

Steel Business

Responding to new needs with advanced steel and an evolving workforce

We refine steel with advanced technologies and respond flexibly to changing needs as a company valued by society.



President and CEO, JFE Steel Corporation
Yoshihisa Kitano

Steel's power to respond

Steel has supported the development of civilization with its unparalleled advantages, including relatively low manufacturing costs, suitability for mass production, tremendous strength, easy processing, and easy recycling. Going forward, I believe that expectations for steel will increase as the world continues to undergo dramatic changes. Steel's power to respond is evident, for example, in thin but strong high strength steel that is helping to reduce the weight of electric vehicles and construction materials that are enabling customers to save labor in response to Japan's shrinking workforce. JFE will continue to provide new value and respond flexibly to ever-changing needs by developing products and technologies that leverage steel's infinite potential.

The driving force behind such initiatives is our highly competitive production system, which is consolidated into two large-scale steelworks in east and west Japan. By continuing to make strategic investments in our domestic manufacturing bases, we aim to dramatically increase our productivity and enhance our cost competitiveness. Furthermore, the technological and quality capabilities that we nurture in Japan are

also being applied to our overseas operations. We promote our global strategy of new investment and use of raw materials from overseas sources to ensure our sustainable growth in the face of declining demand in Japan. We acknowledge the serious concern we caused to our stakeholders due to a series of problems in our blast furnaces in FY2018. We are thoroughly investigating the root causes, and taking permanent measures in response utilizing cutting-edge AI, IoT technologies, and other advanced IT.

Flexible workforce and a willingness to accept challenges

To bring out the full potential of steel and contribute to society, diverse human resources are essential. In order to respond to dramatic global changes with flexibility and speed, JFE aims to be a dynamic company where employees can energetically take on new challenges. Technologies are being passed down to younger workers through the application of AI and IoT, which is facilitating the transfer of on-site skills and expertise, one of the sources of our strength in manufacturing.

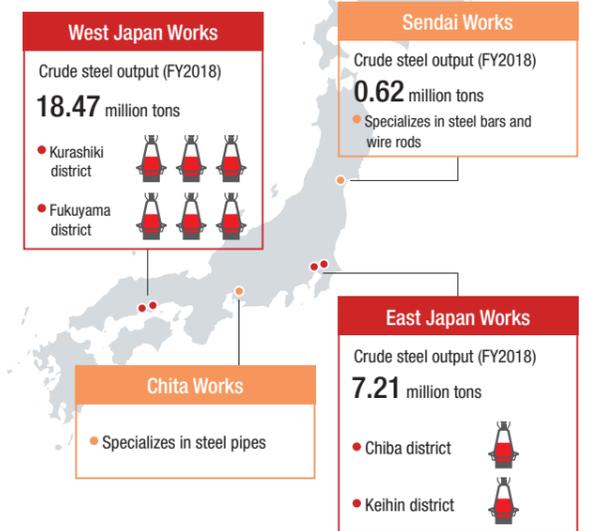
Business Overview

JFE Steel is an integrated steel manufacturer that possesses world-class production scale and advanced capabilities for technological development. The company supplies steel products that meet the diverse needs of global customers.

Competitive production centered on two large-scale steelworks

The production bases of JFE Steel consist of two large coastal steelworks—the East Japan Works comprising the Chiba and Keihin districts and the West Japan Works comprising the Kurashiki and Fukuyama districts. The company also operates the Chita Works specializing in steel pipes and the Sendai Works to produce steel bars and wire rods. JFE Steel's highly efficient and competitive production system makes extensive use of leading-edge technologies for the manufacture and sale of high-quality steel products. The Steel Research Laboratory adjoining each production base develops new products to bring out the potential of steel as well as innovative production processes with consideration to the global environment, while also researching core technologies to support such works.

Steel business production bases in Japan



Global supply system that fully responds to worldwide steel demand

JFE Steel has actively built up a global supply system in response to growing demands for steel, especially in Asia. In recent years, the company has prioritized automobiles, energy and infrastructure materials and has expanded operations into Mexico (steel sheets for automobiles), the UAE (pipes for pipelines) and Myanmar (thin steel sheets for construction material). JFE Steel leverages its advanced technologies and expertise cultivated in Japan to sell high-quality steel materials that respond to local needs, further expanding the presence and reach of the JFE brand.



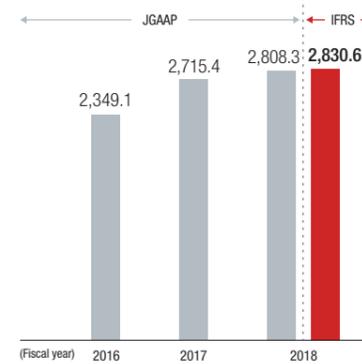
The manufacturing base for pipes for UAE pipelines (AL GHARBIA PIPE COMPANY)



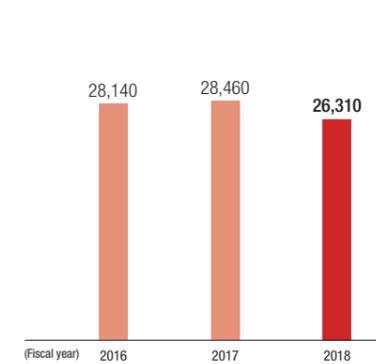
① Night view of steelworks (Fukuyama district) ② Blast furnace (Chiba district)
③ Converter (Fukuyama district) ④ Continuous casting machine (Kurashiki district) ⑤ Completed steel products (Chiba district)

FY2018 Results

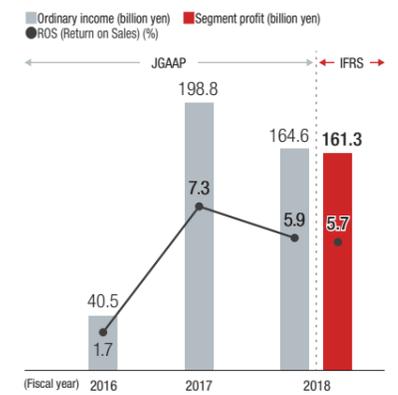
Net sales / Revenue (billion yen)



Non-consolidated crude steel output (1,000 tons)



Ordinary income / Segment profit and ROS (Return on Sales) (%)



*From FY2018, the JFE Group adopted the International Financial Reporting Standards (IFRS) in place of the generally accepted accounting principles (JGAAP) adopted previously.

Strengthening manufacturing capabilities

As a part of the company's focus in FY2019, we will continue to develop manufacturing bases for steelworks and other works in Japan, which is one of the core strategies for the Sixth Medium-term Business Plan. Through measures to increase capabilities and optimize performance centering around West Japan Works, the company will drastically strengthen its manufacturing capabilities. Upgrading our facilities with a view to future growth, we will establish stable production and reduce costs, and secure even greater competitiveness, while making greater progress in increasing our capabilities and developing/manufacturing high-grade steel.

Strengthening initiatives to ensure stable operation

The previous Medium-term Business Plan invested in large-scale facility upgrades including renovation of coke ovens. These enhancements of manufacturing bases bring stability to production, promoting an early recovery of the company's manufacturing capabilities. The Sixth Medium-term Business Plan continues to develop manufacturing bases while planning and implementing capital investments in even greater scale than the previous Medium-term Business Plan.

The West Japan Works and the Kurashiki district aim to increase capabilities and optimize performance through initiatives such as the installation of a new continuous casting machine. Development of innovative production processes will also be expedited, focusing on upstream processes such as use of lower-priced raw materials. Furthermore, superiority in total costs will be thoroughly pursued by improving the productivity of both people and machinery through active use of advanced IT such as AI and IoT technologies, as well as core system renovations at steelworks as implemented from the

previous Medium-term Business Plan, which will be brought into operation in phases.

