tanks, which are mostly made of GFRP. About ten percent is used in automotive or general machinery manufacturing. Miscellaneous goods include everyday goods such as furniture, household boxes or dishes. [3]

Aerospace & defence account for 31% of the global production of carbon composites. The automotive industry has a 21% share, and wind energy (i.e. wind turbines) a 12% share. Sports and leisure applications, such as golf clubs or racing bicycles, also make up 12% of worldwide CFRP production. Civil engineering (i.e. construction) has a 5% share. [14]

Due to different requirements regarding quality and production methods, CFRP industry turnover differs very much according to the area of application. Aerospace and defence account for about 30% of the production volume, but 62% of turnover (global data). Both sectors not only have extremely high technology and quality standards, but also high requirements regarding vetting processes and material control. In the other segments, the share of turnover is smaller than the share of production volume. [14]

In a report published by Carbon Composites e.V. and AVK, experts predict that the automotive and wind energy sectors will drive the market in future. They expect demand in the automotive sector to overtake aerospace & defence by around 2020. [14] According to Japanese industry experts, the carbon fibre market will grow by 16% on average per year worldwide between 2011 and 2020, aerospace & defence by 12% and wind energy by 7%. [22]

Aerospace & Defence

The production value of Japanese aerospace industry suppliers (including materials, parts and attachments) amounted to 1,791.6 billion yen in fiscal year 2015 (approx. 15.6 billion euros). [4] The domestic production value of aircrafts and engines for aircraft was 748.7 billion yen (2014 data, approx. 6.5 billion euros). [5] The Japanese aerospace industry generated a turnover from space-related activities of 282 billion yen in 2013 (approx. 2.45 billion euros), corresponding to a 16.5% share of the industry's overall turnover. [6] Compared to other regions, Japan is not a large-scale producer of aircraft and space technology. However, Japanese parts manufacturers supply OEMs such as Boeing or Airbus and are involved in joint development projects with overseas manufacturers.

After the start of licensed production of military aircraft in the post-war period, aircraft production for civilian use nowadays accounts for two-thirds of production. [6] The Mitsubishi Regional Jet for short and medium-range distances is the first generic Japanese civilian aircraft to have been produced since the 1960s; first deliveries to customers are scheduled for 2018. Japan is a net importer of aerospace equipment. Recently, exports have risen. The share of exports in the aircraft sector was 48% in 2013. Exported goods are mainly airframe and engine parts. [6]

Japanese aerospace suppliers are particularly strong in the field of carbon fibre composites. The use of composites in aircraft manufacturing has risen steadily. For example, the Boeing 787 consists of 50% composite materials. The main parts of the fuselage and the wings are made of carbon laminate materials, and the engine casings of carbon sandwich materials. Fiberglass is used for parts of the wings. [23] Toray Inc. has a near-monopoly position with Boeing in the supply of carbon fibres and carbon fibre composites. For the Boeing 787 and the new 777X models, the two companies have signed supplier contracts worth over 1,700 billion yen. [4] Teijin Ltd. supplies CFRP for aircraft fuselage and other parts to Airbus. [24]

In terms of volume, glass fibre composites account for nearly 90% of the global market for composites used in the aerospace & defence sector. [25] The use of composite materials in this sector is expected to grow further due to demand for lightweight and fuel-efficient materials. China and India are seen as future markets as both countries are putting efforts into developing their aerospace industry. Growth in demand for aircraft is also expected to be driven by low-cost carrier airlines, especially in the Asia-Pacific region. Japan's carbon fibre manufacturers, which are among the leading suppliers worldwide, are following the trend. For example, Toray Inc., one of the leading international carbon fibre manufacturers, is investing around 450 million US$ to increase its production capacity, not only in Japan but also in the U.S., France and South Korea. [25]

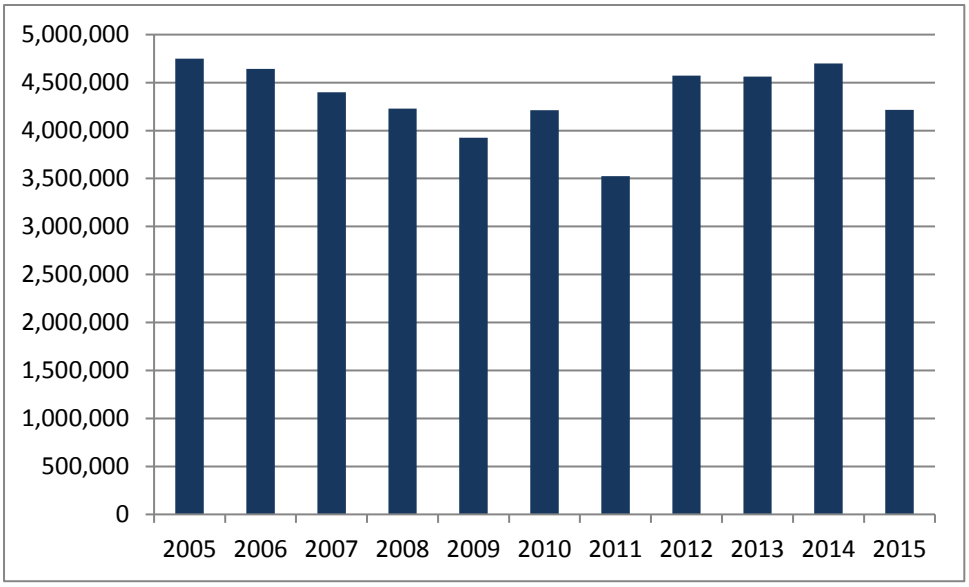
Automotive

Nearly 90 million new vehicles (passenger cars and commercial cars) were sold worldwide in 2015. [26] Production has therefore continued to grow since the global economic crisis in 2009. However, according to industry experts, it will become "slower, not lower". [27] China, Asia-Pacific and North America are seen as growth drivers. [27] Demand for small and basic cars will rise not only in the emerging economies but also in North America, Europe and Japan. Consumers in these regions are shifting their preferences to environmentally friendly and sustainable vehicles. [28] Global disparities in market trends require automobile manufacturers to adapt their strategy accordingly. [29]

Passenger car sales in Japan since 2005 reflect the trends in the overall economy: In 2008, the "Lehman shock" caused a slump in demand (see **Error! Reference source not found.**). The decline in 2011, on the other hand, was caused by difficulties on the supply side due to natural disasters in East Japan and Thailand and their consequences for the supply chain. Despite a further boost in 2013 and 2014, domestic car sales are expected to decline in future

years. High demand in 2012, 2013 and 2014 was driven by subsidies for designated environmentally friendly vehicles ("ecocar")[8]. On the other hand, the market is saturated and younger people are less likely to own a car.

