



德國汽車零組件產業發展與臺灣廠商機會

German Auto Parts Industry Development and Opportunities for Taiwanese Manufacturers

The German automotive industry has always been regarded by the federal government as a core industry to drive employment, economic growth and maintain global competitiveness. It used to be the leader of conventional (internal combustion engine) vehicles. As its deployment of the EV industry is relatively late, in recent years, it has been committed to investing in various infrastructure and the use of policy tools to encourage investment and research and development, in hope of catching up with the global trend of industrial change. In December 2020, the EU announced a 55% reduction in greenhouse gas emissions by 2030 (compared to 1990) and a carbon neutrality target by 2050. The pneumonia epidemic since 2020 has affected the supply chain ecology, and the growth of electric vehicles or vehicle electrification will accelerate the impact on the traditional vehicle and parts industry, which may bring business opportunities for Taiwan manufacturers.

1. Germany's Macro-economy and Automotive Industry

Germany is a member of G7, and the Ruhr is a traditional industrial coal and steel area in Germany. Munich (location of BMW headquarters), Hamburg, Stuttgart (Mercedes Benz and Porsche headquarters), Wolfsburg (VW headquarters) also form a strong manufacturing cluster, Berlin, Leipzig, Dresden is the eastern heartland of German manufacturing, and the emerging industries are concentrated in the Munich area.

Germany is a highly developed market economy with strong economic strength. It is the world's fourth largest economy and Europe's largest economy. It is highly dependent on trade. It has the world-leading automotive manufacturing, electrical, machinery manufacturing and chemical industries and is quite competitive in the global manufacturing industry. **German automotive industry drives 60% of Europe's R&D and 20% of Germany's output value. 5.5 million passenger cars in Europe come from Germany, and 1/3 of the global automotive research and development expenditure come from Germany. 78% of Germany-made vehicles are exported. 20% of the global automotive production lines are related with Germany. Its automotive and components industry occupies a pivotal position, thus showing the influence of German manufacturing industry.** Table 1 shows Germany's macro-economy and the automotive industry.

2. Production and Sales of Automobiles, Components and EVs in Germany

(1) Overview of German Automotive Industry

Automobile and components manufacturing is the core industry of Germany. In 2020, the output value of the automobile industry was US\$500.9 billion, with nearly 1,000 automobile and components manufacturers and more than 880,000 people working in the automobile-related industry. Automobile and components manufacturing is the largest export-oriented industry, wherein the production value of automobiles was US\$ 402.6 billion, US\$ 14.2 billion for car bodies, and US\$ 84.1 billion for automotive components. With the epidemic

Table 1. German Macro-economy and Automotive Industry

Items	2019	2020	2021	2022(e)	2023(f)
GDP (Trillion USD)	4.7	4.5	4.8	5.2	5.5
GDP Growth (%)	1.1	-4.6	3.1	4.6	3.3
Investment as Percent of GDP (%)	22.1	21.1	22.3	22.2	21.8
Population (Unit: 10,000 People)	4,219	4,174	4,141	4,192	4,170
Income Per Capita (USD)	56,523	54,551	58,150	62,404	63,330
Automotive Industry Workforce (Unit: 10,000 People)	92	88	87	86	84
Car ownership (Unit: 10,000 Vehicles)	5,063	5,139	5,216	5,294	5,386

Data source: International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

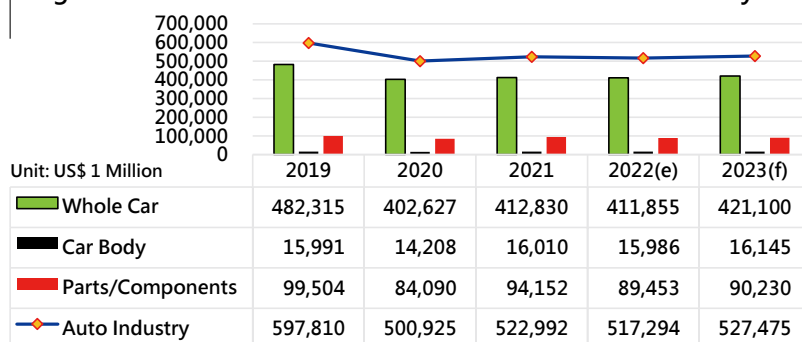
under control and the adjustment of supply chain, the production value of the automotive industry was US\$523 billion in 2021, including US\$16 billion for car bodies, US\$412.8 billion for cars, and US\$94.2 billion for parts and components, representing a growth of 2.5% and 12.0% respectively compared to 2020. The production value forecast for German automotive industry is shown in **Figure 1**.

