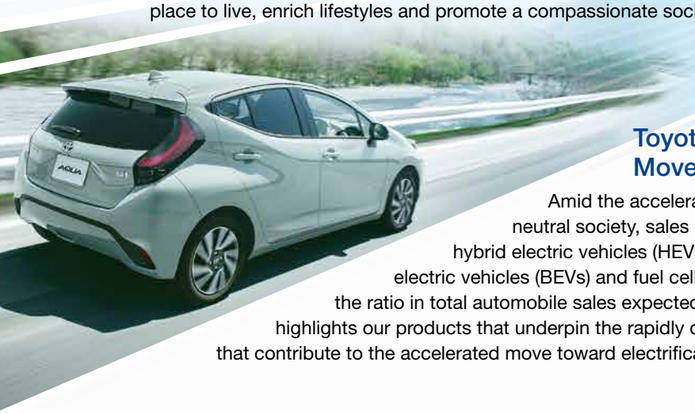
Development of Technologies and Products Contributing to the Resolution of Social Issues

Seeking Further Growth by Evolving and Enhancing Electrified Products We Have Developed Ahead of the Times

In order for car electrification to evolve further, various related devices, including batteries, motors, inverters, converters, car air-conditioning compressors and charging stands as part of social infrastructure, must follow suit. Toyota Industries' products offer not only excellent motor power, driving performance and a comfortable vehicle interior but also greater utility in recreational activities and during disasters. While achieving many accomplishments in these fields, we have also made a foray into new fields. As a key player in the era of electrification, as well as toward establishing a decarbonized society and realizing carbon neutrality, we will accelerate the development and release of electrified products that help reduce CO_2 emissions, thereby contributing to making the earth a better place to live, enrich lifestyles and promote a compassionate society.



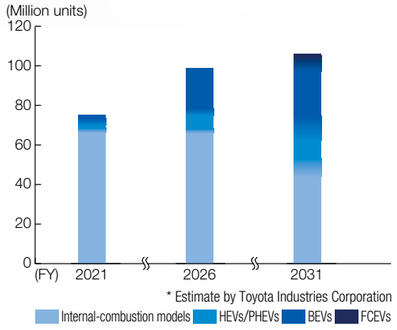
Toyota Industries' Roles in the Accelerated Move toward Electrification

Amid the accelerated global move toward the realization of a carbon neutral society, sales of various types of electrified vehicles, including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs), have been growing, with the ratio in total automobile sales expected to increase sharply in the future. The following highlights our products that underpin the rapidly changing era of car electrification and businesses that contribute to the accelerated move toward electrification.

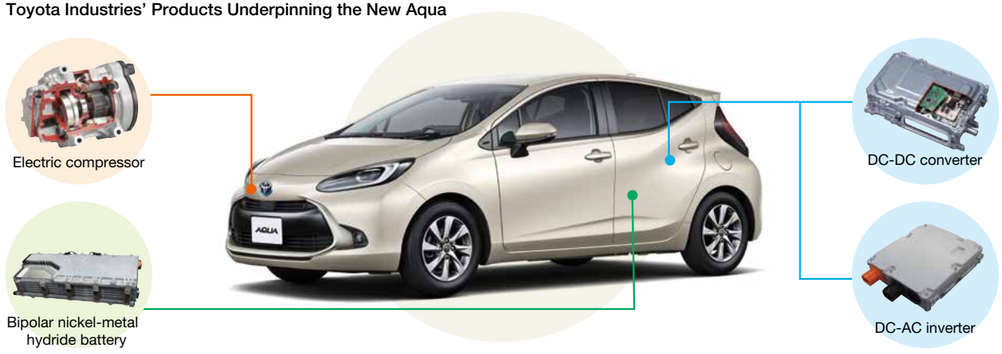
Expanding Lineup of Electrification-Related Products

The new Aqua released by Toyota Motor Corporation (TMC) in July 2021 is equipped with a number of Toyota Industries' electrification-related products that include not only a newly developed bipolar nickel-metal hydride battery but also an electric compressor, DC-AC inverter and DC-DC converter. We have also developed and have been manufacturing products for FCEVs and charging stands, which play an important role as part of social infrastructure. Leveraging our technologies cultivated in these fields to date, we will develop new products and contribute to the expansion of the electrified vehicle markets.

Outlook of Global Automobile Production



Toyota Industries' Products Underpinning the New Aqua



Three Fields Contributing to the Evolution of Electrified Vehicles

Development and Commercialization of On-Board Batteries

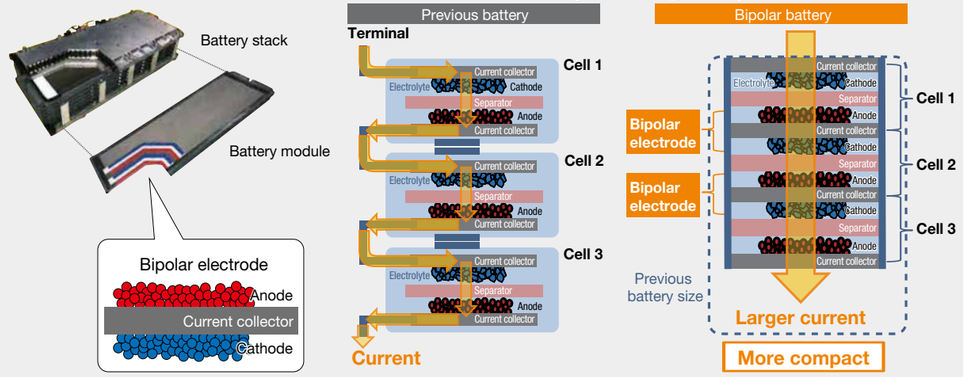
Toyota Industries worked together with TMC and developed the HEV-use bipolar nickel-metal hydride battery fitted in the Aqua. Due to its bipolar structure, which has been adopted for the first time in the world in an on-board battery, the new product has achieved approximately twice the output of the conventional battery equipped in the previous-generation Aqua. It has realized unprecedented battery performance, offering both smooth acceleration from low speed and greater fuel efficiency through a longer driving range in the EV drive mode.

World's First Use* of the Bipolar Structure

* As an electric drive battery

- **Feature 1** Simple structure with less parts, which make a battery more compact
- **Feature 2** Wider electrical path and lower resistance within the battery, allowing the flow of larger currents
- **Feature 3** Can be fitted in a wide range of vehicle models, as the battery's capacity lineup can be enhanced by just changing the number of modules

More Compact and Higher Output



TOPIC

Ishihama Plant

Development of the On-Board Battery Business

In developing the bipolar nickel-metal hydride battery, Toyota Industries has made thorough efforts to raise the level of its products based on the technologies it has cultivated to date, namely battery material synthesis technology, simulation technology for examining materials and structures and analysis technology. These efforts have led to the successful development of the battery. Going ahead, we will work on the five elements of safety, long life, high quality, good products at lower prices and high performance, endeavor to ensure stable battery supply and expand our lineup of batteries to suit various vehicle models. We also plan to establish a new production line in fiscal 2023 at the Ishihama Plant, which is located adjacent to the Higashiura Plant.