These initiatives will achieve stable production of 30 million tons of crude steel while reducing costs on the scale of 105.0 billion yen over three years. The greater stability in production will put the recovery on track and will enhance our manufacturing capabilities, making it stronger and more solid.

Furthermore, as a key initiative for this fiscal year following the problem with blast furnace operations in the previous fiscal year, we have established a system to prevent troubles by identifying hidden risks and applying preventive measures to all districts. In terms of machinery and equipment, sensing technology is steadily being introduced in order to quickly detect and promptly respond to any faults during blast furnace operations. In addition, work is also progressing on the creation of an operator assistance system utilizing AI, concurrent with thoroughgoing training of operators, to support any lack of experience.

Steadily implementing systematic investments in upgrades and increasing capabilities

Large-scale renewal works are still ongoing from the previous Medium-term Business Plan, such as upgrade of coke ovens in the Chiba and Fukuyama districts, upgrade of the sintering machine in the Fukuyama district, and renovation of the thermal power plant in the Keihin district. Meanwhile, systematic investments will accommodate facilities requiring

upgrades in the medium- to long-term, to enable sustainable growth. Further efforts are aimed at increasing capabilities and enhancing competitiveness, including a new continuous casting machine in the Kurashiki district introducing the latest technology to achieve both quality and efficiency.

Progress on major capital investment projects

District	Facility	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Chiba	No. 6 Coke oven (Battery B)	Operational in June 2018	Establish self-sufficient structure for coke				
Fukuyama	No. 3 Coke oven (Battery A)		Second half of FY2019 (to be operational)				
Fukuyama	No. 3 Coke oven (Battery B)			Second half of FY2021 (to be operational)			
Fukuyama	No. 3 Sintering Machine		Second half of FY2019 (to be operational)				
Kurashiki	No. 7 Continuous Casting Machine (New continuous casting machine)			Second half of FY2020 (to be operational)			
Keihin	Renovation of the Ohgishima thermal power plant		Second half of FY2019 (to be operational)				

➡ In operation ➡ To be operational

Domestic capital investment for the Sixth Medium-term Business Plan

IFRS: 1 trillion yen level/3 years (Japanese standards: 850.0 billion yen)

*Difference between the Japanese standards and the IFRS is the wider scope of non-current assets.

Major initiatives

Investment to increase capabilities and optimize performance

- Installation of a new continuous casting machine in Kurashiki, etc.
- ⇒ Achieve a non-consolidated 30 million ton production of crude steel

Strategic investments pursuing cost advantages

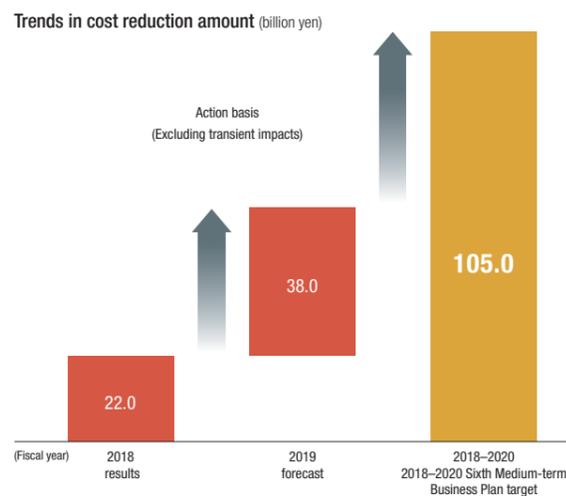
- Increase capability of the sintering machine in Fukuyama, etc.

Systematic investments in upgrades

- Upgrade of coke ovens and energy facilities, etc.

Implement permanent measures to ensure blast furnace stability

- Installation of new facilities for stability, and active use of AI and IoT technologies



Initiatives for stable operation of blast furnaces

Progressively undertaking development of manufacturing bases including measures to enhance the stability of blast furnaces on the scale of 10 billion yen.

Cause of the Problem

- Damage to blast furnace auxiliary equipment**
 - Partial handling failure in deterioration diagnostics and upgrades of blast furnace auxiliary equipment, and increased load on machinery and equipment during non-irregular operations
- Inadequate operational procedure in case of equipment failure**
 - Lack of operational experience due to generational change, and non-standardized handling procedure in response to equipment failure depending on blast furnaces and districts

Response to the problem (Completed)

- Repair of damaged parts and implementation of countermeasures
- Reexamination of standards of countermeasures to equipment failures
- Reinforced operation monitoring (monitoring of operators for early detection of anomalies and reinforced automated sensing)

All blast furnaces returned to normal operation
Recurrence prevention system for a similar problem is implemented in all districts

Major permanent measures (Ongoing)

- Taking measures for deterioration of blast furnace auxiliary equipment**
- Detecting anomalies early and shortening recovery time**
 - Promote "visualization" of blast furnaces via sensors
 - Introduce temperature control and furnace diagnostics using IoT technologies
 - Develop an operator assistance system using AI

Engineering Business

Evolving the engineering business with the mission to “Create” and “Ni-na-u”^{*} the foundation for life

The company is steadily making progress on achieving the key initiatives of the Sixth Medium-term Business Plan, to expand our operating businesses and increase earnings of our overseas businesses. We will transform and strengthen our business structure, focusing on the development of infrastructure that supports people’s lives as the core of our business.

^{*} “Ni-na-u” is a Japanese word meaning supporting and remaining responsible. We aim to provide solutions with our engineering and manufacturing know-how.



President and CEO, JFE Engineering
Hajime Oshita

Establish a stable profits base

JFE Engineering has expanded its operating businesses to “Ni-na-u” the foundation for life, through traditional EPC (engineering, procurement, and construction) as well as Public and Private Partnership (PPP) business, recycling business, and power generation and electric power businesses. In January this year, we began full-scale operation as an energy service provider to supply power and heat to factories in private sectors. In April, as a joint venture with the TEPCO Group, we launched the biggest waste treatment and recycling company in the Tokyo metropolitan area. Thus our operating businesses are steadily expanding. During the current Medium-term Business Plan, we will increase the volume of incoming orders in operating businesses including O&M (operation and maintenance) to 50% of the total, establishing a business structure whose performance is largely unaffected regardless of whether or not major project orders are obtained.

Expanding overseas business and strengthening profitability

JFE Engineering has as its mission expanded the development of infrastructure deeply rooted in everyday life, building

its business in areas such as waste-to-energy and water treatment plants, and bridge construction. For JFE Engineering to grow even more, we must make the most of our technologies honed in Japan, decisively making inroads into overseas markets, particularly in the growth region of Asia. In order to achieve this, we have built up a structure capable of expanding our business, actively engaging in M&As and reinforcement of our overseas bases. As a result, the number of local staff has expanded to approximately 1,600 employees. Each overseas base has grown to take over not only design work but also engineering work like procurement and project management.

Such efforts have been rewarded with success, as overseas orders in FY2018 reached the highest ever figure since our founding of over 70.0 billion yen, including a water treatment plant in Vietnam and bridge construction in India. By making the maximum use of our global engineering structure and thoroughly strengthening pre- and post-order project management via the new project management unit established in April last year, we will ensure that profit is generated from the steady inflow of orders.