In 2021, the export value of the automotive industry was US\$368.9 billion, down 4.4% compared to 2020 due to the pandemic, but still topping the export values of Germany in the past 10 years. Meanwhile, automobiles, parts and components were also Germany's most important import items, with an import value of US\$223 billion, up 6.4% compared to the same period of the previous year, which translated to a trade surplus of US\$145.9 billion. In 2021, due to the continuation of the pandemic and the shortage of automotive chips, German cars sales in China, Japan, India, the United States and Russia decreased, but there was improvement only in the Brazilian market, and only a minor increase in Europe. Germany's main car exporting destinations in order are the United States, China and the United Kingdom. Besides, the Chinese market has long become an important profit source for VW, Benz, BMW and other car manufacturers. The Chinese car market directly drives the profit for German car industry.

In 2021, Germany produced a total of 3.353 million units and sold 2.922 million units of various types of vehicles. Due to the continuing pandemic, car chip shortage and other factors, the production and sales declined by 9.7% and 9.2% respectively compared to 2020, of which 2.59 million units of passenger cars were sold, accounting for 88.6%, **Figure 2** is the German car production and sales forecast. VW ranked first with 18.5% of the market share, Mercedes Benz came in second with 9.4% and Ford followed with 7.8%. The top five car manufacturers accounted for 50.8% of sales volume.

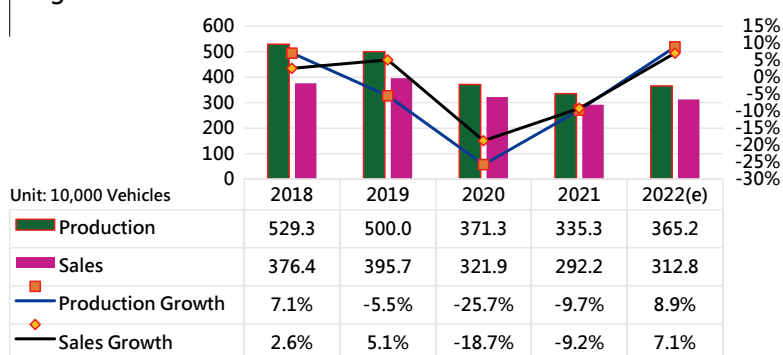
In the past two years, German automobile manufacturing industry has shown a decline in production and sales of automobiles, and it was the same for commercial vehicles and parts and components. With the development of EVs, carbon dioxide emissions will continue to decrease. By 2023, the number of new EVs developed by automakers

Fig. 1. Production Value Forecast for German Auto Industry



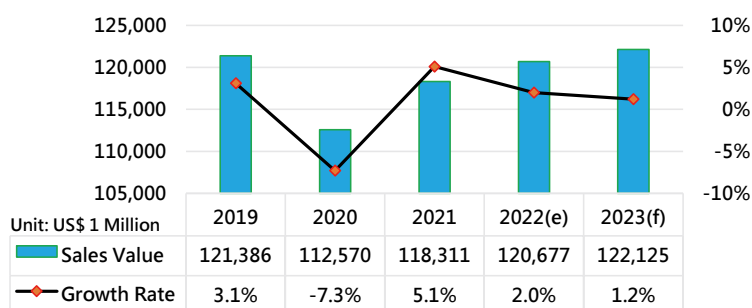
Data source: FOURIN; International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

Fig.2. German Car Production and Sales Forecast



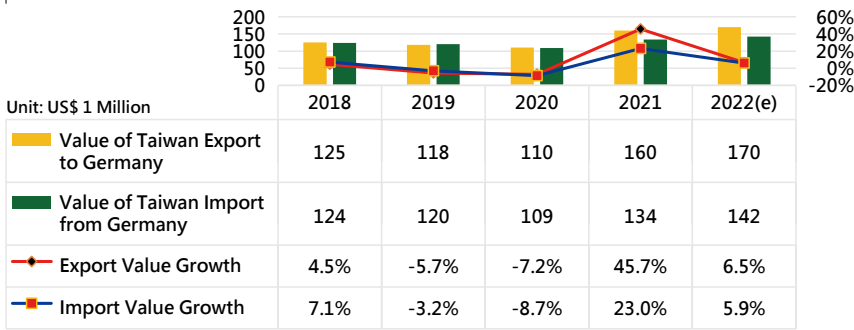
Data source: FOURIN; International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

Fig. 3. Forecast Sales Value of Auto Parts and Components in Germany



Data source: VDA; International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

Fig. 4. Forecast of Taiwan's Import and Export with Germany on Automotive Parts and Components



Data source: Customs Administration, Ministry of Finance; International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

will expand twofold to more than 150 models. Industry investment in R&D of non-fossil fuel alternative vehicles is expected to reach US\$57 billion by 2024