Figure 5: Domestic sales of passenger cars in Japan, 2005–2015, in units



Source: Japan Automobile Manufacturers Association (2016): Yonrinsha shinsha hanbai daisuu (Sales of new four-wheel vehicle units), Internet: http://www.jama.or.jp/industry/four_wheeled/four_wheeled_2t1.html, accessed September 14, 2016, author's own arrangement

Kei cars ("*kei* jidosha", "light vehicles") are peculiar to the Japanese automobile market. Vehicles with a cubic capacity of no more than 660 cm^3, an overall length of 3.40 m or less and a width of 1.48 m or less qualify as "*kei* jidosha" according to the Road Transport Vehicle Law. Their tax levy is less than for ordinary passenger cars and they have a yellow number plate. As the "*kei*" category is specific to the Japanese market, this segment is dominated by domestic products. Their market share has increased steadily in recent years: In 2015, it was 36%. [30]

Japan's automobile manufacturers are very active in designing and promoting hybrid or fully electric passenger cars. Hybrid power (gasoline engine and battery-driven engine combined) automobiles are enjoying increasing popularity in Japan. Over 20% of newly registered cars in Japan are hybrid automobiles. Fuel cell technology is still quite new on the market: Toyota launched its first fuel cell passenger car model in November 2014. However, e-mobility is a trend that automotive suppliers worldwide should not neglect. Japan's automobile manufacturers are among the leading players in this field.

Environmental concerns are important when it comes to designing and manufacturing automobiles. Governments are issuing an increasing number of fuel efficiency and carbon emission regulations. One example is the Corporate Average Fuel Economy (CAFE) standards in the United States. To reduce emissions, alternative powertrain technologies such as electric motors or fuel cells are employed. Another solution is better fuel efficiency. Besides new engine technologies, another way to improve efficiency is "lightweighting" vehicles and components. This also saves on

[8] "Ecocars" are not necessarily hybrid or electric vehicles. Fuel efficiency also qualifies for classification as an "ecocar". Further information can be obtained from the Ministry of Land, Infrastructure, Transport and Tourism or the Japan Automobile Manufacturers Association.

material and thus costs. The use of plastics in an average car is expected to increase from about 200 kg in 2014 to nearly 350 kg in 2020. The use of CFRP is estimated to double in this period. [31]

All composite plastics materials discussed in this report are used in the automotive sector. GFRP and NFRP are used in interior parts such as the backs of car seats or door linings. Bio-plastics (biodegradable plastic and plastics using renewable resources as raw materials, such as cellulose or vegetable fats) are becoming increasingly common. For example, Toyota Motors has used 80% bio-plastic for the interiors of one of its hybrid vehicles since 2011. [32]

CFRP is used for body and interior parts. Another example of the use of CFRP in automotive is hydrogen tanks for fuel cell cars or gas tanks for gas-fuelled cars. However, the advantage of lighter weight and the resulting resource and fuel efficiency (automotive, aerospace) is offset by the high cost of materials and production. A component made of CFRP is up to nine times more expensive than one made of steel. [33] These high manufacturing costs stand in the way of using CFRP in the mass production of automobiles. So far, CFRP materials are applied only in sports and luxury cars. [31] Current research aims to reduce material and production costs, e.g. by using recycled raw materials or optimising the production process. [33]

Construction

GFRP and increasingly NFRP are the most common composite materials uses in construction. Due to environmental awareness and regulations regarding the recycling of construction materials, NFRP is used more often, for example in window or door frames. [34] The use of CFRP in construction is also expected to increase. One application of CFRP in construction is attaching CFRP sheets to concrete structures to provide them with more stability in case of earthquakes. Current research efforts are aimed at examining the use of carbon fibres as reinforcement for concrete. [35]

Industry experts value investments in construction projects at 49,610 billion yen (approx. 431.4 billion euros) for the fiscal year 2016. After investments were up in the aftermath of the East Japan Earthquake, they have decreased recently. However, construction companies expect an increase in orders and sales in the coming years due to infrastructure investments by the government. Especially urban development programmes will contribute to this growth. As in the automotive sector, “smart cities” in which elements of the infrastructure are connected and communicate with each other, are at the focus of current R&D projects. The 2020 Tokyo Olympic and Paralympic Games will spur further construction activities. [9]

Table 2: Investments in construction projects, in billion yen

Fiscal year	2011	2012	2013	2014	2015	2016
Investments in construction projects	43,292	45,291	51,290	51,300	50,010 (estimate)	49,610 (estimate)

Sources: Japan Federation of Construction Contractors (2015): Kensetsugyō handobukku (Handbook of the construction sector), Internet: http://www.nikkenren.com/publication/pdf/handbook/2015/2015_01.pdf; Research Institute of Construction and Economy (2016): Kensetsu tōshi no mitooshi (Outlook on construction investments), April 2016, Internet: http://www.rice.or.jp/regular_report/pdf/forecast/Model201604-2.pdf

Some 46% of construction investments in 2014 were government-funded projects. The share of such public projects has risen recently thanks to the economic policy to spur economic growth through government spending. [8] Private housing accounts for nearly 30% of construction investments. After a brief “boom” prior to the rise in sales tax in 2014, investments declined. [9]

Wind Energy

Wind energy still plays a minor role in Japan; in 2014, a mere 0.5% of electric power supply came from wind turbines. [10] Before the accident at Fukushima-Daiichi nuclear power station, about one-third of the electricity supply came from nuclear power stations. After nearly all of these were shut down, 87.7% of electricity generation came from fossil fuels (coal, oil, gas; 2014 data). [36]

The installed wind power capacity in Japan at the end of 2015 was 3,038 megawatts. The largest markets for wind energy are China, the United States and Germany. In 2015, 245 megawatts (8% of capacity) was newly installed in Japan. [11] The vision of the Japan Wind Power Association is to supply 20% of electric power by 2050. [37] However, the Japanese government is more conservative in its forecast and has set a target of a 1.7% share of wind energy for 2030. [38] Since 2012, the government has guaranteed a feed-in tariff for wind and solar power. However, 93% of the capacity approved since then has been for solar energy plants. The major hurdle for investments is the approval procedure for wind energy plants, which can take up to five years. [10] As Japan's landscape is characterised by steep hills and a high building density, new developments are mainly offshore sites.