Offering Electronics Products Responding to Social Needs

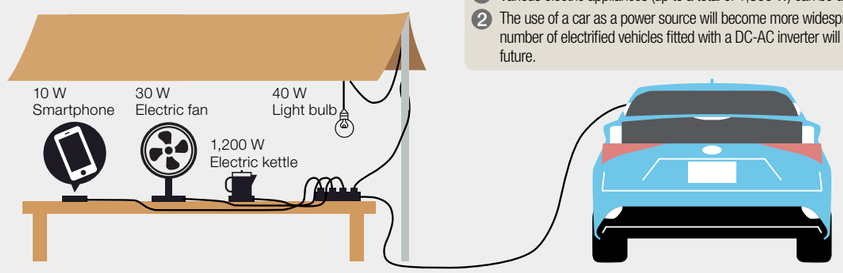
Toyota Industries develops and manufactures electronics products not just for HEVs but also for a wide variety of electrified vehicles. These products, including DC-DC converters and on-board chargers and charging stands for PHEVs and BEVs, respond to the broad needs related to electrified vehicles of TMC and other automakers around the world.

DC-AC Inverter
Converting direct current (DC) from an on-board battery to 100 V alternating current (AC)

DC-AC Inverters Drawing Attention as a Power Source

In recent years, there has been a growing public attention to the use of high-capacity batteries of the Aqua and other electrified vehicles as a power source. The 1,500 W type DC-AC inverter, in particular, can operate appliances that require more power, such as rice cookers and hot plates, and has drawn much attention as an emergency power source in a disaster in addition to camping, outdoor events and other applications.

Electrified Vehicle Supplying Power during a Disaster

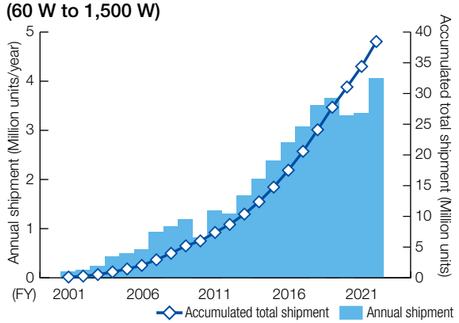


1. Various electric appliances (up to a total of 1,500 W) can be used anywhere.
2. The use of a car as a power source will become more widespread as the number of electrified vehicles fitted with a DC-AC inverter will increase in the future.

DC-AC Inverters Adopted by Automakers around the World

Toyota Industries' DC-AC inverters have steadily increased sales and have been adopted by 26 automakers around the world, including Toyota, Nissan, Honda, Daihatsu, Isuzu, GM and Stellantis. Previously, their vehicles had offered our DC-AC inverter mostly as an option, but the product has been increasingly installed as a standard feature mainly among vehicles manufactured for the Japanese market. The use of DC-AC inverters as a substitute for a power generator has also pushed up the need for even higher output. In the future, we will achieve higher output by increasing efficiency (reducing the amount of heat generation), making our DC-AC inverters more compact for easier vehicle installation, enhancing our product lineup and reinforcing our production structure in responding to the need that will grow in step with the progress in electrification.

Shipment Volume of DC-AC Inverters (60 W to 1,500 W)



TOPIC

Development of a New Unit Integrating an On-Board Charger and DC-DC Converter

For the new bZ4X BEV released by TMC in April 2022, Toyota Industries has developed a new compact, lightweight unit that integrates an on-board charger and DC-DC converter.

<Key Features>
- By integrating these two devices essential for a BEV, the new unit is made 23% smaller in size and 17% lighter in weight versus separately mounting the two.
- Easier vehicle mounting has also contributed to providing more interior space as well as lowering the center of gravity of the dedicated BEV platform adopted for the first time in the bZ series.

Power electronics technologies underpinning the functionality of electrified vehicles, such as the flexible conversion, control and efficient use of electric energy, will become increasingly important. Toyota Industries will remain committed to developing power electronics technologies that enable smaller size, lighter weight and higher efficiency while continuing to provide this two-in-one unit and other car electronics products to support the wider use of electrified vehicles.

Electric Compressor Market Expanding Globally

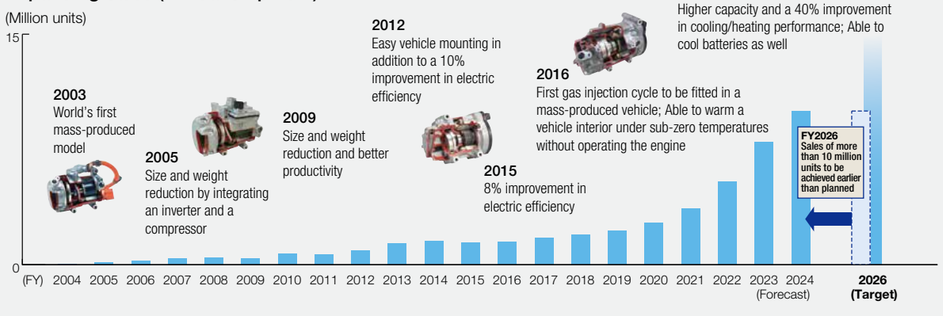
Greater importance has been placed on car air conditioner-related products that help to ensure a comfortable vehicle interior, including our electric compressor fitted in the Aqua. In order to satisfy the diversifying needs of automakers, Toyota Industries' Compressor Division has developed and delivered technologies and products that respond to diversifying customer needs for higher efficiency for longer driving range, quiet operation required in an environment in which an engine is not started and less vibration. For BEVs, which will draw further attention in the future, we provide solutions to improve compressors' radio interference prevention performance, extend their runtime and scope of use for heat pump air-conditioning systems and respond to the need for cooling batteries and peripheral electronic devices.

In this way, we offer a broad range of products not just for HEVs but also for PHEVs, BEVs and FCEVs, thereby enabling us to readily respond to customer needs in line with the growth of these electrified vehicle markets.

Actual Sales and Sales Targets of Electric Compressors

Orders for electric compressors for HEVs accounted for a large portion of total orders. In recent years, we have been receiving more orders for electric compressors for PHEVs and BEVs, and their sales have been showing a sharp increase in total unit sales. Toyota Industries has set a target to sell more than 10 million electric compressors in fiscal 2026. It has already become apparent that we can achieve the target earlier than planned because our electric compressors have been adopted in TMC's all electrified models and sales have expanded to other automakers in and outside Japan. As for production, we currently manufacture electric compressors in Japan and China in view of production efficiency. We do, however, have a plan to manufacture these compressors in North America and Europe to respond to a rise in demand, as manufacturing and supplying products closer to customers will lead to greater competitiveness.

Expanding Sales (Annual Shipment)

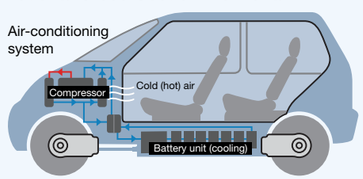


TOPIC

High-Capacity Electric Compressor

As a BEV is fitted with a battery and many electronic devices, its temperature tends to rise when operating under high output or recharging at high speed, causing a drop in performance or a shorter life. To address this issue, Toyota Industries has developed a high-capacity electric compressor that can be used for both cooling/heating a vehicle's interior and cooling its battery. We will work to increase the number of models fitted with the compressor, and by developing more compressors in the same series, will satisfy customer needs that may arise with the more widespread use of BEVs.

Notional Cross-Section View of a BEV



The high-efficient, high-capacity electric compressor is capable of both air-conditioning the interior of a BEV and helping to cool its battery and other devices.

<Key Features>
- A higher speed achieved while keeping a capacity increase at 20%, leading to a 40% better cooling performance than existing products
- Revamping of the compressor structure resulting in a life more than twice as long as existing products
- Achieving very quiet operation suited for electrified vehicles

<Technical Features>
- Improved rotational balance to allow quiet operation at high-speed rotation
- As a measure to increase the compressor's life, higher bearing reliability in particular serving to realize a life more than twice as long as existing products

Materials Handling Equipment

As a market leader with an extensive knowledge of global logistics needs, Toyota Industries provides a range of materials handling equipment, mainly lift trucks, and logistics solutions to customers.