Business Overview

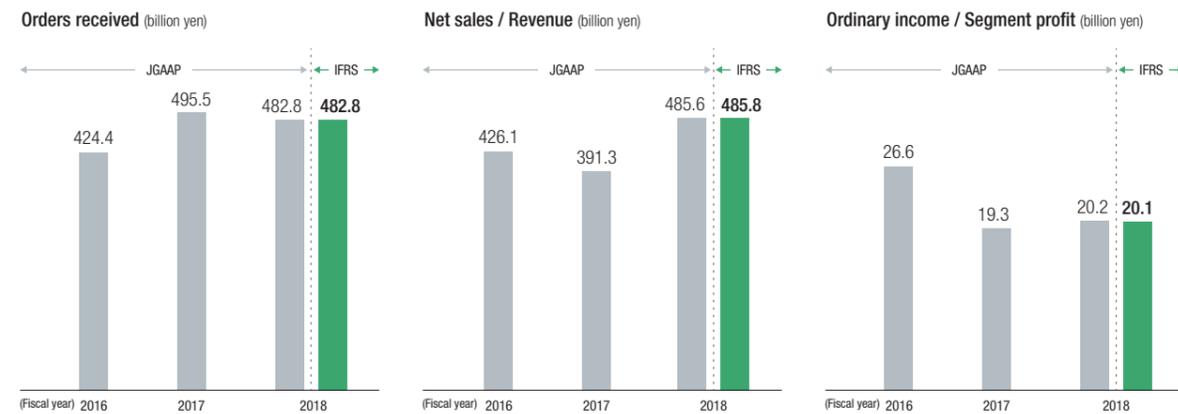
JFE Engineering’s core business is the construction of essential infrastructure, including waste-to-energy plants, water treatment plants and bridges. By focusing on these business fields, we propose integrated services that include business planning, and operating business covering from EPC (engineering, procurement, construction) to the O&M (operation and maintenance) stage.

<p>Environment</p> <ul style="list-style-type: none"> Waste-to-energy plants Recycling industrial waste, food and consumer appliances 	<p>Aqua</p> <ul style="list-style-type: none"> Water treatment plants (water and sewage) Water pipelines 	<p>Energy</p> <ul style="list-style-type: none"> Natural gas treatment plants LNG bases Pipelines 
<p>Infrastructure</p> <ul style="list-style-type: none"> Transportation and logistics infrastructure (bridges, ports and harbor facilities) Disaster-prevention infrastructure (seawalls and breakwaters) 	<p>Machinery and systems</p> <ul style="list-style-type: none"> Industrial machinery (cranes and steam turbines) Environmental equipment for ships Logistics systems 	<p>Power generation and electricity</p> <ul style="list-style-type: none"> Retail sales of electricity and regional new power systems Renewable-energy power generation Energy service provider 



① Waste management and recycling business are merged with Tokyo Waterfront Recycle Power Corporation of TEPCO Group. The photo shows Tokyo Waterfront Eco Clean. ② The Global Remote Center monitors plants at 66 bases. It is the central hub for operating business. ③ Local staff in charge of engineering operations ④ A bridge being built in Bangladesh ⑤ A water treatment plant ordered by Vietnam. It is currently in the trial operation stage.

FY2018 Results



Trading Business

Increasing our abilities to offer proposals and convey information, aiming to be a trading company with presence

As the JFE Group's core trading company, we constantly consider the overall optimum, sharing strategies with other Group companies to work on strengthening functions. Furthermore, we seek to increase our abilities to offer proposals and convey information, growing sustainably with our customers to be a company with strong market presence.



- ① Diverse human resources leveraging global networks and enhanced functionality. Cooperating on a global perspective to pioneer new businesses worldwide.
- ② The "rolled-mat" construction method which uses steel bars pre-assembled in the factory to form flooring, as opposed to the standard method of placing each single bar onsite. This method reduces construction times by 50%, combating frontline workforce shortages and helping achieve the workstyle reforms the construction industry is promoting.
- ③ CWIEME, the world's leading event for electrical steel sheets and magnetic material, held in Berlin. Actively promoting to customers from countries worldwide our motor cores, mitre cores, and works in secondary and tertiary processing.
- ④ JFE Shoji Tinplate Center Corporation held a completion ceremony for a new plant. Reinforcing processing and distribution operations to improve quality further.



President & CEO, JFE Shoji Trade Corporation
Naosuke Oda

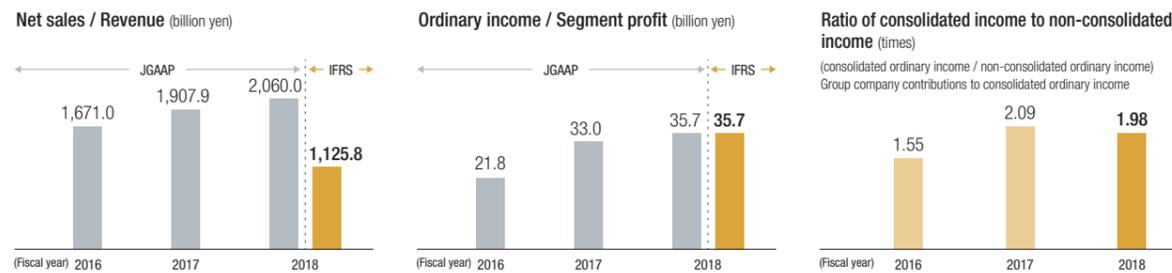
Striving for even greater profits in the next Medium-term Business Plan, in addition to achieving the current targets

JFE Shoji Trade, based on its policy of "maintaining a solid footing while aggressively pursuing future growth," is driving forward with "the establishment of a four-pillar system (Japan, the Americas, China, and ASEAN)" and "expansion of trading income and business income." The company aims to boost income to still higher levels by plying management based on the regional division system, expanding sales of JFE Group products, strengthening the downstream fields inside and outside Japan, improving the structure of processing and distribution functions, and expanding the scope of our activities.

Business Overview

The JFE Shoji Group is engaged in a broad range of businesses, from steel materials, machinery, non-ferrous metals, chemicals and ships to food and electronics, with our focus on steel products. The company provides services that add value to supply chain operations with a global network encompassing 95 companies.

FY2018 Results



*From FY2018, the JFE Group adopted the International Financial Reporting Standards (IFRS) in place of the generally accepted accounting principles (JGAAP) adopted previously.



President & CEO, Japan Marine United Corporation
Kotaro Chiba

Winning the customers' trust with technological capabilities, human resources, and performance

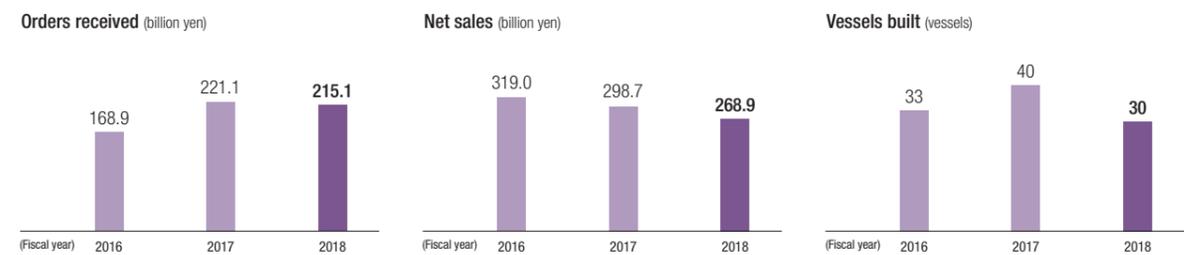
In order to meet the expectations of our customers for "vessels with superior performance at the market price," in April this year we established a new division Production Center, aiming to integrate the management of all the fabrication line in separate locations.

Leveraging these, in combination with our environmental and energy conservation technologies honed over many years, to boost competitiveness in terms of both performance and costs, we are adding higher value for merchant vessels such as tankers, bulk carriers, and container ships. We will also aggressively take up the challenge of new fields in ocean development, such as the manufacture of self elevating platform (SEP) for offshore wind power turbines.

Business Overview

Japan Marine United was launched in 2013 on the merging of two leading companies in the Japanese shipbuilding industry, Universal Shipbuilding Corporation and IHI Marine United. The company is active in four fields: merchant vessels, naval ships, marine engineering, and ship's life cycle, with powerful development and design capabilities backed by a wide-ranging track record in shipbuilding.