The main composite material used in wind turbines is glass fibre for the blades. Carbon fibre is used for the structural parts of the blades. At the moment, the high cost of production prevents it being used in other areas. However, turbine makers aim to replace more GFRP blade parts with CFRP because of its lighter weight and higher stability. Experts from Nikkei Inc. expect global demand for carbon fibres for wind turbines in 2020 to be 26,000 tons, the same as in the automotive sector. [22]

Main Players: Competitors, Customers, Suppliers

Competitors

The Census of Manufacture lists more than 1,300 manufacturers of reinforced plastic products.

Manufacturers of composite materials or parts made of composite materials are often large chemical or glass-related companies such as Toray Inc. or Toho Tenax Co. Ltd. (Teijin Ltd.) in the field of carbon fibre materials, and Nittobo or Asahi Glass Corp. (AGC Matex Co. Ltd.) for GFRP. They provide the raw materials (fibres), prepregs or specific parts, e.g. for the aerospace or automotive industries. The three leading Japanese CFRP suppliers Toray Inc., Tejin Ltd. and Mitsubishi Chemical Holdings hold a global market share of more than 50%. [39]

The majority of manufacturers, however, are SMEs with fewer than 300 employees. They mainly work in the field of construction materials and as components suppliers for several industries. However, more companies manufacturing FRP materials and components are listed in other categories of the census, e.g. manufacturers of automotive parts or of construction materials. [5]

As the markets for some plastic components in Japan are saturated and competition from neighbouring Asian countries is rising in the "traditional" plastic processing fields, SMEs are exploring new fields of business, for example developing components of reinforced plastic with natural fibres. Such projects are supported by local industry associations and business promotion agencies. [40] [41]

The largest Japanese composite materials manufacturers Toray Inc., Teijin Ltd. (Toho Tenax Co. Ltd.) and Mitsubishi Chemical Holdings are expanding into the automotive sector by supplying CFRP and GFRP (Mitsubishi Chemical Hold-

ings) to automotive manufacturers. All three companies are also expanding their production capacities to North America and Europe to supply to local OEMs such as Daimler or BMW. [39]

Suppliers

Large chemical companies supply raw materials or semi-finished products such as pre-impregnated fibres (prepregs).

In 2014, Japanese carbon fibre manufacturers produced 27,000 tons of carbon fibres domestically, amounting to 94.4 billion yen (821 million euros). [5] Domestic production shows an upward trend; however, Japanese manufacturers are also expanding their capacities overseas to cater to local markets. Japan is a net exporter of carbon fibre. In 2015, carbon fibre and carbon fibre products worth 90.7 billion yen were exported. The most important export markets are the United States and China. Exports have risen year-on-year by 16.6%. Imports amounted to 24.5 billion yen in 2015, and half of the imported materials came from the United States. [42] Japan accounts for 20% of global carbon fibre production, but the share of manufacturers from China and Taiwan is rising. [14]

The Census of Manufacture lists 19 manufacturers of carbon fibres in Japan. [5] These are mainly large chemical companies or subsidiaries of large chemical companies. Japanese chemical companies are among the world's leading manufacturers of carbon fibres. The following five firms together have a 63% share of global production of carbon fibre: SGL (Germany), Toray Inc. (Japan), Toho Tenax (Japan), Cytek (USA) and Hexcel (USA). [14] In 2014, Toray acquired the American manufacturer Zoltek, making it the largest manufacturer of carbon fibre by far with an estimated production capacity of 44,000 tons. [14]

Due to different requirements regarding quality and production methods, turnover in the carbon fibre sector varies according to the area of application. Aerospace and defence account for nearly 30% of the global production volume, and for nearly half of the turnover. Both sectors not only have extremely high technology and quality standards, but also high requirements regarding vetting processes and material control. In other segments, the share of turnover is smaller than the share of production volume. [14]

Domestic production of glass fibres and glass fibre products in 2014 was at 224.4 billion yen (approx. 1.95 billion euros). Production has risen again following the shock after the East Japan earthquake disaster in 2011. Glass wool accounts for 42% of the production volume, while rovings, woven materials etc. make up the other 58%. [5] Imports of glass fibre and glass fibre materials stood at 40.75 billion yen, while exports were valued at 43.66 billion yen; glass fibre products are mainly manufactured for the domestic market. [42]

According to industry statistics, there were 138 manufacturers of glass fibres and glass fibre products in Japan in 2014. [5] Six large suppliers of glass fibres and glass fibre materials have formed the industry association Glass Fibre Association of Japan. Among them are two international suppliers (Owens Corning Corp. and Isover St. Gobain). [43]

Customers

Aerospace & Defence

Thirteen manufacturers of aircrafts have operations in Japan. [5] They include Mitsubishi and Honda in the field of regional short- and mid-range passenger jets. Other manufacturers such as Kawasaki Heavy Industries or IHI Aerospace supply helicopters and jets for the Japanese armed forces or space development technology. Around 650 businesses manufacture aircraft parts and accessories such as engines or interior parts. [5] The Japanese aerospace

industry has an excellent reputation as a high-level supplier to international manufacturers such as Boeing or Airbus. The Japanese aerospace industry is located in Tokyo and Chūbu (the region around Nagoya city in Central Japan). [44]

Japan's defence industry is the main supplier of the national Self Defence Forces (SDF). De jure, the Japanese constitution does not allow the country to have armed forces and to engage in war. De facto, however, the SDF were established in the 1950s and have been engaged in UN operations overseas since the 1990s. The SDF employ about 230,000 soldiers in various branches of service. [45] In 2015, the budget for the procurement of military equipment was 740.4 billion yen (approx. 6.4 billion euros). [45] Equipment used by the SDF Japan's armed forces is state-of-the-art. The industry is still not very export-oriented, even though the ban on exporting defence equipment was lifted in 2014. As a consequence, Japan's arms manufacturers are exploring new markets and are seeking international cooperation. [7]

Automotive

According to the 2014 Census of Manufacture, there are about 7,400 manufacturers[9] of automobiles and automotive parts in Japan. The census lists 84 of them as manufacturers of motor vehicles. [5] Nearly all (97%) of Japan's automotive companies are small and medium-sized enterprises (SMEs) with less than 500 employees. Due to the high level of division of labour in the production process in Japan, there are many smaller companies in the automotive and related industries: Nearly three quarters of them have fewer than 50 employees.