In terms of external investment, Germany's three largest car manufacturers are actively investing in setting up plants in foreign countries. Other than having a plant already set up in China, VW deploys wide, with 125 manufacturing plants in Europe and manufacturing sites in 11 countries including America, Asia and Africa. Daimler has set up plants in South Africa, Hungary, Romania, France and the United States. BMW has chosen the United States, Mexico, South Africa, India and Brazil. On the one hand, BMW takes advantage of local production to reduce production costs by localizing the supply chain; on the other hand, BMW breaks free from the high tariffs or administrative measures imposed by some countries on car imports, and is able to supply local consumers and grab local market share. **To cope with the transformation of Germany's domestic automobile industry, automobile manufacturers will consider whether to move the production of conventional (internal combustion engine) automobile factories to overseas locations. German plants will focus on deploying EVs, which is worthy of attention.**

(2) Overview of German Auto Parts Production and Sales as Well as Import and Export with Taiwan

Germany's automotive parts and components is a very complete industry chain, with some companies ranking among the top 10 in the world in terms of revenue, such as Bosch, Continental, ZF, etc. In addition to supplying domestic car assemblers, most companies are also actively setting up factories around the world. **Figure 3** shows the forecast sales value of auto parts and components in Germany, which was US\$118.3 billion in 2021, up 5.1% from 2020 affected by the pandemic. With the pandemic stabilizing and the resumption to normal economic activities, the forecast sales value for 2022 was US\$120.7 billion, a 2.0% increase from 2021.

Germany and Taiwan have very close trade relations. In 2021, Taiwan exported US\$210 million of automotive parts and components to Germany, accounting for 3.3% of the export value, second only to the United States (52.7%), Japan (5.2%), and China (4.0%). Other types of automotive parts and components (Customs code 8708) made an export value of US\$ 160 million. The main exported parts and components were machined wheels, axles, gears, gearboxes, generators and electrical parts and components, etc. Taiwan imported

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US\$200 million of various automotive parts and components from Germany, accounting for 7.2% of the import value, second only to Japan (30.4%), China (26.7%), Thailand (7.6%). Other types of automotive parts and components (Customs code 8708) made an import value of US\$130 million. The main imported parts and components were engine brake control system, chassis control system, steering system, etc. **Figure 4** shows forecast of Taiwan's import and export with German on automotive parts and components (Customs code 8708).

3. Restructuring of EV Components Industry

EVs need to go through a power conversion process of power generation, recharging and discharging. The 35% energy utilization rate of pure EVs is much higher than the 10-20% with conventional internal combustion engines. The power batteries in an EV takes up 40-50% of the whole vehicle structure. Although the unit price of power batteries is going down year by year, the price remains high. The most important feature of EVs is less use of conventional internal combustion engine components and increased integration of electrified components and power semiconductor components.

The power batteries account for the highest cost of EVs (40-50%), followed by the drive system, and the cost ratio of conventional internal combustion engines is down to 10-20% from 22-24%. EVs use electric motors (33-43%), electric motor drives (39-47%), car controllers (4-8%), transmissions and drive shafts (8-10%), and cooling systems (4-6%) to replace existing engines (35-40%), auxiliary equipment (18-22%), transmissions (20-27%), and exhaust systems (8-11%). Other costs for EVs include the vehicle body (8-19%), chassis (5-9%), and other components (6-15%).

Automotive components can be divided into eight major systems according to their function characteristics: (1) engine (2) engine peripherals (3) transmission system (4) brake system (5) steering system (6) suspension system (7) vehicle body and tires (8) other components, etc. EVs use electric motors and power batteries to replace conventional (gasoline or diesel) engines and fuel systems as the main source of power. EVs do not use the intake/exhaust system or fuel supply system of conventional internal combustion engines and other components, and instead are controlled by power motors, controllers and electronic components to start, run, stop, accelerate and decelerate.

In addition, EVs have adjusted the design of components such as shock springs, shock absorbers, suspension arms, air conditioning systems, and high voltage wire sets. With the development of vehicle systems going electrified and smarter, the proportion of power batteries, electric motors and other automotive electronic components in the cost of vehicles has increased significantly. The proportion of conventional engines, transmissions and other fuel systems used in vehicles is gradually decreasing. The difference in the types and selection of components between conventional vehicles and EVs is shown in **Table 2. EVs in comparison to conventional vehicles add controllers, power batteries, power components and power conversion modules, etc. The result is restructuring of the automotive and parts industry that has brought in a change in manufacturing and processing. Taiwan has long been an OEM assembler for automakers, and the rise of the EV industry will open up transformation opportunities for Taiwan's automotive and components industries.**

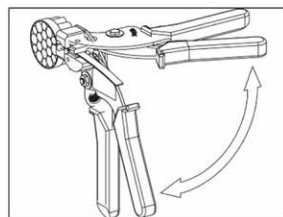


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Instructions for use.