FY2018 Results



Shipbuilding Business

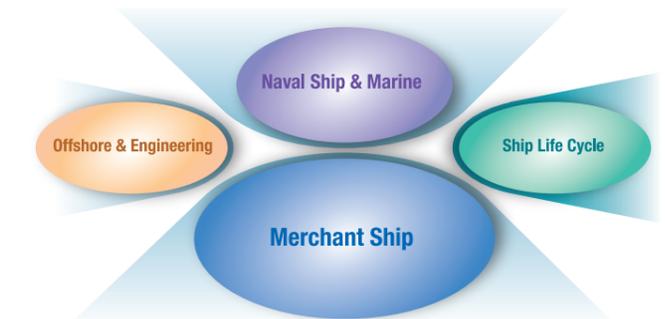
(equity-method affiliate)

Contributing to the ship and offshore field with the finest products and services

As a leading company in Japan's shipbuilding industry, we leverage our world-class environmental and energy conservation technologies in the fields of merchant vessels, naval ships and other offshore undertakings, with the aim of being the most powerful shipyard capable of meeting every need.



- ① 14,000-TEU container ship "ONE COLUMBA"
- ② Large passenger/car ferry "SUNFLOWER KIRISHIMA"
- ③ Hakone Sightseeing Cruise "Queen Ashinoko"
- ④ Floating Offshore Substation "FUKUSHIMA KIZUNA"



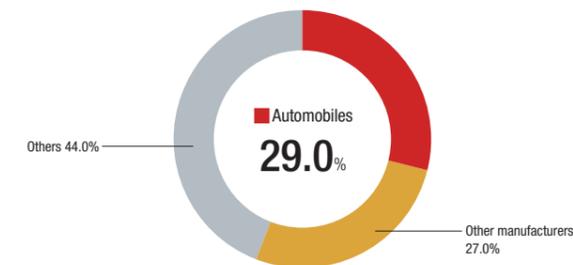


Business overview of the automobile market

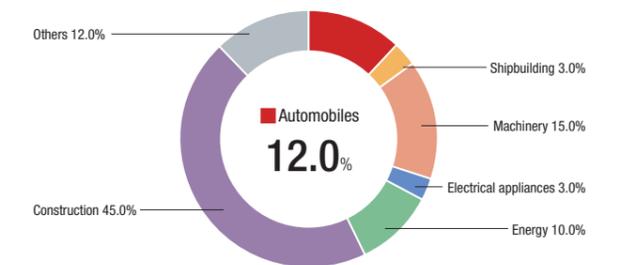
JFE Steel, as a force supporting car manufacturing, has expanded its business globally by focusing on developing products and application technologies for automobile steel, based on its consistent quality and supply. As the environmental regulations in various countries become increasingly tougher, JFE Steel is now promoting to develop products to match changes in society, such as ultra-high strength steel for weight reduction, and electrical steel sheets for drive or dynamo motors in electric vehicles.

Use of ultra-high strength steel requires advanced processing and welding technologies. JFE Steel, ahead of other steel manufacturers, has pioneered the development of application technologies for customers, establishing its Customers' Solution Lab. in the Chiba district in 2005 and the Customer Center Fukuyama in the Fukuyama district in 2014. JFE Steel's ability to create new value with its customers is truly one of its leading strengths.

JFE steel sales percentage for automotive industry



Breakdown of world steel consumption (estimates)

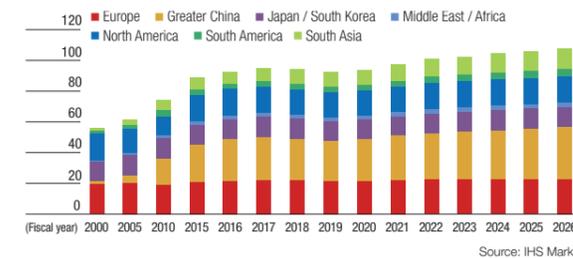


Estimates taken from the Japan Iron and Steel Federation's 2017 Survey Overview on Market Trends for Major Countries and Regions.

The percentage of the company's sales for automotive industry is more than double the demand rate for general automobile steel.

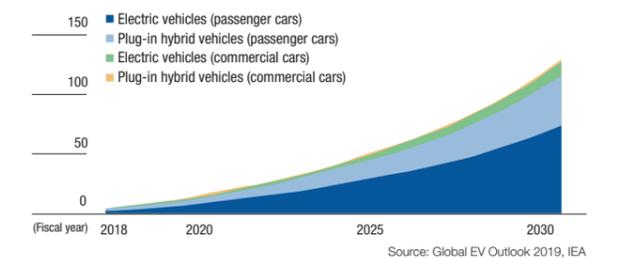
The business environment for the automobile market

Trends in global production (millions of vehicles)



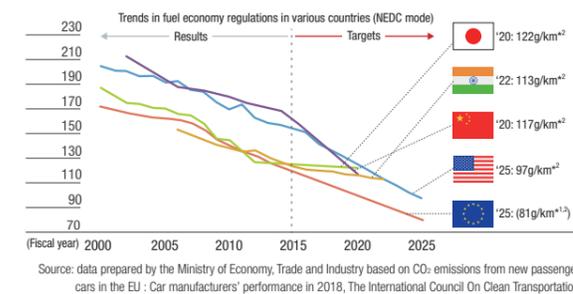
Production numbers of vehicles are expected to continue to grow, primarily outside Japan. The company is expanding its local supply systems in growing markets.

Global ownership of electric vehicles (millions of vehicles)



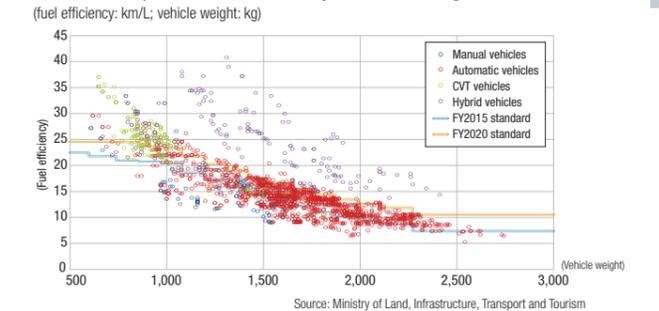
Increasingly tougher environmental regulations in various countries will cause changes to the drive system and powertrains of cars, centering on electric vehicles.

CO₂ emissions regulations (g/km)



The EU has taken the lead in toughening fuel consumption regulations, and is expected to make them even stricter in order to meet the goal of keeping global warming under two degrees until 2050 under COP 21's Paris Agreement.

The relationship between fuel efficiency and vehicle weight



In the search for better fuel efficiency, demand for high strength steel which help lighten vehicle weight is expanding.

*1: Calculated as a 15% reduction vs. 2021 (95g/km) in the draft proposal.
*2: Actual figures up to 2014 for Japan and the USA, and up to 2015 for India, China, and the EU. Figures are in NEDC mode.