One peculiarity of the Japanese automotive market is the *keiretsu*. These are groups of companies organised around an OEM. The four largest tier-one parts suppliers in the Japanese market in terms of sales are part of the Toyota *keiretsu*. In the same way, other large manufacturers are linked to large system suppliers, for example Nissan to Calsonic Kansei Corp. or Honda Motor Co. to TS Tech Co., Ltd. It is important to note that nowadays, these *keiretsu* companies no longer deal exclusively with the OEM they are connected to. In addition, there are a large number of independent automotive suppliers that are mostly specialised in one field. Prominent examples are Yazaki (wiring) or Takata (air bags). Large overseas suppliers such as Robert Bosch GmbH are present in Japan and have already established business with Japanese OEMs.

Vice versa, Japanese parts suppliers often follow their OEM customers to overseas locations. Japanese automotive companies also undertake international mergers and acquisitions to enter foreign markets.

Construction

Over half a million businesses are registered in the field of construction. However, the greatest market share and the implementation of large-scale construction projects are in the hands of so-called "general contractor" construction companies. These "zenecon" companies are responsible for the planning and realisation – and sometimes also for the running (facility management etc.) – of large-scale projects such as office buildings or highways. The "big five" general contractors are Obayashi Corp., Kajima Corp., Sekisui House, Taisei Corp. and Takenaka Corp. [46] These top-level businesses are followed by locally active construction companies specialised, for example, in heating, ventilation and air conditioning (HVAC), electrical installations, port or railway construction. Many medium-sized and smaller businesses work on large-scale projects as subcontractors for bigger companies. [9]

[9] There are, however, more suppliers in this field, listed in other categories of the census.

Wind Energy

The generation and supply of electric power has so far been provided by ten large suppliers; the market is divided locally between these companies. Their sales amounted to 18.16 trillion yen (158 billion euros) in fiscal year 2014. [47] Apart from the ten largest suppliers, there are smaller operators of electrical power plants that supply either the ten large companies or commercial customers. [48] These smaller operators also develop and operate wind energy facilities. The two largest developers of wind parks in Japan are J-Power Electric Power Development Co. and Eurus Energy Corp.; the latter is a joint venture between Toyota Tsusho Corp. and Tokyo Electric Power Company (TEPCO). The liberalisation of electricity supply to private households in 2016 will pose a challenge to electricity companies. They are already forming alliances with each other and with potential retailers.[10] [36]

Japanese manufacturers of wind turbines are catching up in their domestic market, which has so far been dominated by overseas manufacturers, led by Vestas and GE Wind. In 2014, Mitsubishi Heavy Industries formed a joint venture with Vestas, which specialises in offshore projects. [49] [50]

Key Success Factors, Main Challenges, Opportunities

Success factors

A track record of supplying other leading manufacturers in the industry is regarded as a sign of high quality and reliability, particularly in the aerospace and automotive sectors.

Especially considering the traditionally close-knit networks in the automotive supply chain, maintaining contact and nurturing the relationship with Japanese customers and distribution partners can overcome the disadvantage of not being “made in Japan”.

As high-tech products require a high degree of explanation, information material written in Japanese will help engineers and procurement staff at the Japanese firm to learn about your product’s specifications and advantages.

Business in Japan should be given top-management support. This will accelerate internal processes in case of requests and problems. Top managers should meet their Japanese counterparts regularly to cultivate the relationship.

Challenges

As the leading manufacturers of CFRP come from Japan, competition on their home market could be tough.

The Japanese economy has suffered a long-lasting period of economic stagnation. The effects of the “Abenomics” economic stimuli on relevant industries such as construction and the domestic automobile market are still unclear.

Japanese manufacturers prefer long-standing business relations with established partners; especially the construction, the automotive and the aerospace sector are characterised by close-knit supplier networks.

To qualify as a supplier in the automotive and aerospace industries, prospective suppliers have to undergo a thorough vetting process. Prepare yourself for repeated and detailed requests. On-site visits are not uncommon.

[10] For more information on the market for renewable energies in Japan, please refer to the sector report “Renewable Energies in Japan” by Philippe Huysveld on the eubusinessinjapan platform: http://eubusinessinjapan.eu/library/publication/report-renewable-energies-japan.

As a general rule, EU companies should have a keen eye on their Japanese competitors. Japanese manufacturers are very active in monitoring their rivals.

Opportunities

Wind energy and aerospace are industries with high growth potential in Japan.

The Olympic and Paralympic Games in Tokyo 2020 should provide impetus for growth in the construction and sports equipment sectors.

There are good business opportunities in Japan for players who can provide solutions for production process optimisation and recycling.

As the leading composite materials manufacturers from Japan are expanding into Europe through greenfield investments and M&A, opportunities for cooperation may arise for EU companies on their home ground.

Cooperation in R&D could be an opportunity for EU companies to enter the market. The supply chain for composite components is characterised by close cooperation between users and suppliers in the development of new materials and applications.

Distribution Channels

The distribution structure varies depending on the industry. The Japanese automotive industry is characterised by a high degree of differentiation. Networks of suppliers called *keiretsu* are grouped around one OEM, or in pyramids with one manufacturer at the top. However, these "pyramids" are not totally isolated from one another. Historically, until the 1990s, they were separated more rigorously and smaller suppliers tended to be dependent on one large customer. Especially at the lower levels, suppliers are now increasingly catering to more than one customer. Similarly, Japanese first-level suppliers no longer only sell to manufacturers from their own group. Indeed, firms such as Denso or Aisin have become worldwide leading component manufacturers.[11]

There is also a high level of cooperation in the aerospace and wind energy sectors. As in the automotive industry, they have a comprehensive and strict vetting process to ensure a high level of product safety and quality.

