

THE SOCIOECONOMIC SITUATION SURROUNDING THE AUTOMOBILE INDUSTRY

1 Introduction

On February 24, 2022, Russia launched its invasion of Ukraine, setting the scene for a year of turmoil on the international stage. While Japan joined western nations in opposing Russia's actions, U.S.-China relations grew increasingly tense due to the visit by Nancy Pelosi, the Speaker of the United States House of Representatives, to Taiwan in August. With these events acting as reminders of the importance of economic security, this year saw the rise of the concept of "friendshoring," mainly centered in the U.S., whereby countries aim to source semiconductors, batteries, and other strategic materials using supply chains fully enclosed within geopolitical allies. As western nations, China, and emerging countries in the so-called "global south" embraced this idea, there are increasing signs of a trend toward international fragmentation and bloc formation along political and economic lines.

While the global economy slowed due to inflation caused by rising energy and foodstuff prices followed by rapid fiscal tightening, supply chain disruption caused by shortages of automotive semiconductors and the zero-COVID policies of the Chinese government continued to weigh down the recovery of the vehicle market. With the crisis in Ukraine serving to underline once more the importance of stable energy supplies, eyes are on the automotive industry to help address energy issues and ease progress toward carbon neutrality.

This article summarizes the political, economic, and automotive industry situation in 2022, and presents observations on the issues facing the industry in the future.

2 Political and Economic Situation

2.1. The Global Economy (Table 1)

In 2022, the global economy slowed due to inflation and increases in interest rates in various countries. According to the International Monetary Fund (IMF), the

real global gross domestic product (GDP) growth rate in 2022 was 3.4%, slower than the 6.2% recorded in 2021 as the global economy recovered from the COVID-19 pandemic.

The prices of various resources such as energy and foodstuffs then jumped in response to Russia's invasion of Ukraine on February 24. The price of crude oil according to the Brent futures index rose temporarily from 79 dollars per barrel at the start of the year to 128 dollars per barrel in March. In August, the price of European natural gas rose sharply to 315 euros per megawatt hour (MWh), more than ten times higher the average price for the past ten years. The food price index of the Food and Agriculture Organization of the United Nations (FAO), which provides a yardstick for global foodstuff prices, also rose to its highest level since statistics began to be recorded.

Rises in resource prices such as these combined with a tightening in the supply situation accompanying recovery from the COVID-19 pandemic resulted in inflation

Table 1 Real GDP Growth Rates in Major Countries (%)

	2021	2022 estimate	2023 forecast
World	6.2	3.4	2.9
Major developed nations	5.4	2.7	1.2
U.S.	5.9	2.0	1.4
Eurozone	5.3	3.5	0.7
Germany	2.6	1.9	0.1
France	6.8	2.6	0.7
Italy	6.7	3.9	0.6
Spain	5.5	5.2	1.1
UK	7.6	4.1	-0.6
Japan	2.1	1.4	1.8
Emerging markets	6.7	3.9	4.0
China	8.4	3.0	5.2
Mexico	4.7	3.1	1.7
Brazil	5.0	3.1	1.2
Thailand	1.5	3.2	3.7
India	3.7	5.3	4.8
Indonesia	8.7	6.8	6.1
Malaysia	3.1	6.7	4.4

Source: IMF World Economic Outlook, revised forecast, January 2023

across the globe. To help suppress prices, the central banks of key countries shifted to policies involving fiscal tightening. In particular, rapid interest rate increases in the U.S. boosted the value of the dollar, causing currency values to fall in emerging nations vulnerable to inflation and in Japan, the only country of the main economies that maintained a policy of monetary easing.

(1) The U.S.

With the background of high inflation and interest rate rises, the 2022 real GDP growth rate in the U.S. was 2.0%, a downturn from the 5.9% recorded in 2021 that benefitted from the rapid V-shaped recovery from the COVID-19 pandemic. In June, the consumer price index in the U.S. was 8.9% higher than the previous year, the highest leap for 41 years since the second oil crisis in 1981. High resource prices and labor shortages also resulted in wage inflation. To blunt the impact of inflation, the Federal Reserve Bank (FRB) began to raise interest rates in March. By February 2023, bank interest rates had been raised seven times.