Link to product details

Medium-Term Direction of Business

We will work to develop and propose new products and services incorporating cutting-edge technologies through the proactive use of open innovation and co-creation with customers.

Our goal is to become the logistics solutions partner of the first choice for customers by meeting their wide-ranging needs and helping them increase their logistics efficiencies based on the Toyota Industries Group's comprehensive strengths covering both the lift trucks and logistics solutions fields.

Business Characteristics

Strengths

- An extensive logistics-related product lineup both for lift trucks (internal-combustion type, electric type, fuel cell (FC) type, etc.) and logistics solutions products (automated storage and retrieval systems, automatic guided vehicle (AGV) systems, automated lift trucks, etc.)
- High technological capabilities, including those linked to environmental and safety performance
- Production know-how that ensures high levels of quality and production efficiency
- Global, well-developed production, sales and service networks
- An extensive value chain encompassing in-house development and production of engines, motors and other key components; total after-sales services including maintenance and inspections as well as operational management; and sales financing operations offering more options in sales
- No. 1*1 in lift truck unit sales in the world
- A wealth of experience and know-how as well as a global network in the Logistics Solutions Business
- Software development capability to create such systems as a warehouse management system

*1: Survey by Toyota Industries Corporation

Opportunities

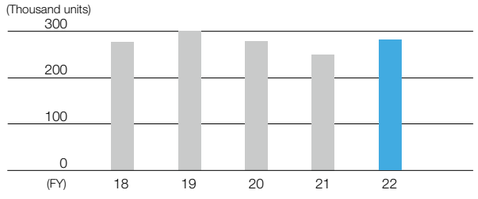
- An expansion of global logistics volume in line with an increase in the world population and economic growth
- Growing need for products with high fuel efficiency and low environmental impact that contribute to carbon neutrality
- Rising need for higher logistics efficiencies prompted mainly by a growth in e-commerce transactions as well as soaring labor costs and labor shortages
- Growing need for automation and labor saving driven by the emerging need for contactless operations due to COVID-19
- Increased recognition that logistics is an essential business

Risks

- Restrained capital investment due mainly to a slowing economy and disasters
- Weaker sales due to intensifying competition
- Change in business environment triggered by an expanding market of low- to mid-priced lift trucks
- Suspension of production caused by supply chain disruptions
- Weaker demand for internal-combustion lift trucks resulting from more stringent environmental regulations
- Emergence of next-generation robotics products as an alternative to lift trucks

Net Sales	Operating Profit
FY2021	FY2021
¥1,431.4 billion	¥109.9 billion
FY2022	FY2022
¥1,789.4 billion	¥113.6 billion

Materials Handling Equipment Sales



Business Overview in Fiscal 2022

The lift truck market in 2021 expanded significantly due to the reactionary rebound in demand from the effects of COVID-19 and exceeded sales of 2 million units for the first time. Amid this business climate, Toyota Industries engaged in sales and after-sales services corresponding to respective markets. As a result, unit sales of lift trucks for fiscal 2022 were up 32,000 units, or 13%, to a total of 282,000 units from the previous fiscal year. In addition, the need for logistics automation and labor saving is rising in step with an expansion of the e-commerce market. Capitalizing on this development, we have sought to further strengthen our business through collaboration with our subsidiaries engaging in logistics solutions operations in Europe and the United States. Net sales in fiscal 2022 increased ¥358.0 billion, or 25%, from the previous fiscal year to ¥1,789.4 billion.

Business Structure

Toyota Industries' Materials Handling Equipment Business is operated under a two-organization structure: Toyota Material Handling Group (TMHG) responsible for the Lift Truck Business and Toyota Advanced Logistics Group (TALG) engaging in the Logistics Solutions Business. TMHG and TALG collaborate with each other to achieve overall growth of the Materials Handling Equipment Business while reinforcing individual businesses.

Toyota Material Handling Group (TMHG)

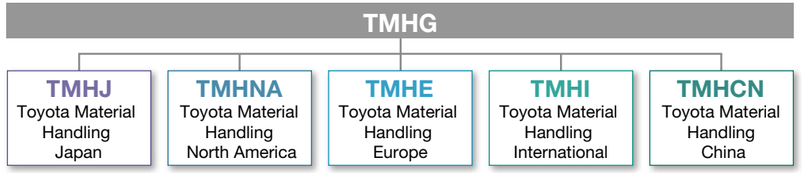
Toyota Industries assists customers worldwide in attaining greater logistics efficiencies as a market leader in the materials handling equipment and logistics fields by delivering optimal logistics solutions based on its comprehensive strengths to respond to their specific and ever-changing needs on a global scale.

Under the TMHG management structure, we engage in the Lift Truck Business under the TOYOTA, BT, RAYMOND, CESAB and Tailift brands. Mutually utilizing the development and sales strengths of each brand, TMHG is promoting business globally.

We basically carry out product development in three regions, namely Japan, North America and Europe. Based on this structure, we develop and manufacture products in each region, which are matched to the specific local needs and characteristics, and ensure quick product delivery to customers. At the same time, we seek greater product appeal by conducting in-house development and production of such key components as engines and motors, which greatly influence the performance of lift trucks. In response to the enforcement of stricter environmental regulations and growing eco-consciousness worldwide, we are improving the energy-saving performance and enhancing our electric lift truck lineup. We are also promoting the development of autonomous driving technology as a response to growing needs for greater logistics efficiencies mainly driven by labor shortages.

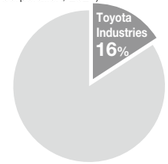
In addition to supplying high-quality products, we consider our strength to be able to support customers throughout our entire value chain that encompasses from providing after-sales services through our extensive networks to offering sales financing operations. On the sales front, we are offering products and logistics improvement solutions optimally matched to individual customers' logistics sites. Simultaneously, we are responding to needs for fleet management that optimizes the operation of multiple lift trucks for customers conducting business globally. In terms of services, we assign experienced and highly skilled personnel and utilize leading-edge information technology (IT) to provide finely tailored services to customers. Our service personnel visit customers on a periodic basis and provide maintenance services to prevent troubles from occurring. When a problem does occur, they swiftly make a visit to the customer and promptly take appropriate action. We are also strengthening our internal sales financing operations mainly in Europe, the United States and other developed countries in order to flexibly respond to customers' diverse needs. Additionally, TMHG is collaborating with TALG to create synergies between the lift trucks and logistics solutions fields in development and other domains.

Toyota Material Handling Group



The Toyota Material Handling Group possesses several brands such as TOYOTA, BT and RAYMOND and engages in business by dividing the world into five areas: TMHJ (Japan), TMHNA (North America), TMHE (Europe), TMHI (Asia, Australia, etc.) and TMHCN (China).

Toyota Industries' Global Lift Truck Market Share
(Survey by Toyota Industries Corporation, 2021)



World No. 1

Main Products


Electric lift truck


Reach-type electric lift truck


Electric low lift truck


Internal-combustion lift truck


Automated lift truck

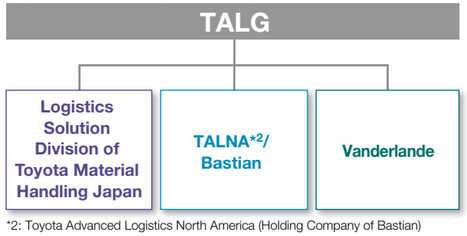
Toyota Advanced Logistics Group (TALG)

With accelerated expansion of the e-commerce market, the need for logistics automation has been on the rise across the world. This has entailed increases in the number and size of distribution centers, which in turn have necessitated solutions for more advanced logistics issues.