To enter the market, trading firms could act as a go-between. It is advisable to cooperate either with a Japanese trading company or with an international trading firm with long-standing experience in Japan. A general trading company could be a good choice because of its international experience and network of liaison offices in Europe. Trading companies are even investing in the field of composite materials themselves: Mitsui & Co.Ltd., one of the largest Japanese general trading companies, has signed a cooperation and equipment lease agreement with the Kanazawa Institute of Technology. They conduct joint research in the field of automotive composite materials. [51]

Traditionally, large Japanese industry groups and automotive OEMs have a (general) trading branch, for example Mitsubishi Corp., Honda Trading or Toyota Tsusho Corp. These companies are not only engaged in trade but also in the development of new businesses. Especially in the field of new materials, they could act as a door-opener to business with Japanese manufacturers.

[11] For more information about the Japanese automotive industry and business opportunities for EU companies, please refer to the report "Exporting Automotive Parts to Japan" by Silke Bromann on the eubusinessinjapan.eu platform: http://eubusinessinjapan.eu/library/publication/report-exporting-automotive-parts-to-japan.

On the other hand, a smaller, specialised trading firm has the advantage of having more detailed knowledge of the market sector and contacts in the respective industry.

A liaison office in Japan can be useful to maintain ongoing contact with local business partners. Furthermore, the representative office can be used for market research purposes.

Importers & Related Organisations, Important Trade Fairs

Industry Associations

Industry associations coordinate and facilitate communication between companies in the respective industry and with government agencies and the general public. They cooperate with the government and the Japan Standards Committee in developing regulations and industry standards. Many offer training courses for workers as well as management seminars and consulting services. Larger industry associations, for example in the automotive industry, also have overseas offices and are involved in international industry associations.

Membership in such associations is voluntary. Some overseas industry players with subsidiaries in Japan are members. It could be useful for EU companies setting up business in Japan to join an association as a means to gathering more information on the market in general and on the players and local trends in the industry.

Industry associations in the customers' industries can also be a source of useful information regarding market trends and customers' needs. They are present at the relevant trade fairs (see below) or even involved in the organisation.

The Japan Reinforced Plastics Society (JRPS)	Business Place Sotokanda, 3F 6-2-8 Sotokanda, Chiyoda-ku, Tokyo 101-0021, Japan Tel: +81-(0)3-5812-3370 E-mail: hdqtr@jrps.or.jp http://www.jrps.or.jp/index_en.html
The Japan Plastics Industry Federation (JPIF)	Aroma Bldg. 3-5-2 Nihonbashi-Kayabacho, Chuo-ku, Tokyo 103-0025, Japan Tel: +81-(0)3-6661-6811 http://www.jpif.gr.jp/english/index.html
Japan Chemical Industry Association (JCIA)	Sumitomo Rokko Bldg.1-4-1 Shinkawa, Chuo-ku, Tokyo 104-0033, Japan Tel: +81-(0)3-3297-2576 https://www.nikkakyo.org/
The Japan Chemical Fibres Association (JCFA)	Seni Kaikan 3-1-11 Nihombashi-Honcho, Chuo-ku, Tokyo 103-0023, Japan Tel: +81-(0)3-3241-2311 http://www.jcfa.gr.jp/english/index_e.html http://www.carbonfiber.gr.jp/english/index.html

Japan Glass Fibre Association	Japan Glass Industry Centre Bldg. 3-21-16 Hyakunin-cho, Shinjuku-ku, Tokyo 169-0073, Japan Tel: +81-(0)3-5937-5763 E-mail: mail-gfa@glass-fiber.net http://www.glass-fiber.net/
The Society of Japanese Aerospace Companies	NOF Tameike Bldg., 2F 1-1-14 Akasaka, Minato-ku, Tokyo 107-0052, Japan Tel: +81-(0)3-3585-0511 http://www.sjac.or.jp
Japan Association of Defense Industry (JADI)	Yotsuya Sanchome Bldg. 6-5 Funamachi, Shinjuku-ku, Tokyo 160-0006, Japan Tel: +81-(0)3-6743-6755 http://www.jadi.or.jp/
Japan Automobile Manufacturers Association (JAMA)	Jidosha Kaikan (NBF Tower), 16F 1-1-30 Shiba Daimon, Minato-ku, Tokyo 105-0012, Japan Tel: +81-(0)3-5405-6126 http://www.jama-english.jp/
Japan Auto Parts Industries Association (JAPIA)	Jidosha Buhin Kaikan, 5F 1-16-15 Takanawa, Minato-ku, Tokyo 108-0074, Japan Tel: +81-(0)3-3445-4211 E-mail: info@japia.or.jp http://www.japia.or.jp/english/compendium.html
Japan Federation of Construction Contractors	Tokyo Kensetsu Kaikan Bldg., 8F 2-5-1 Hatchobori, Chuo-ku, Tokyo 104-0032, Japan Tel: +81-(0)3-3553-0701 http://www.nikkenren.com/
All Japan Construction Industry Association	Tokyo Kensetsu Kaikan Bldg., 5F 2-5-1 Hatchobori, Chuo-ku, Tokyo 104-0032, Japan Tel: +81-(0)3-3551-9396 E-mail: koho@zenken-net.or.jp http://www.zenken-net.or.jp/
Japan Wind Power Association (JWPA)	Kamichi Bldg. 3-15-3 Nishi-Shinbashi, Minato-ku, Tokyo 105-0003, Japan Tel: +81-(0)3-5733-2288 http://jwpa.jp/index_e.html

Trade Fairs

Trade Fairs offer an excellent opportunity to gather information on the Japanese market for your products and services and to meet prospective customers and distributors.

Plastic Japan	Tokyo / Osaka	http://www.plas.jp/en/
Next event: 5-7 April 2017 (twice a year: Spring in Tokyo, autumn in Osaka) Attendance at previous event: 59,700 (Tokyo, April 2016) Number of exhibitors at previous event: 191		
N+ Materials and Technlogies	Tokyo	http://www.n-plus.biz/english/
Next event: Autumn 2017 (annually) Attendance at previous event: 32,000 Number of exhibitors at previous event: 255		
IPF Japan	Makuhari	http://www.ipfjapan.jp/english/
Next event: 24-28 October 2017 (triannually) Attendance at previous event: 42,900 Number of exhibitors at previous event: 776		
Japan International Aerospace Exhibition	Tokyo	http://www.japanaerospace.jp/eng/Index
Next event: 12-15 October 2016 (every four years) Attendance at previous event: 21,700 (visitors on trade days) Number of exhibitors at previous event: 664		
Automotive World	Tokyo	http://www.automotiveworld.jp/en/
Next event: 18-20 January 2017 (annually) Attendance at previous event: 27,100 Number of exhibitors at previous event: 781		