Quickly turn off

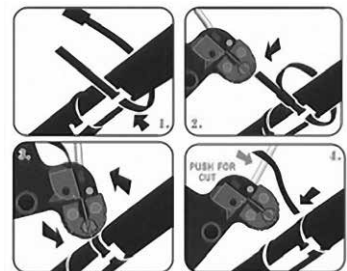
- ◆ Tie the tie into a bundle and insert the tip into the head, tighten the tie tightly with a hand-tied tie.
- ◆ Squeeze the handle as much as possible to tighten the tie to the desired tension.
- ◆ When final pressure is applied to the handle, rotate the tool 1/4 or 1/2 turn until the excess tail is removed. Remove the excised part from the tool.



Cut off with the knife handle

The tensioning tool is manually operated, so simply squeeze and grip the handle to tighten the stainless steel tie to the required tension. When you are satisfied with the tension, use the shear bar to cut the tie. Due to the design and cutting angle, this tool will not leave any sharp edges if done correctly. After releasing the handle, the self-replacing spring brings the tool back to the next tie.

Suitable for ties up to 0.3mm thick x 12mm wide



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Table 2. Restructuring of EV Components Industry

Components	Conventional Engines	Hybrid Vehicles (Including Plug-in Types)	Pure EVs
Intake system (Intake manifold, intake valve, air filter)	○	○(Required)	×(Not required)
Exhaust system (exhaust manifold, exhaust valve, catalyst and stator, silencer, turbocharger)	○	○	×
Internal combustion engine (cylinder head, cylinder block, piston, piston ring, connecting rod, crankshaft, camshaft, balance shaft, flywheel, etc.)	○	○	×
Transmission/transmission system (automatic transmission, manual transmission/clutch)	○	○	○(Reducer)
Air conditioning system (fan, water tank/sub-tank, cold/hot water pipes, etc.)	○	○	○(Electric Air Conditioning)
Lubrication system, fuel system (oil pump, nozzle, injection pump, etc.)	○	○	×
Integrated start & stop motor (Light hybrid and above)	○Design change		
Electric motor	○	×	
Electric motor controller (Inverter)	×	○(Auxiliary power)	○(Main power)
DC/DC Converter	×	○	○
Power Conversion Components (Power Devices)	×	○	○
Cable ties (with connector) (High current ties)	○(Ordinary ties)	○(Mid/high current ties)	○
Residual power management	×	○(Plug-in PHEV)	○
Recharging facilities	×	○(PHEV)	○
Energy storage (energy recovery) management	×	○	○
Power cells and their management systems	×	○	○
Electric motor and engine (complex power) coupling technology	×	○	×

Data source: International Strategic Development Institute of Industrial Technology, ITRI (Jan., 2023)

4. Opportunities for Taiwan's Key EV Component Manufacturers

EVs will not only be the mainstream of the future market, but also lead related industries for a new change. Do EVs represent a crisis or opportunity? The electrification of automobiles has become an irreversible trend, and ICE-powered vehicles are seen as an outdated technology. As the power source of vehicles shifts from fuel to electric power, it is not just the overall system architecture of the vehicle that is changing. EVs are an innovative industry that combine with IT and bring a variety of manufacturing models, making the EV market increasingly dynamic.

Compared to internal combustion engine powered vehicles, which use conventional components such as engines and transmissions as the power system, EVs are powered by batteries, motors and controllers. The market keeps emphasizing the importance of "three-electric system", and for manufacturers originally responsible for a number of automotive components, does it mean the market demand will greatly weaken and cause the market to shrink?

There are three key differences in the structure of fuel-powered vehicles and EVs, including the replacement of engines by motors, the replacement of fuel tanks by batteries, and the replacement of transmissions by reducers. Looking at power devices which harbor the greatest distinction, in the past an engine required 1,200 parts. Replacing a conventional engine with a power motor significantly reduces the number of parts required to 100. The demand for different parts such as cylinder block, piston, crankshaft, exhaust valve and camshaft which are required by engines has changed, and the transmission goes simplified due to the absence of engines and intake/exhaust systems.

Although key components such as engines and transmissions are eliminated in electrified vehicles, other components such as gearboxes (gear sets), aluminum alloy wheel rims, light alloy (aluminum alloy) body panels, and components related to the three power sources (power batteries, power motors and their controllers) will not disappear. Taiwan's automotive component manufacturers have a strong track record and potential opportunities, and there are many hidden champions. On the surface, it seems that the popularity of EVs will have an impact and pressure on the automotive parts industry, but the market is not lopsided. Germany is the largest and most robust economy in the European Union, and the automotive (including EVs) market is very important. The future market will be full of challenges and opportunities. ■