Feature

01

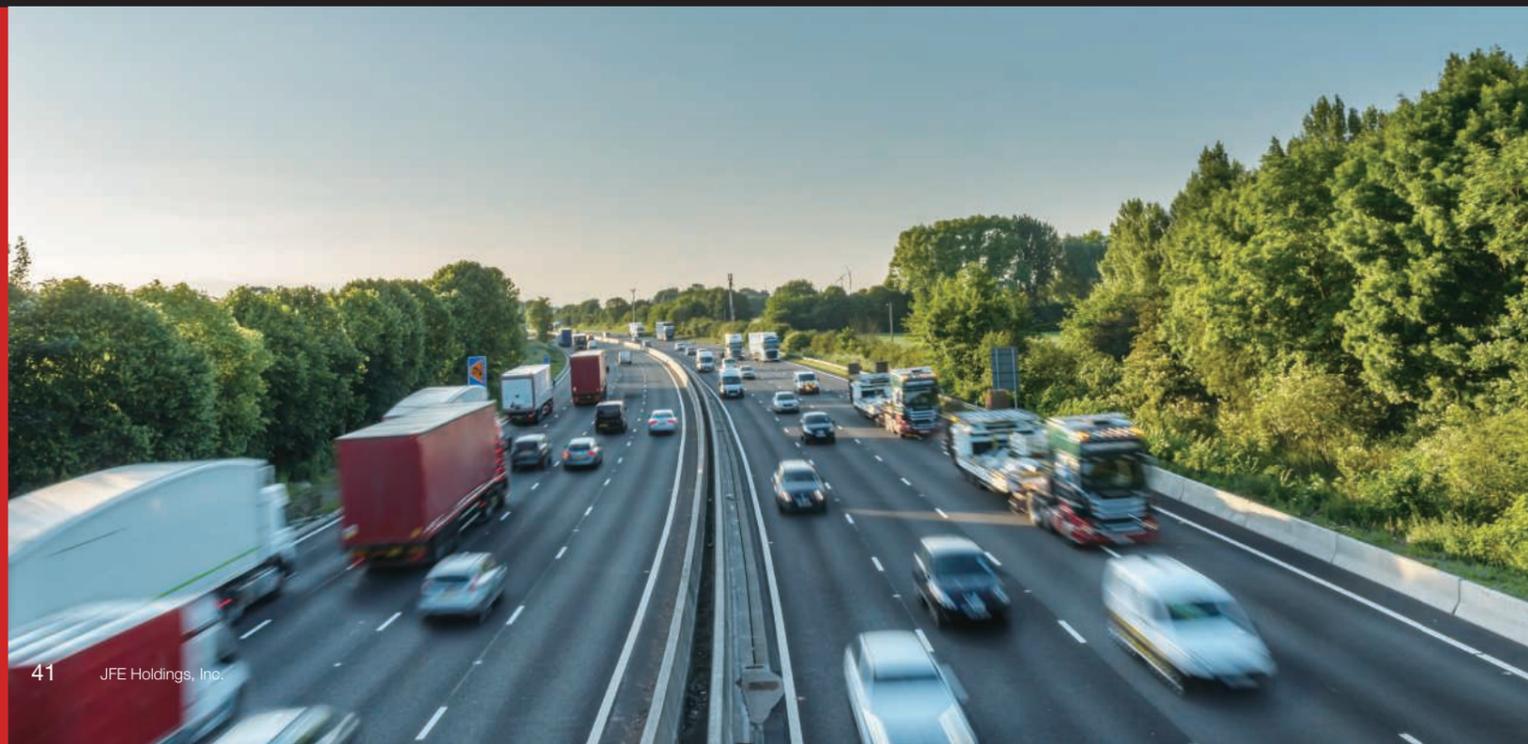
Business Strategy for the Automobile Market

Establish a strong presence through leading-edge technology and global supply network in the face of changing market needs

The JFE Group's medium-term business plan is regarding automobiles, infrastructure materials and energy as the three major fields, and forging ahead with technological development and global expansion in these areas. In particular, taking this substantial changes in market needs occurring in the automobile industry, described as being in a once-in-century transformation, as a major opportunity, we are expanding our business for the automobile industry. The company further differentiates ourselves by rolling out cutting edge technology and services globally.

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Strategy 1 Expanding sales of high strength steel via unique solutions combining materials and application technologies

The use of high strength steel in vehicle parts is an effective measure to increase their collision safety while also improving fuel efficiency at a low cost through weight reduction. However, high strength steel, is difficult to form or weld under standard automobile parts manufacturing methods and conditions. In some cases the required quality or performance as parts cannot be attained, limiting the materials strength and applicable parts that can be used.

JFE Steel independently researches and develops the so-called "application technology" to process and weld the steel sheets from its perspective as a materials manufacturer, which leads to the development of the best materials to suit the diverse needs of its customers. We intend to expand the scope for use of high strength steel through leveraging the accurate materials designs and application technology solutions that other manufacturers would struggle to match.

A broad lineup of steel sheets for automobiles in pursuit of usability

JFE Steel maintains strong competitiveness and expands profitability by rapidly brings to the market high strength steel that the company has developed and manufactured by leveraging the most advanced technology in response to the needs of weight reduction of automobiles. Our high strength steel is suited for weight reduction of any kinds of parts, including for frames contributing to collision safety, for panels with superior flexibility and ease of processing, as well as for the suspension. We also develop GI-JAZ, which provides a better friction coefficient for galvanized iron (GI) coating used widely by US and European automobile manufacturers, and expand its sales.

2 UNIHITEN™

UNIHITEN™ is high strength steel with a tensile strength grade of 440 MPa for thinner outer sheets like for doors and hoods achieving both superior surface quality and dent resistance for formed panel parts, thanks to low yield strength, high work-hardenability, and bake-hard-ability. It is in mass production for cold rolling and GA, and is employed as hood outer material for Toyota's JPN-TAXI.

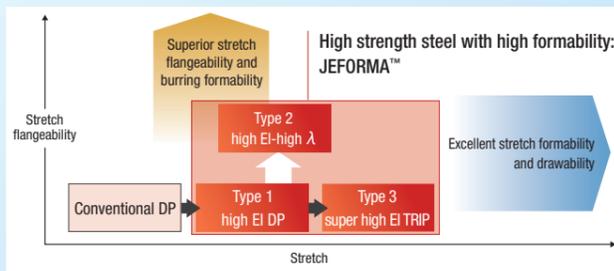


3 GI JAZ™

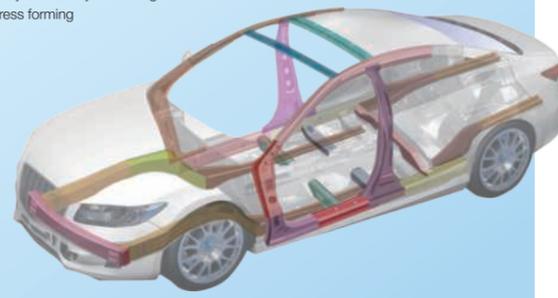
This product applies the lubrication facilitating technology developed with JAZ™ (JFE Advanced Zinc) high-lubricity hot-dip galvanized (GA) steel sheets to galvanized (GI) steel sheets, which are commonly used by US and European manufacturers. More stable press formability is gained through the excellent slidability.

1 JEFORMA™

JEFORMA™ stands for JFE Excellent FORMAbility: steel sheets for automobile frames with superior processability. To provide the optimum materials matched to the forms and processing methods of parts aiming at the basic forming characteristics (elongation and stretch flangeability) required for press forming of high strength steel, we offer a line-up of three types of high formability steel sheets, with the tensile strength grades of 590, 780, 980 and 1180MPa for cold rolled and galvanized (GA) steel sheets.



* Stretch flangeability: formability of the edge of steel sheets during press forming



4 1470MPa-grade cold-rolled/ GA high strength steel

1470 MPa-grade cold-rolled high strength steel, formed through cold forming at room temperature, has the world's highest tensile strength for automobile parts. Commercialized for bumper reinforcement, it has future potential for use in frame parts.