Although these actions led to higher interest rates on loans and an obvious downturn in the housing market, consumer demand remained unexpectedly robust, particularly with regard to the consumption of services, despite higher inflation. Combined with the ongoing positive employment market due to general labor shortages, consumer demand was propped up by excess savings (amounting to approximately 1 to 2 trillion dollars) that built up during the COVID-19 pandemic when people refrained from traveling or eating out, as well as by cash transfers.

However, instability occurred in the financial system prompted by the failure of several regional banks in March 2023. Caution is required in the future since tighter credit conditions for vehicle loans may exert downward pressure on the automotive market.

(2) Europe

Due to its strong dependence on Russian energy, Europe was one of the regions most affected by the crisis in Ukraine. The real GDP growth rate in the eurozone was 3.5%, down from the 5.3% recorded in 2021. Despite strong consumption in the first half of the year as economic conditions normalized after the COVID-19 pandemic, high energy prices caused by the crisis in Ukraine and fiscal tightening forced a slowdown in the second half.

In September, faced by official European opposition to

its actions, Russia suspended operation of the Nord Stream pipeline, the main supply conduit for natural gas to Europe. This caused natural gas prices to spike. As a result, the consumer price index reached 10.6% in October, the first double-digit record of inflation since the launch of the eurozone in 1999. The European Central Bank (ECB) raised interest rates in July for the first time in eleven years. By March 2023, it had raised interest rates by 3.5% in six separate increments. GDP figures for the October to December period showed that France and Spain managed to maintain positive growth. However, Germany and Italy, which rely heavily on Russian natural gas fell into negative growth.

In 2022, the real GDP growth rate in the UK was 4.1%, down from the 7.6% recorded in 2021. The Bank of England raised interest rates eleven times between December 2021 and March 2023 in an attempt to control prices. However, the GDP of the country has yet to recover to pre-pandemic levels and recovery remains slower than other European nations.

(3) China

In 2022, the real GDP growth rate of China was 3.0%, a sudden slowdown from the 8.4% recorded in 2021. Excluding the 2.2% growth rate recorded in 2020 at the start of the COVID-19 pandemic, this was the lowest growth rate since 1976 when the Cultural Revolution ended. The main causes of this economic slowdown were citywide lockdowns implemented under zero-COVID measures and a downturn in the real estate market. Despite active government support for the economy, the 5.5% growth target set by the National People's Congress in March was not achieved.

Under zero-COVID measures, Shanghai and other areas were placed under lockdowns that continued for two months from March, which had a negative impact on the economy. Factory shutdowns and logistical disruption affected production in Japan and across the world as well as in China. Starting in the autumn, protests against the severe restrictions in place spread on an unprecedented scale and led to the Chinese government practically lifting the zero-COVID measures on December 7. Subsequently, between that time and January 2023, up to 80% of the population of China (1.4 billion people) are thought to have contracted the coronavirus. However, new infections ceased after approximately a month and the country transitioned to the "living with COVID" phase of the pandemic.

A serious downturn in the Chinese real estate market began in 2021 and has continued since then. This downturn was prompted by more stringent political regulations designed to rein in the real estate bubble that had formed. Faced with a worsening cash-flow situation, several real estate developers collapsed, as represented by the Evergrande Group. Entering 2022, despite government measures to lower interest rates and support the cash-flow situation of developers, excess investment and the structural issue of population decline caused by falling birth rates and an aging society mean that it will not be simple to resolve the underlying issues of the real estate market.

On the political side, Xi Jinping secured a third term as General Secretary at the National Congress of the Chinese Communist Party in October. At the Central Economic Work Conference held between December 15 and 16, stable growth was set as the first priority for economic policy in 2023. Various financial measures were raised with the aim of encouraging an expansion in consumption.

(4) Emerging Markets

The economic success of emerging nations was split between resource-rich countries, which benefitted from the price increases accompanying the crisis in Ukraine, and non resource-rich countries.

In Mexico, the real GDP growth rate was 3.1%, the second successive year of positive growth following on from the 4.7% recorded in 2021. With the semiconductor supply chain emerging from the worst of the disruption, automakers that act as a driving force of Mexican industry managed to endure a difficult year. The government adopted measures to support purchases of gasoline and diesel to help minimize the upward pressure on prices.