Amid this environment, we go a step beyond just providing a broad range of materials handling equipment and associated software programs and are reinforcing our Logistics Solutions Business to more meticulously satisfy each customer's varying needs by leveraging our logistics improvement know-how accumulated to date.

Under the TALG management structure, the Logistics Solution Division of Toyota Material Handling Japan, U.S.-based Bastian Solutions LLC and Netherlands-based Vanderlande Industries Holding B.V. are collaborating with each other in development, sales and other activities to expand business while leveraging their individual strengths.

Toyota Advanced Logistics Group



*2: Toyota Advanced Logistics North America (Holding Company of Bastian)

Under TALG, the Logistics Solution Division of Toyota Material Handling Japan, Bastian and Vanderlande work together to promote the Logistics Solutions Business on a global scale while leveraging their individual strengths.

Main Products and Systems

Automated storage and retrieval system

Simple AGV

Sorter

High-speed storage and picking system

Airport baggage handling system

Business Activities in Fiscal 2022

In 2021, global demand recovered significantly due to the reopening of economic activities in respective countries, which led to record-high unit sales in the lift truck market. Amid this environment, we worked to enhance the product appeal of our mainstay lift trucks and expand sales. We also strove to offer reliable after-sales services, enhance responsiveness to large-order customers and provide solutions for logistics issues through the introduction of optimally packaged systems.

In the field of lift trucks, we made efforts to increase our product lineup in each region and promoted the development of autonomous driving technology internally and with external organizations. We also worked to reinforce our IT-based services, enhance safety and augment our competitiveness in the environmental field mainly through electrification in order to ensure a more accurate response to individual customers.

In the logistics solutions field, we have been fostering cooperation in sales activities by mutually supplying equipment and systems while encouraging each TALG company to leverage its strengths to bolster business. We have also been accelerating coordinated activities such as promoting collaborative efforts by TMHG and TALG in the planning and development fields. T-Hive B.V., a company newly established in the Netherlands in April 2021, develops a seamless control system encompassing all autonomous vehicles within the Toyota Industries Group, such as automated guided forklifts (AGFs), automated guided vehicles (AGVs) and autonomous mobile robots (AMRs).

Meanwhile, Aichi Corporation, which possesses the top brand*3 in the field of aerial work platforms in Japan, saw a recovery in renewal demand in the electric power industry. However, cautious investment targeting construction demand in the leasing industry resulted in sales of ¥56.5 billion, down ¥2.7 billion, or 5%, from the previous fiscal year.

*3: Survey by Aichi Corporation

Aichi Corporation's aerial work platform

Activities of TMHG

Japanese Market

In 2021, the environment surrounding the Japanese lift truck market continued to be difficult due mainly to intermittent declarations of a state of emergency caused by COVID-19, resulting in only a slight increase in sales from the previous year. Unit sales of Toyota Industries' lift trucks increased 4% from the previous fiscal year to 47,000 units, and maintained the top position*4 in calendar 2021 for the 56th consecutive year.

The diversification of customer needs, heightened on the back of changes such as an expansion of the e-commerce market, labor shortages and growing safety and environmental consciousness among companies, has further accelerated amid the COVID-19 pandemic. As the leading manufacturer of materials handling equipment, Toyota Industries has been proactively promoting the development and release of new products that lead to resolving issues facing customers.

As with the automobile industry, where development has been proceeding for cars equipped with advanced safety technologies, the logistics industry is facing a growing need for more widespread use of lift trucks equipped with functions to support safe and secure operations. In August 2021, we released SEnS+ (Sense Plus), the industry's first operator assist system that detects workers behind lift trucks. It distinguishes between pedestrians and objects from among the obstacles behind lift trucks and automatically controls the traveling speed and prevents the truck from moving backward.

SEnS+

Together with our autonomous towing tractor, SEnS+ was awarded the 2021 Good Design Award for its ingenuity in distinguishing and recognizing pedestrians from objects and giving different warnings. In addition, the autonomous towing tractor was selected as one of the Good Design Best 100, which is awarded to the designs that draw particular attention of the judges as exceptional designs considered to create and inspire the future from among the recipients of the Good Design Award.

In October 2021, we launched the new 3TE25 electric towing tractor as an environmentally conscious materials handling equipment. The aviation industry, which is a major user of towing tractors, has been also making efforts to reduce CO_2 emissions. We aim to contribute to carbon neutrality at airports and other facilities by satisfying the replacement needs for electrification of towing tractors.

*4: Calculated by Toyota Industries Corporation based on the data issued by the Japan Industrial Vehicles Association

Autonomous towing tractor

North American Market

The North American lift truck market in 2021 outperformed the previous year thanks to growing demand from the e-commerce sector and a recovery in the retail sector. Although we suspended the shipment of certain internal-combustion lift trucks sold in the United States, we recorded solid sales of electric lift trucks and other products. In fiscal 2022, the combined unit sales of the TOYOTA and RAYMOND brands decreased by 5% from the previous year to 76,000 units.

In 2021, Toyota aggressively launched new electric lift trucks in response to growing market needs for electrification. In addition, to meet the rising need for logistics automation on the back of labor shortages, we released an automated guided vehicle (AGV) that can be customized according to customer needs and requires no large-scale building modifications.

Raymond is also actively expanding its product offerings and services to meet various customer needs. For example, Raymond enhanced sales of compact and highly functional lithium-ion batteries that reduce the charging time compared with conventional lead-acid batteries and contribute to the improvement of customer productivity. Raymond is also contributing to the further improvement of customer safety by releasing an electric low lift truck equipped with a telematics function and launching a service to support driving in dangerous areas by linking the telematics function with the real-time location system.

Looking ahead, we will continue to leverage the strengths of each brand and reinforce technological development to meet electrification needs. In addition, through closer collaboration with the Logistics Solutions Business, we will accurately respond to customers' needs for logistics automation. At the same time, we will strive to expand the lineup of products with excellent environmental performance, while responding to the accelerating trend toward carbon neutrality by utilizing the latest technologies.

Customizable AGV

Link to product details

New electric low lift truck

Link to product details

European Market

The European lift truck market in 2021 grew year on year thanks to a recovery from a downturn during the COVID-19 pandemic. Toyota Industries posted unit sales of 92,000 units in fiscal 2022, up 20% from the previous fiscal year compared to the pre-COVID-19 level. In addition to equipment sales, orders for after-sales services and sales of parts remained steady.

In response to the accelerating trend toward carbon neutrality in Europe, Toyota Industries has been working to expand the lineup of products equipped with lithium-ion batteries and released a high-output counterbalanced lift truck. We have also launched internal-combustion lift trucks that comply with the latest EU emissions regulations to meet the needs of environmentally conscious customers.

In terms of environmental initiatives, electricity used at all European bases has been completely switched to renewable energy by selecting the optimum method matched to each base's energy situation. This marks the first instance in the entire materials handling equipment industry that 100% of power is sourced from renewable energy at all European bases.

We will continue to expand our product lineup with excellent environmental performance, while responding to the accelerating trend toward carbon neutrality.

High-output counterbalanced lift truck

Link to product details

Solar panels installed at plants in Sweden (left) and Italy (right)

ALOMA and Chinese Markets

Toyota Industries covers the ALOMA markets of some 60 countries in Asia, Latin America, Oceania, the Middle East and Africa as well as the Chinese market. We are serving these markets with a lineup consisting of TOYOTA, BT, RAYMOND and Tailift brands.