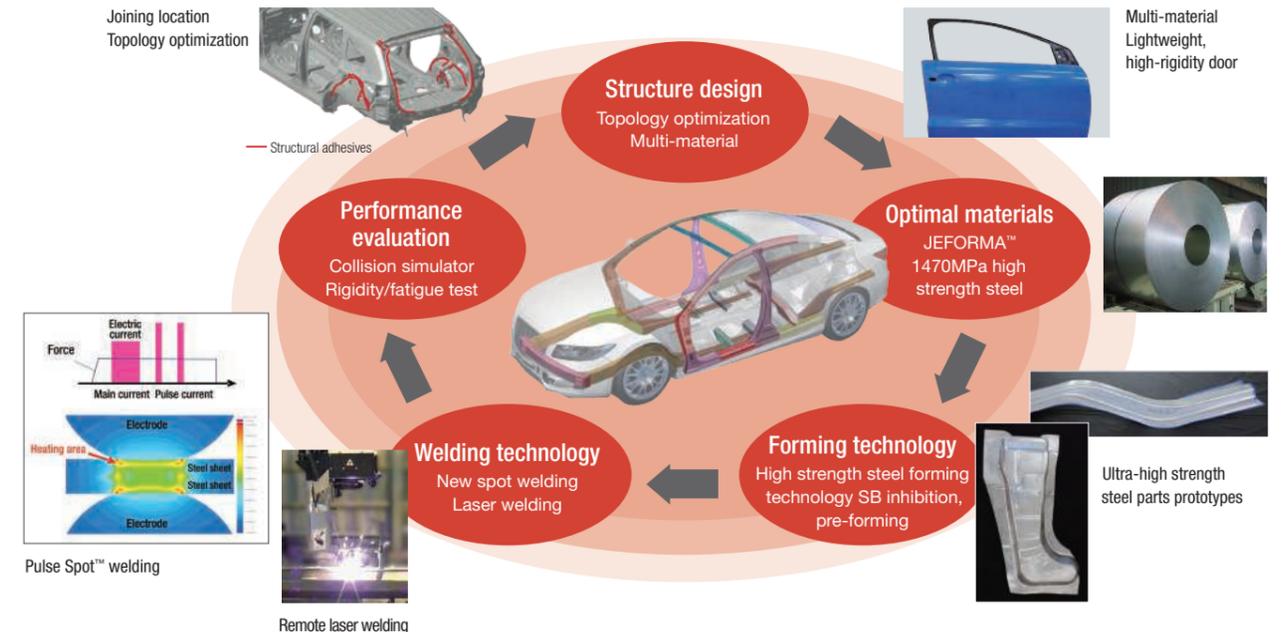
We have also completed development of GA high strength steel with the same tensile strength. Several automobile companies are looking to make use of this material.



Providing solutions applying high strength steel (EVI)

JFE Steel has been developing its own application technologies to make the best use of high strength steel for manufacturing automobile parts. Application technologies, used for manufacturing parts for automobile manufacturers, are categorized into design, forming, welding, and other categories. The company accurately understands the needs of customers to supply our development technologies to them via a process called Early Vendor Involvement (EVI). The result is a win-win relationship where the company secures and expands sales of newly developed products centering on high strength steel, while its customers achieve further weight reduction and stability in manufacturing processes.

*EVI means participating in the joint development of new vehicles from the early stage and making technical suggestions to automobile manufacturers at each stage of vehicle design, parts processing, assembly and so on.



System supporting business for the automotive industry

CSL-CCF

The CSL (Customers' Solution Lab.) is an exhibit and experiment combined study center established in the Chiba district in order to conduct joint research working as a team with customers and researchers of the Steel Research Laboratory. Over the total of 5,000 people from 1,200 companies have visited since its establishment in August 2005, leading to new joint development on multiple themes.

The Customers' Center Fukuyama was established in the Fukuyama district in October 2014 so that customers in west Japan in diverse sectors including automobiles, shipbuilding, construction and energy can interact directly with the JFE Group's latest technologies. JFE Steel leverages these bases to offer powerful support to our customers employing high strength steel.



Development of processing technologies and capital investment

Developing the best processing technologies and building facilities to manufacture high strength steel is essential for highly efficient manufacturing and a stable supply. JFE Steel plans to renew old facilities into the latest operations to manufacture high strength steel in Japan, while constructing state-of-the-art manufacturing lines for high strength steel in China, Thailand, Indonesia, and Mexico. We aim to secure further growth by capturing the global demand for automobiles.

Quality assurance system

JFE Steel has adopted the quality management system in accordance with ISO 9001, and has obtained the international standard IATF 16949 certification for the West Japan Works, a JFE Steel's primary manufacturing base for automotive steel sheet. With this as the foundation, we respond to the needs of customers. The company has built a solid quality assurance system through use of its independently developed manufacturing technology and sensors for process monitoring, as well as through product testing utilizing high-precision testing and inspection equipment.

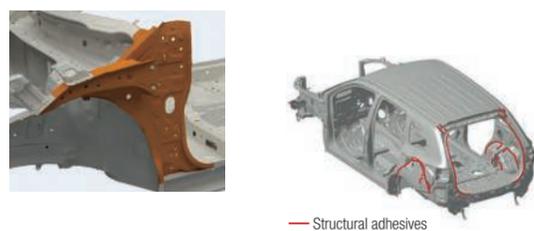
JFE Steel's newly developed proprietary technologies serve various needs, from reducing vehicle weight to improving vehicle comfort and design qualities while reducing manufacturing man-hours for our customers, continuing to be "JFE — the company always chosen by our customers." Shifting to new materials such as aluminum and carbon fiber is gaining attention in recent years, but steel retains its place as the primary material. JFE Steel has accumulated the vast store of knowledge about automobile structure, and this has enabled us to combine steel with other materials (multi-material), creating new value to steel sheets.

Examples of development with JFE's proprietary application technology

1 Topology optimization

Topology optimization technology is an analytical method that retains the necessary elements to satisfy the characteristics required in the given design space, to find the most efficient distribution of materials. JFE's topology optimization technology incorporates the design space (the space where the particular part will be allocated) into a section of the vehicle for analysis, to form the optimum shape for the parts which effectively improve the collision safety with less weight.

This technology was used as a design method for the shaping of parts for SUZUKI MOTOR's Swift Sport, and to determine the areas to apply structural adhesives for MITSUBISHI MOTORS' OUTLANDER PHEV S Edition and other cars.



2 New spot welding technology

Spot welding joins overlapping steel sheets placed between two electrodes by applying heavy current to melt them together at that point. It is most commonly used in the assembly of automobiles. However, the more widespread use of ultra-high strength steel in cars in recent years has brought difficulties to construction management of spot welding, placing limits on the design of vehicle structures.

In order to solve these technological challenges, JFE Steel developed J-MAC Spot™ welding, Pulse Spot™ welding, Single-Side Spot™ welding, and Intelligent Spot™ welding. Such technologies are contributing to greater use of ultra-high strength steel.



3 New forming technology (stretch preforming)

We are developing new forming technologies employable for parts difficult to process. Among these, the stretch preforming technology makes it possible to process difficult shapes by optimizing the shape in the first stage of the standard two-stage press working. It can be applied to, regardless of the strength of the steel, from soft steel to ultra-high strength steel, helping to improve the performance and design qualities of all types of parts while also reducing the weight.

This forming technology has successfully been employed to create an air spoiler integrated back door, demonstrating the potential for manufacturing low cost parts with high design qualities.



4 Supporting multi-material

We propose multi-material structures incorporating lightweight materials like resins so that customers can achieve the goals of further reduction in vehicle weight, and thus we are contributing to weight reduction of vehicles.

Newly developed doors were designed using our independently developed topology optimization technology. Optimal arrangement of Mitsubishi Chemical's fiber-reinforced resin inside the steel sheet door panel has made it possible to achieve both the improved panel rigidity and substantial light weight due to the thinner panels. By combining steel with other materials in this way, we work to offer even greater performance and ways to reduce weight, and maintain and expand the applicability of steel sheets.