In Brazil, the real economic growth rate was 3.1%, lower than the 5.0% recorded in 2021. Although Brazil is a resource-rich country, weak economic fundamentals prompted a depreciation of the real and high inflation. The Central Bank of Brazil accelerated increases in interest rates until August. By then, the bank rate had risen to 13.75%, which exerted downward pressure on the economy. A general election held in October saw the return of the leftist Lula da Silva as president for the first time in twelve years, defeating the incumbent Jair Bolsonaro. The start of Lula da Silva's term in office in January 2023 marked the birth of the first left-wing government in Brazil for around six-and-a-half years.

In Thailand, the real economic growth rate was 3.2%, higher than the 1.5% recorded in 2021. A relaxation in pandemic restrictions boosted the country's important tourism industry, which accounted for just under 20% of Thailand's GDP before the pandemic. However, the economy slowed in the October to December period, weighed down by slower external demand at the end of the year and higher interest rates.

In Indonesia, the real economic growth rate was 5.3%, above the 3.7% recorded in 2021, and the highest growth for eight years. With consumption and investment gradually recovering as the economy normalized, results were boosted by strong resource exports.

In India, the real economic growth rate was 6.8%. Although this was lower than the 8.7% recorded in 2021, economic growth remained high. Recovery from the COVID-19 pandemic continued. However, with higher prices and fiscal tightening in the second half of the year, signs began to emerge of a slowdown in growth.

2. 2. The Japanese Economy

In 2022, the Japanese economy maintained a gradual recovery after the lifting of measures to address the COVID-19 pandemic in March. Although the real GDP growth rate of 1.4% was lower than the 2.1% recorded in 2021, the potential growth rate of approximately 0.6% was higher than the previous year. The consumption of services and demand for inbound tourism started to rebound after October, which saw government support for nationwide travel and a major relaxation in border controls.

The yen depreciated against the dollar, falling to levels not seen for thirty-two years. With the Bank of Japan continuing its unprecedented policy of monetary easing, the interest rate gap with the U.S. expanded. The exchange rate of 115 yen to the dollar at the beginning of the year had risen to over 150 yen in October. This trend of a strong dollar and weak yen has not occurred to this degree since 1990.

The combination of a dramatic depreciation of the yen and rising resource prices due to the crisis in Ukraine put upward pressure on the consumer price index toward the end of the year. In December, this index reached 4%, recording the highest level of inflation for forty-one years since the second oil crisis in 1981. At the same time, wage growth gradually petered out, recording a 0.9% drop in real wages after factoring in the effects of prices. This was the first drop in real wages for

Table 2 Sales Trends in the Japanese Automobile Market

Unit: 1,000 vehicles

	2017		2018		2019		2020		2021		2022	
	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year
Total	5,234	105.3%	5,272	100.7%	5,195	98.5%	4,599	88.5%	4,448	96.7%	4,201	94.4%
Vehicle registrations	3,391	104.5%	3,348	98.7%	3,285	98.1%	2,881	87.7%	2,796	97.1%	2,563	91.7%
Passenger vehicles	2,943	105.1%	2,895	98.4%	2,822	97.5%	2,479	87.8%	2,400	96.8%	2,223	92.6%
Ordinary trucks	1,548	103.9%	1,583	102.2%	1,586	100.2%	1,371	86.4%	1,447	105.5%	1,346	93.1%
Light-duty trucks	1,395	106.4%	1,313	94.1%	1,236	94.1%	1,108	89.7%	953	86.0%	877	92.0%
Trucks	432	101.0%	439	101.5%	449	102.4%	392	87.3%	389	99.2%	334	85.9%
Ordinary trucks	176	101.8%	180	102.2%	182	101.2%	161	88.1%	158	98.2%	123	77.7%
Light-duty trucks	256	100.5%	259	101.0%	267	103.2%	232	86.8%	231	99.8%	212	91.6%
Buses	16	100.6%	14	87.9%	14	99.2%	9	68.7%	7	73.7%	5	79.7%
Mini-vehicles	1,843	106.8%	1,924	104.4%	1,910	99.3%	1,718	89.9%	1,653	96.2%	1,638	99.1%
Passenger vehicles	1,443	107.3%	1,496	103.6%	1,479	98.9%	1,331	90.0%	1,276	95.8%	1,225	96.0%
Trucks	400	105.1%	428	107.1%	431	100.6%	387	89.7%	377	97.4%	413	109.7%

Sources: Japan Automobile Manufacturers Association(JAMA), Japan Automobile Dealers Association (JADA), Japan Light Motor Vehicle and Motorcycle Association

two years.