The ALOMA and Chinese markets in 2021 expanded significantly due to the resumption of economic activities that were temporarily restricted in many countries following the rapid spread of COVID-19 infections. Both the ALOMA and Chinese markets recorded the largest ever expansion, growing 156% and 128% year on year, respectively.

Under such circumstances, we are working to expand the introduction of lithium-ion batteries and release compact electric stackers to meet the needs for electrified equipment whose demand is expected to increase in step with heightened environmental awareness.

BT Tyro SHE100 compact electric stacker

Link to product details

Customer needs will continue to diversify, including the accelerating trend toward electrification, greater logistics efficiency and automation. In response, we will continue to collect information from dealers in each country and regional offices in Asia, the Middle East and South America in our efforts to provide products and services that satisfy our customers.

In addition, jointly with dealers, Toyota Industries operates a program to promote sales activities with a focus on logistics improvement solutions and has been making proposals to visualize customers' logistics sites, improve their safety and reduce costs. Through the program, we have been strengthening our relationships of trust with customers and have successfully expanded our business domains.

In the field of after-sales services, we have established a structure to provide swifter and more efficient after-sales services by centrally and digitally managing information on lift trucks owned by customers and their history of repairs. We are putting in place a structure to offer extensive after-sales services by establishing a system to certify dealers' after-sales service facilities and offering programs to train service staff so that customers can use our products with an increased sense of reassurance.

As a total solutions partner capable of satisfying diverse logistics needs, we will make concerted efforts with dealers in each country to undertake various initiatives.

Activities of TALG

Logistics Solution Division of Toyota Material Handling Japan

The spread of COVID-19 infections has had an impact on the logistics industry. It brought about a further increase in small cargo deliveries arising from the rapid growth of the e-commerce market, an emerging need for non-contact, non-face-to-face work operations and a renewed recognition of the social value of logistics (essential business). In addition, the imminent shortage of truck drivers will present a serious issue as the work style reform-related law goes into effect in 2024 in Japan, which further increases expectations for automation and greater efficiency through logistics solutions.

Amid such changes in the environment, the number of large-scale projects to introduce the latest equipment from Vanderlande is steadily growing, and ZOZO Co., Ltd., which operates a mail-order website for fashion items, became the first company in Japan to adopt the Pocket Sorter™. The versatile system realizes significant labor savings by automating the storage, sorting and picking processes of goods packaged in a diverse variety of styles. We will continue to contribute to the greater efficiency of logistics with the aim of approaching customers in a wide range of sectors suitable for the introduction of this system.

Moreover, there is an urgent need for better efficiency and labor saving at relay centers (logistics nodes) to counter the serious shortage of truck drivers. As such, we have participated in the demonstration projects*5, 6 promoted by Japan's Ministry of Economy, Trade and Industry and have been developing automated guided forklifts (AGFs).

Looking ahead, we will continue to participate in various demonstration projects. At the same time, we will strive to provide new logistics solutions quickly and in a timely manner by utilizing digital transformation (DX) technologies such as Digital Twin, which creates a virtual replication of an actual environment on a computer to enable running a variety of simulations, in order to achieve more efficient development.

*5: Partnered with NEXT Logistics Japan Co., Ltd. and participated in the 2021 R&D and Demonstration Project to Improve Transportation and Delivery Efficiency through Visualization, Mixed Loading and Automation to work on a feasibility test on automatic truck handling.

*6: Partnered with Daiwa House Co., Ltd., Aeon Global SCM Co., Ltd., Kao Corporation and Hitachi Transport System, Ltd. and participated in the 2021 Project to Further Promote Transport Efficiency by Utilizing AI, IoT, etc., a joint undertaking aimed at improving the efficiency of cargo handling and logistics as well as energy savings in the entire supply chain by utilizing AGFs and other materials handling equipment and linking them with truck operations.

Automated truck loading/unloading by AGF

Simulation in an airport environment

Bastian

Bastian, mainly operating in the North American market, has been responding to the logistics automation needs of customers in a broad range of fields, including the manufacturing, retail and e-commerce sectors, and receiving an increasing number of orders.

Based on a wealth of know-how accumulated in past projects, Bastian is well recognized by customers for its capabilities for system development and integration. It received record-breaking orders in fiscal 2022 thanks to the acquisition of repeat orders for large-scale projects.

Capitalizing on its strengths in technology development, Bastian has been promoting collaboration with other companies in the Toyota Industries Group. For example, Bastian has received, jointly with Vanderlande, orders for multiple projects of leading e-commerce operators and provides software programs to the Logistics Solution Division of TMHJ. In North America, Bastian has also been accelerating its offering of logistics solutions to lift truck users by reinforcing collaboration with dealers of the TOYOTA and RAYMOND brands.

Providing logistics solutions to lift truck users

Link to product details

Vanderlande

Vanderlande, offering logistics solutions globally, has received many orders from leading companies in various business categories for their projects to establish distribution centers, capturing growing needs prompted by COVID-19 for more advanced logistics in the e-commerce, retail and parcel services sectors. For the warehouse logistics and parcel/postal services businesses, Vanderlande has been accelerating system development respectively optimized for operations of industry's top companies and focused business categories in its efforts to strengthen its response to increasingly sophisticated customer needs.

In the airport business, the market has been anemic due to a significant drop in the number of passengers. To get ready to receive orders when demand recovers, Vanderlande has been focusing on providing better services to strengthen long-standing relationships of trust with existing customers.

Vanderlande is also promoting collaboration to further augment relationships with other companies within the Toyota Industries Group, working together with the Logistics Solution Division of TMHJ and Bastian to introduce its systems into the markets in Japan and North America, respectively.

Pocket Sorter™, a hanging high-speed sorting system

Automobile

In the fields ranging from vehicles to engines, car air-conditioning compressors, electronic devices and batteries, Toyota Industries continues to meet the expectations and trust of its customers.

Link to product details

Business Characteristics

Strengths

- An agile structure to undertake all aspects from planning and development to production within a plant (Vehicle)
- Highest-level production efficiency and quality among all Toyota-affiliated automobile body manufacturers (Vehicle)
- Know-how on the development and production of diesel engines and turbochargers (Engine)
- Highly efficient production of high-quality gasoline engines, including those for use in hybrid electric vehicles (HEVs) (Engine)
- Excellent product development capability centered around fuel efficiency and car electrification (Car air-conditioning compressor)
- Global top-share*1 products for use in a full range of vehicles, from internal-combustion vehicles to HEVs, plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs) (Car air-conditioning compressor)
- *Monozukuri* (manufacturing) using equipment created in-house to produce high-quality products and flexibly accommodate changes in production volume (Car air-conditioning compressor)
- Higher technological capabilities accumulated through the development and production of products for Toyota Motor Corporation (TMC), external sales and internal use (Electronics)
- Development, production and top-level quality of electronic parts and devices for electrified vehicles (Electronics)
- Material synthesis technology, simulation technology for examining materials and structures and analysis technology (Battery)

Opportunities

- Increasing needs for fuel-efficient products due to stricter environmental regulations and growing environmental consciousness
- Sales expansion in each sector in line with growth of the automobile market

Risks

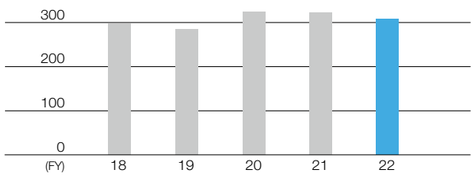
- Shrinking of the automobile market caused by economic slowdown
- Customers becoming less willing to buy fuel-efficient products following less stringent environmental regulations
- A drop in product competitiveness due to the yen's appreciation or rises in costs for logistics and raw materials
- Suspension of production caused by supply chain disruptions