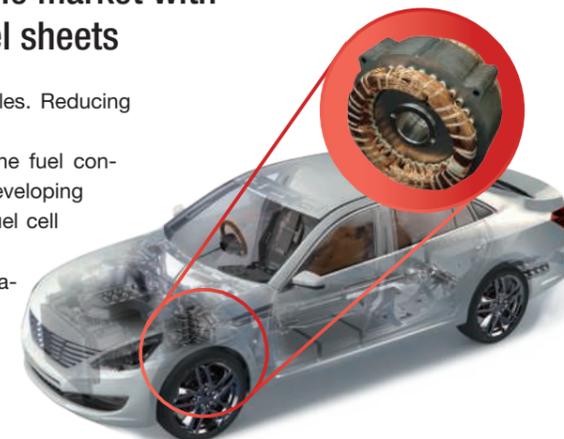


Strategy 2 Capturing the electric vehicle market with cutting-edge electrical steel sheets

About 20% of Japan's CO₂ emissions come from automobiles. Reducing such emissions has been a vital issue.

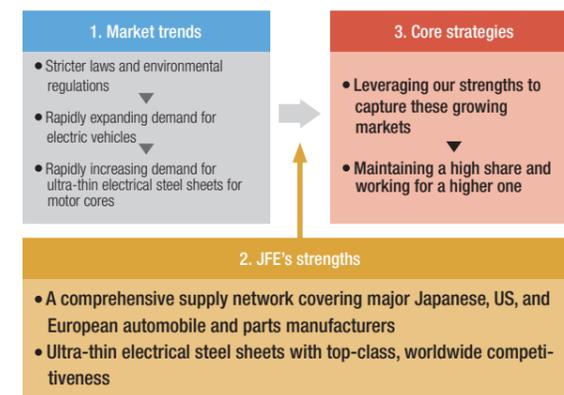
Automobile companies are working urgently to improve the fuel consumption of gasoline-fueled cars while at the same time, developing hybrid electric vehicles (HEVs), electric vehicles (EVs), and fuel cell vehicles (FCVs).

JFE Steel's non-oriented electrical steel sheet is used by major automobile manufacturers as a core material in these motors that are the central element of electric vehicles, helping to make them more compact and efficient.



Core strategies

- The adoption of electric vehicles will expand the demand for high-grade electrical steel sheets that allow smaller yet more efficient motors.
- The ultra-thin electrical steel sheets developed by JFE Steel are designed to achieve low iron loss, and so making motors more efficient. Working together with JFE Shoji Trade, JFE Steel has established a broad global supply network and a high-powered service system.
- By using our strengths to capture more and more of the growing electric vehicle market, we are expanding our business and contributing both to our customers and to a sustainable society.



Characteristics required for electrical steel sheets

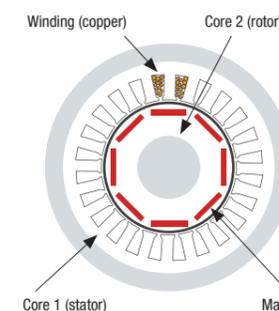
Characteristics	Performance	
	High efficiency	High torque
Low iron loss	<ul style="list-style-type: none"> • Reduction of heat generation • Reduction of iron loss • High efficiency 	—
High magnetic flux density	<ul style="list-style-type: none"> • High power at low current • Reduction of copper loss • High efficiency 	<ul style="list-style-type: none"> • Strongly magnetizing core • Generate strong rotational force

Electric motors work through an electrical current which flows through the copper wire wound around the edge of the first core (the stator) which rotates the second core (the rotor), causing the motor to rotate.

The problem is that the motor efficiency decreases due to the generation of heat caused by the current flow through the copper wire (copper loss) and the magnetic flux through the iron core (iron loss).

If magnetic flux is easily generated in the core (high magnetic flux density), the core becomes a powerful magnet, generating a strong rotary force (high torque).

From this, the two characteristics that are required for electrical steel sheets used in motor cores are low iron loss and high magnetic flux density.



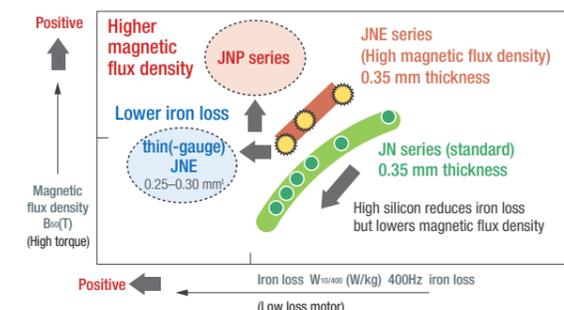
A product lineup satisfying diverse needs

For lower iron loss of non-oriented electrical steel sheets suited to motors, adding silicon (Si) is effective, but it has the disadvantage of lowering the magnetic flux density.

JFE's JNE series solves this problem with a higher magnetic flux density than our previous JN series, and so has achieved a fine balance between the magnetic flux density and iron loss, greatly contributing to a much more technically challenging.

The characteristics required for motors for electric vehicles in recent years have consistently become more and more advanced.

In order to meet all these demands, JFE Steel works to differentiate itself from the competitors by commercializing the JNP series with an even higher magnetic flux density, as well as the thin-gauge JNE series which gives even lower iron loss, to meet the requirements of electric vehicles with world-class performance.