Architecture and Construction Materials	Tokyo	https://messe.nikkei.co.jp/en/ac/
Next event: 7-10 March 2017 (triannually) Attendance at previous event: 103,300 Number of exhibitors at previous event: 244		
Japan Home and Building Show	Tokyo	http://www.jma.or.jp/homeshow/en/
Next event: Autumn 2017 (annually) Attendance at previous event: 32,800 Number of exhibitors at previous event: 534		
World Smart Energy Week	Tokyo, Osaka	http://www.wsew.jp/en/
Next event: 1-3 March 2017 (twice a year: Spring in Tokyo, autumn in Osaka) Attendance at previous event: 64,400 (Tokyo event in 2015) Number of exhibitors at previous event: 1,387		

Summary and Recommendations

The composites market covers a wide range of materials and applications. There are many different players: suppliers of raw materials, intermediate or semi-finished goods, parts and components manufacturers and OEMs in different industries. Composite materials, especially FRP, are used above all in the aerospace, defence, automotive, construction and energy sectors. These sectors are characterised by a high level of R&D and close cooperation between players in the development of new materials and applications. This need for cooperation in product development also opens up opportunities for EU companies in Japan.

Especially the following fields offer interesting points of entry into business with Japanese partners:

- CFRP applications in aerospace, wind energy, or automotive
- Recycling technologies for all kinds of composite materials
- Cost efficient production technologies for carbon fibre composites
- Composite materials using natural fibres and resins

The largest challenge for overseas companies entering the Japanese market is meeting local standards, e.g. in terms of construction materials and local customer preferences. Another hurdle is the propensity of Japanese customers for established Japanese business partners. An imported product or service has to face this competition.

To prepare for entry into the Japanese market, research is necessary to identify relevant players and possible opportunities and challenges. Information sources are EU Japan Centre, Japan External Trade Organisation (JETRO), and specialised consultants. If you already do business in Japan, your Japanese distributor can also be a valuable information source.

Peculiarities of a high-tech sector such as the composite materials sector are a high degree of cooperation in R&D projects and experts' networks. This means for EU companies planning to enter business with Japanese partners to be visible in these networks. To raise visibility it is recommended to be present at the relevant conferences and trade fairs on a regular basis. Especially in the aerospace and automotive sectors, a track record of supplying other manufacturers in the industry is regarded as a sign of high quality and reliability.

International investments of Japanese composite materials companies offer further opportunities for EU companies for R&D cooperation on their home ground. The Japanese Government supports R&D projects in the field of innovative technologies. Some of these programmes allow for cooperative projects between Japanese and international companies, for example, the Japanese External Trade Organisation's (JETRO) Subsidy Program for Global Innovation Centres, which gives financial support to R&D alliances between Japanese and overseas companies.[12] [52]

Finding the right distribution partner is crucial. You can either work with a general or a specialised trading firm. Some large OEM even have an own trading branch. Your partner should be well acquainted with the local market situation and regulations. To find a suitable distribution partner in Japan, it is useful to consult the respective industry associations or institutions that promote foreign trade such as the Japan External Trade Organisation or international chambers of commerce and industry. Trade fairs also offer a good opportunity to find prospective partners.

[12] The current application period expires in October 2016. Please check JETRO's homepage for further information: https://www.jetro.go.jp/en/invest/incentive_programs/info.html

Japanese business customers and consumers have high expectations regarding quality, cost effectiveness and service. It is important to provide Japanese business partners with extensive information and detailed manuals, preferably in Japanese and adapted to local preferences. Be prepared for repeated and detailed requests during the negotiation process. This is especially the case in the supplier selection process in the aerospace and automotive industries. To qualify as a supplier in the automotive and aerospace industries, prospective suppliers have to undergo a thorough vetting process.

Due to the propensity for established and long-term business relations, it is recommended to ensure top-management support for your company's activities in Japan. Top-level commitment also makes things easier if there are any complaints or problems.

Appendix A: Bibliography

[1] Marketsandmarkets.com (2016): *Composites market worth 105.26 billion US$ by 2021*, Internet: http://www.marketsandmarkets.com/PressReleases/composite.asp

[2] Mathes, Volker (2014): Werkstoffe der Zukunft oder Nischenprodukte: Marktentwicklung Composites (Materials of the future or niche products: Market trends for composites), in: *Konstruktion*, October 2014, p. 2.

[3] Japan Reinforced Plastics Society (2016): *Heisei 26, 27- (2014, 15)-nen FRP yōtobetsu, seikeihōbetsu tōkei* (FRP statistics 2014, 2015, by application and manufacturing method), Tokyo: Japan Reinforced Plastics Society.

[4] Nikkei Inc. (2016): Gyōkai jōhō: Kōkūki kanren hin, buhin (Sector report: Aeroplane parts and attachments), in: *Nikkei Needs gyōkai kaisetsu ripooto*, Tokyo: Nikkei Inc.

[5] Ministry of Economy, Trade and Industry (2016): *Census of manufacture*, Internet: http://www.meti.go.jp/english/statistics/tyo/kougyo/index.html

[6] The Society of Japanese Aerospace Companies (2015): *Japanese aerospace industry 2015*, Internet: http://www.sjac.or.jp/common/pdf/sjac_gaiyo/info/habataku2015E.pdf

[7] Pollmann, Mina (2015): The trouble with Japan's defence exports, in: *The Diplomat*, October 2, 2015, Internet: *http://thediplomat.com/2015/10/the-truth-about-japans-defense-exports/*

[8] Japan Federation of Construction Contractors (2015): *Kensetsugyō handobukku* (Handbook of the construction sector), Internet: http://www.nikkenren.com/publication/pdf/handbook/2015/2015_01.pdf

[9] Nikkei Inc. (2016): Gyōkai jōhō: Doboku kenchiku (Sector report: Civil engineering and construction), in: *Nikkei needs gyōkai kaisetsu ripooto*, Tokyo: Nikkei Inc.