*1: Survey by Toyota Industries Corporation

Net Sales	Operating Profit
FY2021	FY2021
¥591.6 billion	¥4.7 billion
FY2022	FY2022
¥792.8 billion	¥33.0 billion

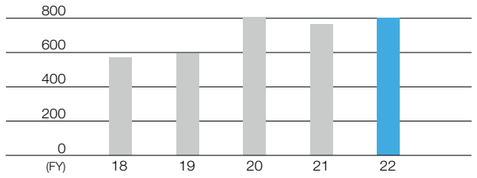
Vehicle Sales

(Thousand units)



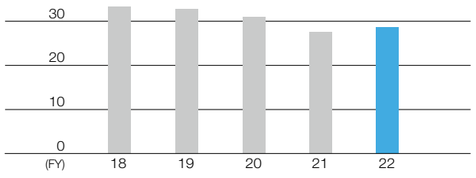
Engine Sales

(Thousand units)



Compressor Sales

(Million units)



Vehicle

Medium-Term Direction of Business

We will contribute to TMC as a development and production base of compact sports utility vehicles (SUV) by leveraging our comprehensive strengths derived from the highest level of safety, environment, quality, cost and delivery (SEQCD) among all Toyota-affiliated automobile body manufacturers and through greater collaboration within the Toyota Industries Group.

Business Overview in Fiscal 2022

In fiscal 2022, sales of the RAV4 decreased both in and outside Japan. As a result, unit sales declined by 15,000 units, or 5%, to 308,000 units. Net sales decreased by ¥4.9 billion, or 6% year on year, to ¥83.4 billion.

Nagakusa Plant Supporting Development and Production of RAV4 Global Strategic Vehicle

Toyota Industries produces the RAV4, a global strategic vehicle sold by Toyota Motor Corporation (TMC) in more than 180 countries and regions, including North America, Europe and Asia. Starting from June 2020, we started producing the PHEV models in addition to internal-combustion and HEV models. More than 60% of the production volume now accounts for HEVs and PHEVs.

Our Nagakusa Plant in Aichi Prefecture is involved not only in assembly of the RAV4, but also in the design of the vehicle's upper body, as well as the development of exterior, interior and color design. The plant also has strengths in manufacturing capabilities and is working to enhance product quality and productivity through continuous *kaizen* (improvements).

We will continue to strengthen our vehicle planning and development capabilities to meet the expectations of our customers while ensuring vehicle quality.

Partially Remodeling RAV4 and RAV4 PHV and Commencing Production at the Nagakusa Plant

In December 2021, we partially upgraded the RAV4 and RAV4 PHV to enhance product appeal. Externally, we made design changes to the headlamps, aluminum wheels and other parts for a more solid and dynamic style. Moreover, a hybrid specification (E-Four) has been added to the RAV4 ADVENTURE model, which symbolizes the off-road image of the vehicle, and a new solid grayish blue paint color is now available for a sporty and powerful impression.

Partially remodeled RAV4 (grayish blue)

Presenting a RAV4 Concept Model at Tokyo Auto Salon 2022

Under the mantra "Make even better SUVs" to see a smile of joy of our customers, we are working with TMC to make the RAV4 a more attractive SUV. Based on the professional concept model RAV4 5D ADVENTURE exhibited in 2021 under the theme of mountain rescue, in 2022 we mainly improved indoor equipment. Focusing on the time-sensitive nature of mountain rescue missions, we have made it possible to flexibly arrange the interior space of the vehicle, such as an expandable storage function for loading items (Maximum Base*2) and a seat arrangement function for loading a stretcher carrying a rescued person, which garnered the attention of professionals from the police and fire departments. We intend to utilize the outcome of these activities in future development of the RAV4.

RAV4 5D ADVENTURE 2022 garnering the attention of visitors

Expandable storage function for loading items

*2: A loading function that enables an efficient storage arrangement and quick retrieval of rescue equipment

Link to online brochure (in Japanese)

Engine

Medium-Term Direction of Business

With environmental awareness rising worldwide each year, there is an unprecedented demand for vehicles that are more fuel efficient and emit cleaner exhaust gas. Despite this background, diesel engines, which boast a high level of durability and superb running performance, remain in strong demand to support lives in certain regions and applications.

Under such circumstances, we will continue to uphold our vision to create an engine that benefits people, society and the environment, pursue the development of cleaner engines and deliver them to people who depend on the power of engines in their daily lives.

In fiscal 2022, TMC's diesel engine business was transferred to Toyota Industries. By comprehensively taking charge of the processes from development to production, we intend to accelerate the development of new technologies and products for the era of carbon neutrality and conscientiously respond to a wide variety of customer needs.

Business Overview in Fiscal 2022

Unit sales in fiscal 2022 totaled 804,000 units, an increase of 39,000 units, or 5%, from the previous fiscal year due mainly to a growth in sales of GD diesel engines. As a result, net sales increased by ¥127.7 billion, or 91% year on year, to ¥267.6 billion.

Engines for Automobiles

Diesel Engines

There are diverse needs mainly in emerging countries for diesel engines, which have high fuel efficiency and excellent torque at a low speed, as a power unit suited for SUVs and such commercial vehicles as pickup trucks.

Our mainstay products are in-line 4-cylinder GD diesel engines and V-type 6-cylinder F33A diesel engines that we began production in June 2021.

Compliant with fuel efficiency and emissions regulations in various regions and countries, the GD diesel engine has been introduced in more than 150 countries around the world, mainly in Asia and Latin America, and fitted in nine vehicle models, including TMC's Innovative International Multipurpose Vehicle (IMV) series targeting emerging countries and the HiAce. With a view to the era of carbon neutrality, the F33A diesel engine has been downsized from the previous 8 cylinders to 6 cylinders to reduce mass, while the twin turbo developed in-house realizes high levels of environmental performance, quiet operation and output. As proof of our technological prowess highly recognized by a wide range of people, Toyota Industries received the Technology Development Award at the 72nd Society of Automotive Engineers of Japan Award for the F33A diesel engine. In addition, it has been installed in the new Land Cruiser, which was fully remodeled in 2021. This marked the first time in 14 years that a diesel engine was fitted in the vehicle released for the Japanese market.

Land Cruiser released in August 2021


3.3L V6 twin turbo engine (F33A)

Gasoline Engines

The Toyota New Global Architecture (TNGA)*3 gasoline engines that we produce, namely the 2.5-liter A25A and 2.0-liter M20A, are mainly fitted in the RAV4 and HARRIER, which are achieving robust sales. Developed based on the TNGA concept, these engines offer both excellent driving performance and environmental performance. Responding to the advancement of car electrification, we have also added an HEV version of the A25A engine to our lineup.

*3: Development policy and method for vehicle creation based on a modular platform

Engines for Industrial Fields

Toyota Industries' engines are highly renowned for their reliability and excellent environmental performance in industrial fields as well. These engines are used for a wide variety of applications, including our lift trucks, and adopted by many manufacturers of GHPs*4, CHPs*5, generators and construction machinery. They offer downsized displacement compared with conventional models with equivalent output, resulting in higher fuel efficiency, cleaner emissions and a reduction in size.