01 Strategy 3 Global rollout matched to customer needs and market expansion

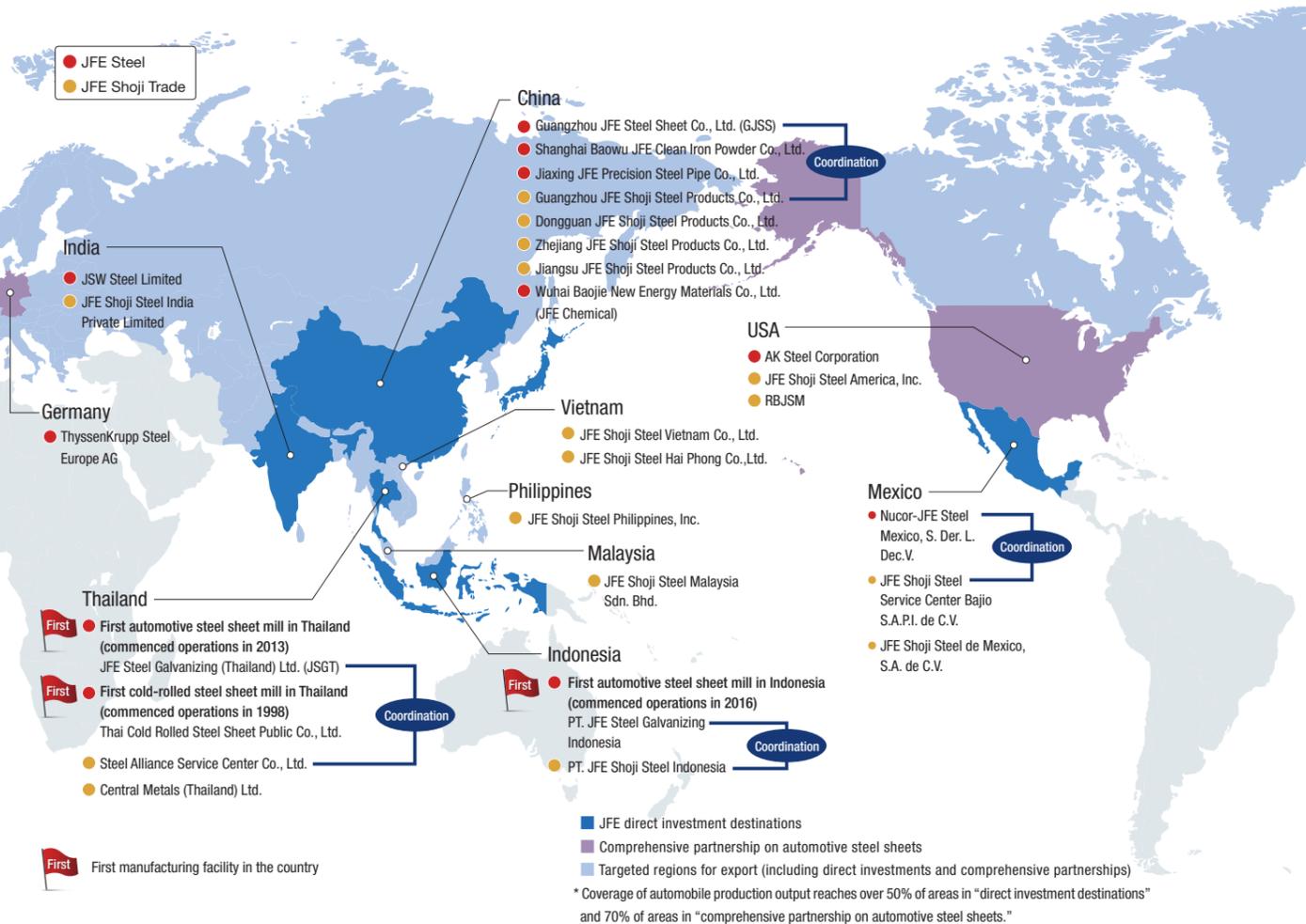
Basic policy

The JFE Group has actively expanded its business to other countries, centering on Asia in particular, to capture the growing demand for steel. We will also establish a base in Mexico in order to tap into the vast North American market.

The advanced technologies and expertise cultivated in Japan allow us to provide high quality steel materials matched to local needs at the right times.

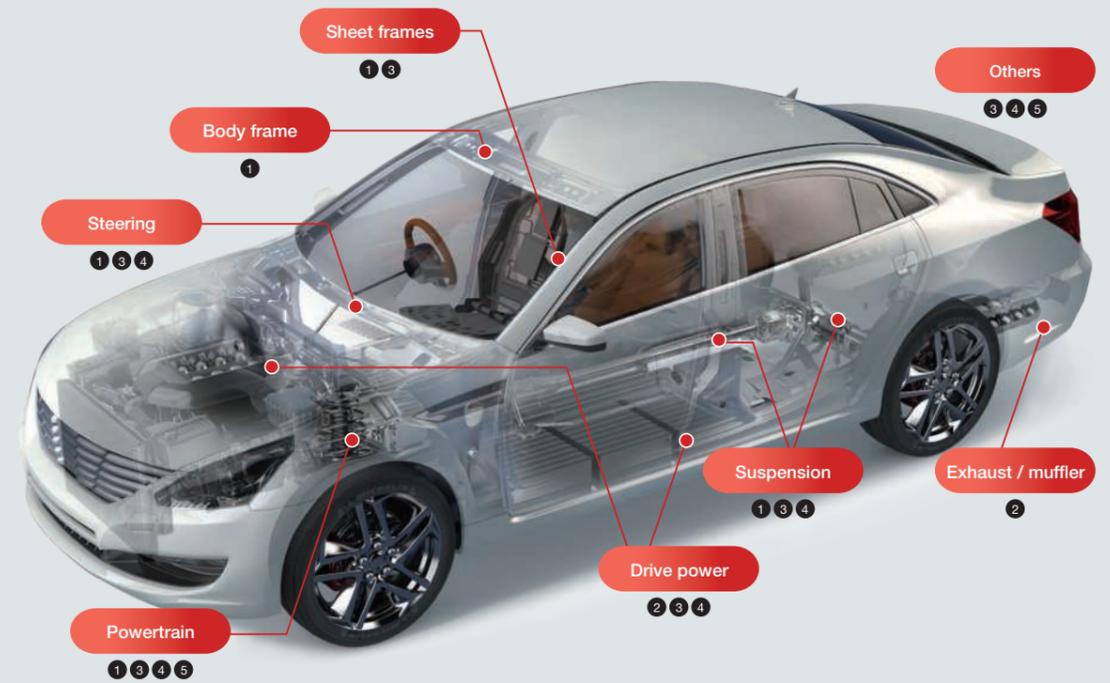
Main measures

- Asia** → We are capturing growing markets by actively constructing new manufacturing lines and capital participation in local mills. In the ASEAN region in particular we have established footholds ahead of our competitors.
- Mexico** → New lines are going into operation in 2019, to gain access to the growing North American and Mexican markets.
- USA/ Europe** → JFE Steel has entered into a comprehensive partnership for automobile steel sheets with AK Steel and ThyssenKrupp AG, to bring JFE's cutting edge technologies to customers in the U.S. and Europe.
- Group coordination** → Through coordination with JFE Shoji Trade, JFE Steel has established an integrated supply chain from production to distribution. Group companies are also accelerating their expansion overseas, with various merchandise such as iron powder, steel pipes, and more.



Strategy 4 Satisfying multiple needs via a broad product lineup and collective Group power

With access to product lineup of not just high strength steel sheets and electrical steel sheets but also steel pipes, stainless steel, steel bars and wire rods and iron powder, as well as the non-ferrous products and components of other Group companies, JFE Steel meets various needs including greater performance such as car's ride quality, reduced costs and greater productivity in the manufacturing processes of our customers.



Product type	Characteristics / main products	Product type	Characteristics / main products
1 Steel pipes	The combination of developing materials (steel pipes) plus secondary processing, developing evaluation and testing technology allows closed-sectional structures particular to steel pipes, contributing to (1) high rigidity, (2) lighter weight, and (3) reduced costs. Product example: HISTORY™ steel pipes	4 Iron powder	A lineup covering a wide range of powder metallurgy applications, such as pure iron powder with excellent compressibility and forming properties, or various types of alloy steel powders for high-strength parts, contributing to lighter weight and better productivity. Product example: FM series of nickel-free high-strength alloy steel powder
2 Stainless steel	Contributing to lower fuel efficiency and reduced exhaust gas emissions of internal combustion vehicles with highly heat-resistant and highly processable stainless steel sheets. Product example: TF1™ (received the Minister of Economy, Trade and Industry's Award at the Monodzukuri Nippon Grand Awards 2015)	5 Non-ferrous/ components	Proposing new materials through the comprehensive resources of the JFE Group. Product example: High performance electrode material, KP sheet (JFE Chemical) Hydrogen station tank, high pressure gas cylinder (JFE Container)
3 Steel bars and wire rods	Contributing to longer product life via advanced cleanliness technology ¹ and reduction of processes resulting from better cold forming properties through controlled rolling and deposition control. ² Product example: *1 Long-lasting bearing wire rod, *2 JECF™		

For more details: <https://www.jfe-steel.co.jp/products/car/index.html> (only in Japanese)

With customers

Flexibly adapting to changing markets with years of experience and cutting edge technological capabilities
The JFE Group—Always chosen by our customers

The automobile industry is in an age of transformation. Both stricter environmental regulations and the shift to electric vehicles are making vehicles lighter, with smaller and more efficient power sources required particularly in the shift. Yet the automobile industry is expected to continue to grow worldwide, including for conventional engine-powered cars. JFE Steel is committed to meeting diverse needs and maintaining its role as a partner always chosen by our customers by leveraging our wide-ranging product lineup of steel materials, from high-strength steel with superior processability like JEFORMA™ to high performance electrical steel sheets together with our ability to make technology proposals and timely deliveries. Through our strategic global supply network and product development capabilities precisely focused on customer needs, we continue to create and supply new value to the world.



JFE Steel Corporation Representative Director and Executive Vice President
Toshinori Kobayashi