With supply restrictions still in place, the weaker yen only boosted exports to a limited degree. With rising resource and energy import costs, the trade balance fell into the red by 20 trillion yen, the largest deficit in history. Although vehicles and other transport-related items recorded a positive trade balance of 15.7 trillion yen, this was not enough to offset the negative trade balance recorded by mineral fuels (-31.3 trillion yen). With the expanding trade deficit, the current account surplus in 2022 fell by approximately half compared to 2021 to 11.4 trillion yen.

During this time, although the Bank of Japan firmly maintained its unprecedented policy of monetary easing, it took the unexpected step of modifying this policy in December. Within the framework of the yield curve control (YCC) policy that aims to keep short-term interest rates at a negative level and long-term 10-year bond interest rates at around 0%, the bank expanded the permitted range of fluctuation of the latter from $\pm 0.25\%$ to around $\pm 0.5\%$. By relaxing distortions in the interest rate structure in the government bond market, the bank is aiming to enhance the sustainability of monetary easing. In April 2023, Haruhiko Kuroda was succeeded as the Governor of the Bank of Japan by Kazuo Ueda. Attention is now focusing on the direction of financial policies under the new governor.

3 Current State of the Automotive Industry

3.1. Inside Japan (Table 2)

New vehicle sales in Japan in 2022 (January to December, including mini-vehicles) dropped 5.6% from 2021 to 4.20 million units, falling to the level of sales in 2011, the year of the Great East Japan Earthquake. Continuing on from 2021, sales were affected by production slowdowns and plant shutdowns caused by the global semiconductor supply chain disruption and part shortages due to the zero-COVID policy in China. The number of vehicle registrations fell by 8.3% to 2.56 million, the fifth consecutive year-on-year decline. Despite a slight easing in the supply restrictions in the second half of the year, mini-vehicle registrations fell by 0.9% to 1.64 million, the third consecutive decrease over the previous year.

Passenger vehicle registrations were boosted by incentives to purchase clean energy vehicles (CEVs). Sales of both electric and plug-in hybrid vehicles increased slightly, with electric vehicles accounting for 1.4% of sales (up 0.5% from 2021), and plug-in hybrid vehicles accounting for 1.7% of sales (up 0.8% from 2021). With sales of hybrid vehicles expanding due to rising gasoline prices to make up 49% of sales (up 6.2% from 2021), electrified vehicles of all varieties accounted for more than 50% of the overall market.

3.2. Outside Japan (Table 3)

(1) The U.S.

In the U.S., sales of new vehicles in 2022 fell by 7.5%

Table 3 Sales Trends in the Overseas Automobile Market

Unit: 1,000 vehicles

	2017		2018		2019		2020		2021		2022	
	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year
China	28,879	103 %	28,081	97 %	25,769	92 %	25,311	98 %	26,275	104 %	26,864	102.2 %
North America	21,261	99 %	21,287	100 %	20,866	98 %	17,528	84 %	18,266	104 %	17,045	93.3 %
Europe	20,512	104 %	20,559	100 %	20,652	100 %	16,484	80 %	16,262	99 %	14,473	89.0 %
Asia & Oceania	10,946	105 %	11,473	105 %	10,626	93 %	8,631	81 %	9,897	115 %	11,566	116.9 %
Central and South America	3,801	113 %	4,103	108 %	3,935	96 %	2,893	74 %	3,228	112 %	3,266	101.2 %

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from 2021 to 14.38 million vehicles. Despite the government changing track and adopting a tighter fiscal policy, consumption remained extremely robust. However, the impact of supply restrictions due to part shortages caused by disruptions in the semiconductor supply chain and China's zero-COVID policy resulted in sales up to the summer months falling below the level of the previous year. Subsequently, inventory levels showed signs of recovery as the effects of China's zero-COVID policy faded. The semiconductor supply chain disruption also grew substantially less severe from 2023.