*4: Short for gas heat pump; air conditioner driven by a gas engine
*5: Short for combined heat and power; co-generation system

Link to product details

TOPIC

Commissioned by the Ministry of the Environment for Low Carbon Technology Research and Development Program

Toyota Industries and Osaka Gas Co., Ltd. have jointly commenced technological development and feasibility tests of a small engine using ammonia as a fuel, which is a 2021–2022 program commissioned by Japan's Ministry of the Environment, as a carbon neutral engine. Our proprietary reforming technology has made it possible to neutralize the fire retardancy of ammonia and use it as a fuel that does not emit CO_2. Toyota Industries is tasked with designing the engine system and manufacturing the actual product, while Osaka Gas is responsible for improving the thermal efficiency of the engine. Together, the two companies aim to realize the development of the world's first small engine system that can be used with ammonia fuel alone.

Car Air-Conditioning Compressor

Medium-Term Direction of Business

In a future society in which the significant advancement in car electrification and autonomous technology is expected, we aim to leverage our core compression technology and become an innovative component supplier.

We will further enhance our capability to develop products that offer excellent fuel efficiency, quieter operation, easier vehicle mounting, compactness and light weight. In addition, with the aim of satisfying needs of a broader variety of customers, we will utilize our accumulated technologies to expand our development domain into core components for drive systems.

Business Overview in Fiscal 2022

In fiscal 2022, unit sales of car air-conditioning compressors increased 1.24 million units, or 5%, from the previous fiscal year to 28.75 million units due mainly to higher sales in North America. Net sales were up ¥54.5 billion, or 18% year on year, to ¥356.1 billion.

Environment Surrounding the Automobile Market

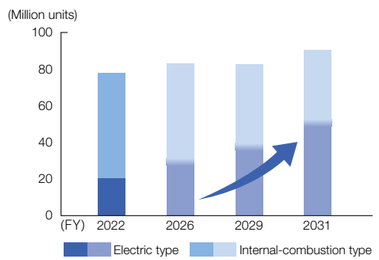
Even though the car air-conditioning compressor market is currently sluggish due to parts supply shortages at automakers, we expect continued growth over the medium term on the back of expanding automobile sales and an increase in the number of vehicles fitted with an air conditioner. As new developments in the automobile market, especially for electrified vehicles, by 2035 all automobiles sold in China must be electrified*6 and sales of internal-combustion vehicles, including HEVs and PHEVs, will be banned in Europe. In light of such tightening regulations and expanding needs in various countries and regions, automakers are aggressively releasing new models, and unit sales of electrified vehicles are expected to increase significantly in the future.

*6: Announced by the Chinese Society of Automotive Engineers

Outlook for Electrified Vehicle Market

Demand for electrified vehicles is expanding dramatically due to heightened environmental awareness and more stringent regulations on internal-combustion vehicles around the world. In step with this development, demand for electric compressors is expected to exceed the demand for compressors for internal-combustion vehicles in fiscal 2031.

Demand Forecast by Compressor Type[*7]



*7: Survey by Toyota Industries Corporation

Responding to New Needs for Electrified Vehicles

CSR Material Issue

As needs for electric compressors diversify in step with the growth in electrified vehicles, there have been new challenges for BEVs, in particular, as vehicles. In response to such new, diversifying customer needs, we are rolling out new products by utilizing our product development capabilities cultivated to date.

Electric compressors for BEVs are currently used for cooling the battery during quick charging and heating the vehicle interior (heat pump). As such, we have been not only enhancing the lineup of large-capacity and high-voltage products to accommodate an expansion in applications, but also increasing product competitiveness in terms of reliability and efficiency.

Meeting the Needs for Large Capacity

In order to prevent a deterioration in battery performance and shortened life during high-power operation and quick charging of vehicles, we have newly developed and started production of large-capacity compressors capable of cooling the interior of the vehicle as well as the battery.

Meeting the Needs for Longer Life, Higher Reliability and Greater Efficiency

As it has become necessary to secure a heat source that substitutes for the exhaust heat of the engine, there is a need to operate the compressor even when heating the vehicle interior. We are improving the reliability of electric compressors to accommodate extended operating hours for heat pump air conditioning and a growing range of use.

In addition to enhancing such product appeal, we plan to further strengthen support for automakers and expand sales by making proposals for solving issues concerning the entire vehicle along with taking other initiatives.

Production-Related Strengths Underpinning Quality and Performance

High-precision machining and assembly technologies are essential in realizing high quality and the superior performance of products. Toyota Industries realizes high-speed and high-precision machining by leveraging its know-how accumulated through responding to the stringent demands of automakers worldwide and by developing devices from processing machines to associated cutting tools in-house.

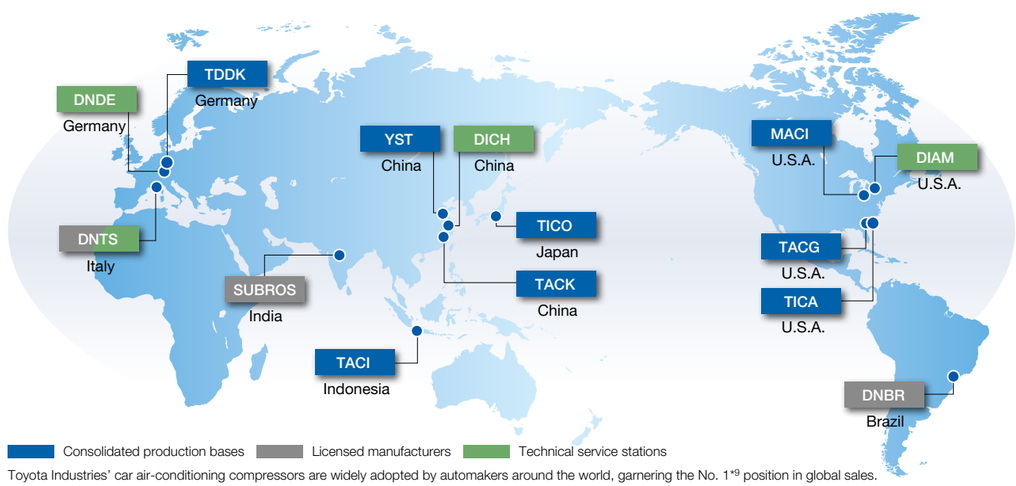
Establishing Stronger Global Production and Supply Structures

In step with the move toward more stringent fuel efficiency regulations and car electrification, the car air-conditioning compressor market is expected to witness fluctuations in demand for compressors both for internal-combustion vehicles and electrified vehicles. In response, we are building a production structure less vulnerable to changes in production volume through such measures as automating our plants to save labor, designing mixed lines that enable the production of a wide variety of products and creating a framework to increase production capacities in a phased manner.

Meanwhile, we expect the rapid spread of electrified vehicles in China driven by the country's new energy vehicles (NEV) regulation[*8]. Accordingly, we will make sure to capture booming demand by promoting the local production of electric compressors. We have already initiated local production at TD Automotive Compressor Kunshan Co., Ltd. (TACK) in March 2020 and at Yantai Shougang TD Automotive Compressor Co., Ltd. (YST) in June 2021. Currently, we are engaging in production in Japan and China from the viewpoint of production efficiency. Believing that producing and supplying products close to our customers will lead to improving our competitiveness, however, we are considering local production in Europe and the United States depending on future orders.

*8: Regulation in China mandating automakers to produce a certain percentage of BEVs and other new energy vehicles

Worldwide Bases of Car Air-Conditioning Compressors (As of March 31, 2022)



Toyota Industries' car air-conditioning compressors are widely adopted by automakers around the world, garnering the No. 1[*9] position in global sales.