[10] Japanmarkt (2016): Windkraft kommt in Schwung (Wind power is gaining momentum), in: *Japanmarkt*, February 24, 2016, Internet: http://www.japanmarkt.de/2016/02/24/wirtschaft/windkraft-kommt-in-schwung/

[11] Global Wind Energy Council (2016): *Global statistics*, Internet: http://www.gwec.net/global-figures/graphs/

[12] Centre for Better Living (2016): *BL labelling system*, Internet: http://www.cbl.or.jp/english/1.html

[13] Marketsandmarkets.com (2016): *Glass fibre reinforced plastic (GFRP) composites market worth $45.12 billion by 2019*, Internet: http://www.marketsandmarkets.com/PressReleases/glass-fiber-reinforced-plastic-composites.asp

[14] Carbon Composites e.V. / AVK Industrievereinigung verstärkte Kunststoffe (2015): *Composites market report 2015: Market development, trends, outlook and challenges*, http://www.eucia.eu/userfiles/files/Composites_Market%20Report_2015.pdf

[15] Marketsandmarkets.com (2016): *Carbon fibre market worth 3.51 & CFRP market worth 35.75 billion USD by 2020*, Internet: http://www.marketsandmarkets.com/PressReleases/carbon-fiber-composites.asp

[16] Unknown Author (2016): New report on global carbon fibre prepreg market, in: *Materialstoday.com*, April, 06, 2016, Internet: http://www.materialstoday.com/carbon-fiber/news/new-report-on-global-carbon-fiber-prepreg-market/

[17] Japan Reinforced Plastics Society (2016): *FRP saishigenka jisshou centaa* (Centre for the Demonstration of FRP Recycling), Internet: http://www.jrps.or.jp/frpcenter/index.html

[18] Kageyama Ryōshō (2015): Shōene kiki: Shōene o kakushin suru jisedai sozai „CFRP", risaikuru kadai ni idomu benchaa tōjō (Venture companies taking on the task of "CFRP" (next-generation material for innovative energy saving) recycling enters the stage.), in: *IT Media Smart Japan*, October 28, 2015, Internet: http://www.itmedia.co.jp/smartjapan/articles/1510/28/news053.html

[19] Unknown Author (2015): FRP engine parts could reduce vehicle weight, in: *Materialstoday.com*, April 24, 2015, http://www.materialstoday.com/composite-parts/news/frp-engine-parts-could-reduce-vehicle-weight/

[20] Japan Reinforced Plastics Society (2016): *Kyōkai shōkai* (Introducing the society), Internet: http://www.jrps.or.jp/syoukai/goaisatu.html

[21] Nikkei Inc. (2015): Kagaku (Chemical industry), in: *Nikkei gyōkai chizu 2016-nendo* (Nikkei sector maps. Fiscal year 2016), Tokyo: Nikkei Inc.

[22] Nikkei Inc. (2016): Gyōkai jōhō: Kagaku seni: tanso seni (Sector report: Chemical fibres: carbon fibres), in: *Nikkei Needs gyōkai kaisetsu ripooto*, Tokyo: Nikkei Inc.

[23] The Japan Carbon Fibre Manufacturers Association (2016): *Kōkū uchū bunya (Aerospace applicatons)*, Internet: http://www.carbonfiber.gr.jp/field/craft.html

[24] Nikkei Inc. (2016): *Nikkei NEEDS gurobaru gyōkai kaisetsu ripooto: Zōsen, kōkūki, tetsudō sharyō* (Nikkei NEEDS global sector report: Shipbuilding, aircraft, railway carriages), Tokyo: Nikkei Inc.

[25] Marketsandmarkets.com (2014): *Press release: The aerospace composites market*, Internet: http://www.marketsandmarkets.com/PressReleases/aerospace-composites.asp

[26] Organisation Internationale des Constructeurs d'Automobiles (OICA) (2016): *Sales statistics 2005-2015*, Internet: http://www.oica.net/wp-content/uploads//total-sales-20151.pdf

[27] IHS Markit (2015): *Press release: Slower, not lower: IHS automotive forecasting 88.6 million unit global light vehicle market in 2015*, Internet: http://press.ihs.com/press-release/automotive/slower-not-lower-ihs-automotive-forecasting-886-million-unit-global-light-v

[28] KPMG (2015): *KPMG's Global automotive executive survey*, Internet: https://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/global-automotive-executive-survey/Documents/2015-report-v1.pdf

[29] Hirsh, Evan et al. (2015): Industry perspectives: 2015 auto industry trends, in: *PwC Strategy& industry perspectives*, Internet, http://www.strategyand.pwc.com/perspectives/2015-auto-trends.

[30] Japan Automobile Manufacturers Association (2016): *Yonrinsha shinsha hanbai daisū* (Sales of new four-wheel vehicle units), Internet: http://www.jama.or.jp/industry/four_wheeled/four_wheeled_2t1.html

[31] IHS Markit (2016): Driven by fuel efficiency and emissions regulations, plastics help automakers design for practicality while appealing to buyers' emotional needs, IHS Markit says, *IHS Markit press release*, August 25, 2016, In-

ternet: http://press.ihs.com/press-release/automotive-light-weighting/driven-fuel-efficiency-and-emissions-regulations-plastics-h

[32] Japanmarkt (2011): 80 Prozent Ökoplastik im Innenraum (80% of interiors made of bio-plastics), *Japanmarkt*, October 19, 2011.

[33] Woidasky, Jörg (2013): Weiterentwicklung des Recyclings von faserverstärkten Verbunden (Enhancing the recycling of fibre-reinforced composites), in: Thomé-Kozmiensky, Karl J. / Goldmann, Daniel (Eds.): *Recycling und Rohstoffe, Bd. 6*, Nietwerder: TK Verlag, pp. 241-259.

[34] Marketsandmarkets.com (2014): *Press release: Natural fibre composites market worth 6.50 billion US$ by 2021*, Internet: http://www.marketsandmarkets.com/PressReleases/natural-fiber-composites.asp

[35] The Japan Carbon Fibre Manufacturers Association (2016): *Application of building and civil engineering fields*, Internet: http://www.carbonfiber.gr.jp/english/field/building.html

[36] Nikkei Inc. (2015): Denryoku, gasu (Electric power, gas), in: *Nikkei gyōkai chizu 2016-nendo* (Nikkei sector maps. Fiscal year 2016: Electric Power, gas), Tokyo: Nikkei Inc.

[37] Japan Wind Power Association (2016): *JWPA vision and mission*, Internet: http://jwpa.jp/englishsite/jwpa/vision.html

[38] Ministry of Economy, Trade and Industry (2016): *Japan's energy white paper*, Internet: http://www.enecho.meti.go.jp/en/category/whitepaper/pdf/whitepaper_2016.pdf

[39] Nikkei Sangyō Shinbun (2016): Kagaku, saisendan ni idomu Nihonsei: Tanso seni,(Chemicals: Japanese manufacturers are challenging the top: Carbon fibres), in: *Nikkei Sangyō Shinbun*, May 26, 2016.