One significant measure introduced to address climate change that affected the automotive industry was the Inflation Reduction Act (IRA), which was signed into law in August 2022. The purpose of this act is to reduce excessive inflation while providing impetus to measures for increasing energy security and addressing climate change. The act provides incentives for direct investment in facilities to produce clean vehicles (i.e., fuel cell, electric, and plug-in hybrid vehicles) as well as for switching production of existing facilities to clean vehicles, and incorporates tax credits worth up to 7,500 dollars per vehicle to purchasers of clean vehicles assembled in North America. The conditions for these clean vehicle tax credits also incorporate provisions about the source of key battery minerals and the rate of component part production within North America, which are likely to greatly impact the supply chain strategies of all manufacturers in the future.

(2) Europe

In Europe, sales of new vehicles in 2022 fell by 11.0% from 2021 to 14.47 million vehicles. In addition to the adverse impact of semiconductor supply chain disruption on production, the Ukraine crisis caused bottlenecks in parts procured from Eastern Europe. Inflated energy and foodstuff prices and the subsequent fiscal tightening measures adopted to suppress these rises all affected

consumer sentiment and resulted in lower sales.

Related to government-led measures for the environment, the European Commission (EC) announced the Fit for 55 policy package in July 2021 that aims to lower greenhouse gas emissions by 55% in 2030 compared to 1990 levels. Then, in October 2022, the three related parties of the Council of the European Union, the European Parliament, and the EC agreed to a proposed amendment to CO₂ emissions rules for passenger vehicles and light-duty commercial vehicles. These rules target a 55% reduction in CO₂ emissions from passenger vehicles by 2030 (compared to 2021) and a 100% reduction by 2035. In effect, this means that sales of ICE vehicles will be prohibited. At the same time, the rules also incorporate a revision clause that was strongly called for by the automotive industry. This clause requires a thorough assessment of the necessity for revising these rules by 2026 based on the degree of progress toward the zero emission target. This act was due to be formally adopted in 2023. However, Germany expressed its opposition in March 2023 and forced the addition of internal combustion engine (ICE) vehicles capable of running only on zero-emission e-fuels.

In addition, in November 2022, the EC also unveiled proposals for the Euro 7 emissions regulations. These regulations call for a 35% reduction in nitrogen oxides (NO_x) from passenger vehicles and light-duty commercial vehicles from 2035 levels, and include new standards for battery durability. With these regulations due to be enacted in 2025, discussions about environmental policies in Europe are accelerating.

In the UK, sales of new vehicles in 2022 fell by 5.4% from 2021 to 1.9 million vehicles. In addition to the supply chain disruptions, consumption dropped due to higher prices and interest rates in the wake of the Ukraine crisis. However, the market showed signs of recovery in the second half of the year as the supply chain disrup-

tions eased.

In Germany, sales of new vehicles in 2022 fell by 0.4% from 2021 to 2.91 million vehicles. The market was affected by rising prices and weaker consumer sentiment due to the crisis in Ukraine. Although the government extended its so-called “environmental bonus” program of subsidies for purchasing new electric, plug-in hybrid, and fuel cell vehicles until the end of 2022, in July, it announced the ending of subsidies for plug-in hybrid vehicles and reductions in the size of subsidies for electric and fuel cell vehicles starting in 2023. This caused a rush of last-minute demand at the end of the year before these programs were ended or scaled down.

In France, sales of new vehicles in 2022 fell by 10.1% from 2021 to 1.93 million vehicles. Sales decreased due to higher prices and interest rates as well as weaker consumer sentiment due to the crisis in Ukraine. June saw a rush of last-minute demand before a reduction in electrified vehicle subsidies.