*9: Survey by Toyota Industries Corporation

Electronic Devices and Other Products

Medium-Term Direction of Business

Car electrification is steadily progressing in keeping with the enforcement of more stringent environmental regulations and growing energy-saving consciousness among customers. The Electronics Division offers not only on-board power source devices, but also charging stands and products to feed electricity externally that are conducive to improving social infrastructure. Moreover, the Battery Division, which was newly established in fiscal 2022, will contribute to the widespread use of electrified vehicles through the development and production of on-board batteries.

Business Overview in Fiscal 2022

In addition to an increase in sales of DC-AC inverters, in particular, full-fledged commencement of production and sales of batteries resulted in an increase in net sales by ¥23.9 billion, or 39%, over the previous fiscal year to ¥85.5 billion.

Contributing to Car Electrification

Toyota Industries develops and manufactures various car electronics products by utilizing power electronics as our core technology and sells these products mainly to TMC and other automakers across the world. As the electrification of automobiles accelerates, we are working to contribute to the widespread use of electrified vehicles by enhancing our product appeal and lineup and establishing a robust production structure.

As products that contribute to the electrification of vehicles, we develop and manufacture on-board power source devices such as DC-DC converters, on-board chargers and DC-AC inverters, as well as charging stands.

DC-DC converter

A DC-DC converter converts the high voltage of on-board batteries into a lower voltage level to supply power to standard electrical devices such as lights and wipers. Our DC-DC converters are fitted in the Prius, Aqua and other major electrified vehicles. By utilizing such technologies as the world's first thick copper substrate, we have reduced the product size and weight.

An on-board charger converts AC voltage from the power grid into DC voltage in vehicles and is necessary for charging PHEVs and BEVs, for which the market is expected to expand in the future. We offer chargers compatible with a wide range of voltages to enable their use in various parts of the world.

On-board charger

Amid expectations for more diverse on-board power source devices with higher performance (higher efficiency as well as size and weight reduction), we will pursue even higher environmental performance and expand the scope of our development efforts to power source system products.

Helping to Increase the Competitiveness of Our Electrified Products

We will leverage our technology and know-how cultivated in the development of vehicle power source devices to engage in the development of electronic components in other businesses as well, such as materials handling equipment and textile machinery, and to increase the appeal of our products. Through these efforts, we intend to spur greater synergistic effects among our businesses in moving ahead with electrification.

Use of an Electrified Vehicle as a Power Source during a Disaster CSR Material Issue

In recent years, there has been a growing public attention to the use of high-capacity batteries of electrified vehicles as a power source.

The 1.5-kW type DC-AC inverter, in particular, can operate appliances that require more power, such as rice cookers and hot plates, and has drawn much attention as an emergency power source in a disaster in addition to camping, outdoor events and other applications.

In September 2021, we conducted a demonstration test for workcation*10 and in-vehicle telework in an emergency situation to see whether further utilization of the power source function of the 1.5-kW type DC-AC inverter was feasible. Throughout the day, we used PCs and home appliances with the power sourced from the vehicle alone and checked the operating status of the vehicle and DC-AC inverter, including the amount of power used and the frequency of engine operation. Toyota Industries will independently conduct these tests to gauge the usability and psychological stress from the standpoint of the user and promote product development that will lead to the more widespread use of electrified vehicles.

Workcation

*10: A coined word that combines "work" and "vacation," workcation is a way of spending vacation while working at a resort or travel destination.

Developing Batteries Conducive to the Spread of Electrified Vehicles CSR Material Issue

Toyota Industries has newly established the Battery Division and commenced production of bipolar nickel-metal hydride batteries for TMC's new Aqua at our Kyowa Plant. We have commercialized the battery by establishing a proprietary development method based on our technological strengths cultivated to date, including battery material synthesis technology, simulation technology for examining materials and structures and analysis technology. Looking ahead, we plan to expand the battery lineup to accommodate more vehicle models. To this end, the new Ishihama Plant is being constructed in Higashiura-cho in Chita-gun, Aichi Prefecture, and a new production line is slated to become operational in fiscal 2023. While promoting various initiatives toward carbon neutrality, we intend to contribute to the more widespread popularity of TMC's electrified vehicles by developing and supplying batteries that provide new value to electrified vehicles.

Bipolar nickel-metal hydride battery

Textile Machinery

Carrying on the philosophy of founder Sakichi Toyoda, which reflects his strong commitment to manufacturing, Toyota Industries responds to a broad range of needs with its extensive product lineup, from air-jet looms to ring spinning frames and roving frames.

Link to product details

Medium-Term Direction of Business

With growing environmental consciousness worldwide, needs are expected to increase further for textile machinery offering superior environmental performance. Toyota Industries' products are highly acclaimed by customers for their excellent reliability and productivity as well as energy-saving performance. We will continue to develop energy-saving and other innovative technologies and seek to achieve further growth and evolution as a leading manufacturer of textile machinery.

Business Characteristics

Strengths

- Broad product lineup both in the spinning and weaving machinery fields
- Global, well-developed service network
- Ability to develop products that excel in reliability, energy-saving performance and versatility

Opportunities

- A rise in textile demand in line with an increase in the world population
- Further increasing applications in industrial textile products
- Increasing needs for high-quality and highly functional yarn and textile products, following the economic growth of emerging countries

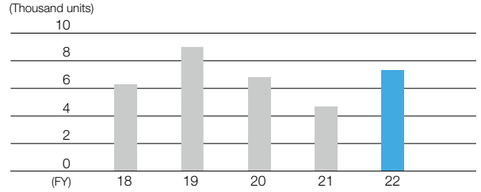
Risks

- Changes in each government's policies concerning promotion of the country's textile industry
- Weaker sales due to intensifying competition
- A decline in capital investment due to economic slowdown and raw cotton and/or yarn price fluctuations

Net Sales	Operating Profit
FY2021	FY2021
¥40.8 billion	(¥1.1 billion)
FY2022	FY2022
¥69.2 billion	¥5.5 billion

Air-Jet Loom Sales

(Thousand units)



Business Overview in Fiscal 2022

The market was strong in Asia, including China, which is our primary market. Unit sales of air-jet looms increased 2,600 units, or 55%, from the previous fiscal year to 7,300 units. In addition, an increase in quality measurement instruments for fiber, yarn and fabric pushed up net sales by ¥28.4 billion, or 69% year on year, to ¥69.2 billion.

Growing Needs for Air-Jet Looms

Fabrics woven by Toyota Industries' air-jet looms are widely used not only for clothing such as shirts and pants, but also for curtains and other interior items as well as industrial products such as airbags and base fabrics for electronic substrates.

Especially in the field of glass fiber fabrics such as electronic substrate material, our air-jet looms are used to weave precision fabrics with a thickness of several microns to a few dozen microns in order to achieve both miniaturization and thinning of smartphones and superb functionality. Recently, the loom has been highly acclaimed as a machine capable of stably producing high-quality fabrics in cutting-edge fields that require even higher precision and quality, such as servers for 5G communication.

Complete Renewal of Simultaneous Doffer for Roving Frames

Even in emerging countries where the spinning industry is thriving, rising labor costs have raised the need for labor savings. In response, Toyota Industries has completely renewed the roving frame by incorporating the simultaneous doffer that automatically replaces full bobbins with empty bobbins ("doffing") into the main body of the roving frame. The built-in doffing system has simplified the operation, with added benefits of about 40% shorter doffing time and roughly 37% smaller machine base area for space savings.

We will continue to work on the development of products that reflects the needs of the spinning industry requiring labor savings and higher efficiency.

Link to video of doffing function