[40] Nikkei Keizai Shinbun (2016): Shokubutsusei no shinsozai de shōbu, Nissei, tokenikui aisu, Toclas, jidōsha no naisōzaini (Competing with plant materials: Nissei: Ice-cream that does not melt as easily; Toclas: Interior materials for automobiles), in: *Nihon Keizai Shinbun*, August 8, 2016, p. 13.

[41] Chūbu Keizai Shinbun (2016): Shinshun intabyuu: Hirano Kōji, Nagoya-shi Kōgyō Kenkyūjo-jochō: Kenkyū setsubi kōdai de chūshō shien (New Year's interview: Hirano Kōji, Director of Nagoya Municipal Industrial Research Institute: Supporting SMEs by expanding research facilities), in: *Chūbu Keizai Shinbun*, January 11, 2016, p. 3.

[42] Ministry of Finance (2016): *Foreign trade statistics*, Internet: http://www.customs.go.jp/toukei/info/index_e.htm

[43] Glass Fibre Association of Japan (2016): Kyōkai no soshiki to katsudō (The association's activities and organisation), Internet: http://www.glass-fiber.net/organization_activity.html

[44] Germany Trade & Invest (2014): Japans Flugzeugindustrie steuert neue Ziele an (Japan's aircraft industry is heading for new destinations), Internet: http://www.gtai.de/GTAI/Navigation/DE/Trade/Maerkte/suche,t=japans-flugzeugindustrie-steuert-neue-ziele-an,did=1085204.html?view=renderPdf, published September 22, 2014.

[45] Ministry of Defence Japan (2016): *Heisei 28-nenban bōei hakusho* (Defence white paper 2016), Internet: http://www.mod.go.jp/j/publication/wp/wp2016/pdf/index.html

[46] Nikkei Inc. (2016): Gyōkai jōhō: Sōgō kensetsu (zenekon) (Sector report: Construction, general contractors), in: *Nikkei Needs gyōkai kaisetsu ripooto*, Tokyo: Nikkei Inc.

[47] The Federation of Electric Power Companies in Japan (2015): *Electricity review Japan 2015*, Internet: http://www.fepc.or.jp/library/pamphlet/pdf/2015ERJ_full.pdf

[48] Deutsche Industrie- und Handelskammer in Japan / Bundesministerium für Wirtschaft und Technlogie (2012): *Zielmarktanalyse Windenergie Japan* (Analysis of the wind energy market in Japan), Tokyo: Deutsche Industrie- und Handelskammer in Japan.

[49] Nikkei Inc. (2014): Fūryoku hatsudenki (Wind turbines), in: *2014-nen Nikkei shea chōsa* (Nikkei survey on market shares 2014), Tokyo: Nikkei Inc.

[50] Nikkei Inc. (2015): Fūryoku hatsuden (Wind energy), in: *Nikkei gyōkai chizu 2016-nendo* (Nikkei industry maps. Fiscal year 2016), Tokyo: Nikkei Inc.

[51] SpecialChem.com (2015): Industry News: Mitsui and KIT collaborate to develop novel methods for production of carbon fiber composites, *SpecialChem.com*, May 04, 2015, Internet: http://polymer-additives.specialchem.com/news/industry-news/mitsui-kit-collaborate-to-develop-novel-methods-for-production-of-carbon-fiber-composites

[52] Japan External Trade Organisation (JETRO) (2016): *FY2015: Subsidy Program for Global Innovation Centres*, Internet: https://www.jetro.go.jp/en/invest/incentive_programs/info.html

Appendix B: Literature and Web Links

Additional Materials

EU Business in Japan website: http://www.eubusinessinjapan.eu/

Manufactured Imports and Investment Promotion Organisation (MIPRO)	World Import Mart Bldg., 6F Sunshine City 3-1-3 Higashi-Ikebukuro, Toshima-ku, Tokyo 170-8630, Japan Tel: +81-(0)3-3988-2791 http://www.mipro.or.jp/english/	Brochures on import regulations and procedures (pdf file downloads from the website)
Japan External Trade Organisation (JETRO)	Ark Mori Building, 6F 1-12-32 Akasaka, Minato-ku, Tokyo 107-6006, Japan Tel: +81-(0)3-3582-5511 http://www.jetro.go.jp/en/	JETRO operates offices in the following EU countries: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Poland, Romania, Spain, Sweden, United Kingdom.

Authorities Responsible for Laws and Regulations

Customs regulations and tariffs	Ministry of Finance, Customs and Tariff Bureau 3-1-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8940, Japan Tel: +81-(0)3-3581-4111 http://www.customs.go.jp/english/index.htm
Japanese Industrial Standards	Ministry of Economy, Trade and Industry, Japanese Industrial Standards Committee 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901, Japan Tel: +81-(0)3-3501-9245 http://www.jisc.go.jp/eng/ Japanese Standards Association (JSA) Mita MT Bldg. 3-13-12 Mita, Minato-ku, Tokyo 108-0073, Japan Tel: +81-(0)3-4231-8503 http://www.jsa.or.jp/default_english/default_english.html
Government support for public and private R&D	New Energy and Industrial Technology Development Organisation (NEDO) Representative Office in Europe 10, rue de la Paix 75002, Paris, France Tel: +33-(0)1-4450-1828 http://www.nedo.go.jp/english/index.html

BL label	Center for Better Living Stage Bldg. 2-7-2 Fujimi, Chiyoda-ku, Tokyo 102-0071, Japan Tel: +81-(0)3-5211-0556 http://www.cbl.or.jp/english/index.html
Eco mark	Japan Environment Association, Eco Mark Office Bakurocho Daiichi Bldg. 1-4-16 Nihonbashi Bakurocho, Chuo-ku, Tokyo 103-0002, Japan Tel: +81-(0)3-5643-6255 http://www.ecomark.jp/english/
Act on the Promotion of Effective Utilisation of Resources	Ministry of Economy, Trade and Industry, Recycling Promotion Division 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901, Japan Tel: +81-(0)3-3501-4978 http://www.meti.go.jp/english/policy/energy_environment/3r/index.html