(3) China

In China, sales of new vehicles in 2022 increased by 2.2% from 2021 to 26.86 million vehicles. Sales had fallen drastically as the COVID-19 pandemic spread in the spring, economic activity tailed off due to the zero-COVID policy, and disruptions occurred to supply chains. As new infections fell in June, sales rapidly recovered due to the effects of measures to stimulate demand such as lower purchase taxes on vehicles, less stringent application of number plate restrictions, and subsidies for new energy vehicles (NEVs: electric and plug-in hybrid vehicles). Sales of NEVs in particular grew rapidly due to the impact of these subsidies and the launch of inexpensive models by local Chinese manufacturers. NEVs accounted for more than 25% of sales, exceeding the 2025 government target of 20%. However, sales fell back again in November as COVID-19 infections increased and then surged.

(4) Emerging Markets

In Mexico, sales of new vehicles in 2022 fell by 7.9% from 2021 to 1.09 million vehicles. Part shortages and semiconductor supply chain disruptions due to the impact of the COVID-19 pandemic forced production to fall to levels that are still below those before the pandemic.

In Brazil, sales of new vehicles in 2022 fell by 0.7% from 2021 to 2.1 million vehicles. In addition to the ongoing supply chain disruptions, rising prices and vehicle loan interest rates adversely affected the purchasing en-

vironment, causing falling demand that has yet to recover to pre-pandemic levels.

In Thailand, sales of new vehicles in 2022 rose by 14.4% from 2021 to 890,000 vehicles. Although the market recovered in the first half of the year as supply chain disruptions eased and automakers filled existing orders, part supply shortages caused by the lockdown in Shanghai between May and June, serious flooding in the second half of the year, and higher interest rates stopped the recovery and prevented sales rebounding to the level before the pandemic.

In Indonesia, sales of new vehicles in 2022 rose by 27.6% from 2021 to 1.05 million vehicles. The market continued its recovery due to sales promotions by automakers and a range of measures to stimulate demand. For example, the lower tax rate on luxury goods that was introduced in 2021 was extended for some models until March 2022 and the lower taxes on low-cost green cars (LCGC) were extended until September 2022 while gradually reducing the scope of the tax reductions.

In Malaysia, sales of new vehicles in 2022 rose by 41.6% from 2021 to 720,000 vehicles. Market recovery was stimulated by the government extending the lower sales and service tax (SST), which was introduced in the second half of 2020 (including tax exemptions for domestically produced vehicles and 50% tax reductions on imported vehicles), until the end of June 2022 from the original planned date at the end of 2020. These measures pushed sales well above pre-pandemic levels.

In India, sales of new vehicles in 2022 rose by 26.7% from 2021 to 4.76 million vehicles. The easing of supply chain disruptions, pent-up demand, and the impact of monetary relaxation in the first half of the year stimulated robust market demand and boosted sales above the level before the pandemic.

3. 3. Production (Tables 4 and 5)

In 2022, vehicle production in Japan was 7.84 million vehicles, virtually unchanged from 2021 due to semiconductor supply chain disruptions. Although demand for automotive semiconductors is increasing in response to vehicle electrification and other trends, a lack of investment, particularly in previous-generation automotive semiconductors, resulted in a structurally tight supply and demand situation despite an easing of the general disruption to the semiconductor supply chain. For this reason, the semiconductor supply situation remains vulnerable even in 2023.

Table 4 Trends in the Number of Automobiles Produced in Japan

Unit: 1,000 vehicles

	2017		2018		2019		2020		2021		2022	
	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year	Volume	Compared to previous year
Total	9,691	105.3%	9,730	100.4%	9,684	99.5%	8,068	83.3%	7,847	97.3%	7,836	99.9%
Vehicle registrations	7,795	103.1%	7,798	100.0%	7,778	99.7%	6,332	81.4%	6,187	97.7%	6,101	98.6%
Passenger vehicles	6,863	103.8%	6,861	100.0%	6,856	99.9%	5,603	81.7%	5,335	95.2%	5,265	98.7%
Ordinary trucks	5,147	103.0%	5,256	102.1%	5,317	101.2%	4,193	78.9%	4,166	99.4%	4,063	97.5%
Light-duty trucks	1,716	106.5%	1,605	93.5%	1,538	95.8%	1,410	91.7%	1,169	82.9%	1,202	102.8%
Trucks	808	98.2%	824	101.9%	799	97.0%	660	82.5%	779	118.0%	751	96.5%
Ordinary trucks	516	101.9%	518	100.4%	506	97.8%	405	80.1%	517	127.5%	513	99.2%
Light-duty trucks	293	92.3%	306	104.6%	293	95.7%	254	86.8%	262	102.9%	239	91.2%
Buses	123	94.9%	113	92.0%	123	108.3%	70	56.9%	74	105.5%	85	114.9%
Mini-vehicles	1,896	115.5%	1,931	101.9%	1,907	98.7%	1,736	91.0%	1,660	95.6%	1,734	104.5%
Passenger vehicles	1,485	117.5%	1,498	100.9%	1,473	98.4%	1,358	92.2%	1,284	94.6%	1,301	101.3%
Trucks	411	108.8%	433	105.3%	434	100.1%	378	87.2%	375	99.3%	433	115.4%

Source: Japan Automobile Manufacturers Association (JAMA)

Table 5 Trends in Domestic and Overseas Production by Japanese Automobile Manufacturers

Unit: 1,000 vehicles

	2000		2005		2010		2015		2020		2021		2022	
	Volume	Proportion	Volume	Proportion	Volume	Proportion	Volume	Proportion	Volume	Proportion	Volume	Proportion	Volume	Proportion
Domestic production	10,141	61.7%	10,800	50.5%	9,629	42.2%	9,278	33.9%	8,068	34.4%	7,847	32.3%	7,836	31.6%
Overseas production	6,288	38.3%	10,606	49.5%	13,182	57.8%	18,095	66.1%	15,376	65.6%	16,463	67.7%	16,962	68.4%
Total	16,429	100.0%	21,406	100.0%	22,811	100.0%	27,373	100.0%	23,444	100.0%	24,310	100.0%	24,797	100.0%

Source: Japan Automobile Manufacturers Association (JAMA)

In contrast, production of Japanese automakers outside Japan rose by 3.0% from 2021 to 16.96 million vehicles. Although supply chains were disrupted on a global basis, restrictions in semiconductor supplies eased more quickly outside Japan meaning that 68.4% of vehicle production by Japanese automakers occurred outside Japan, a higher proportion than the previous year.

4 Issues of the Automotive Industry in Japan

In 2022, the Japanese automotive industry faced a number of major issues.

One of these issues was supply shortages, particularly of semiconductors. Although supply chains were affected by semiconductor plant shutdowns during the COVID-19 pandemic and transportation disruptions, another factor was trade friction between the U.S. and China. Japan and the U.S. have historically grappled with various instances of trade friction, including voluntary caps on vehicle imports (that were later lifted), the liberalization of beef and orange trading, the prevention of semiconductor dumping, and the like. However, in the future, it will be neces-

sary to closely monitor the relationships between other countries as well. In terms of GDP, Japan's economy has been overtaken by China and is likely to be overtaken in the future by Germany and India. Cases of trade friction are currently scattered throughout the world. Although it is difficult to prevent trade friction between other countries, it will be important to predict the effects of this friction and prepare alternative procurement sources for automotive parts. In the case of semiconductors, special provisions will have to be made with respect to the relationship between China and Taiwan.

The second issue was rapid exchange rate fluctuations (i.e., the depreciation of the yen). One measure adopted by many countries to address the COVID-19 pandemic was large-scale monetary easing. Although this helped to encourage economic growth, excessive easing helped to accelerate inflation, particularly in the U.S. In its role as arbiter of the U.S. economy, the FRB raised interest rates to counter inflation, a decision that was copied by many other countries, especially in Europe. The increasingly large difference between interest rates in Japan and the U.S., pushed the value of the yen down to 150 to

the dollar at one point. Although a weak yen may be helpful to the Japanese automotive industry, which exports a high proportion of its products, excessive depreciation makes the country as a whole extremely attractive to outside capital. The Japanese stock market is no exception. Maintaining share prices on a dollar basis is likely to be an issue in the future.

The third issue relates to energy and carbon neutrality.

In 2022, crude oil prices spiked mainly due to Russia's invasion of Ukraine. Exacerbated by the major depreciation of the yen, crude oil prices had a major impact on Japanese industries and vehicle users. Government support for retail gasoline prices (i.e., the fuel subsidy program to curb extreme price increases) reached as high as 41.9 yen per liter. Without subsidies, the retail price of gasoline would have reached 214.1 yen per liter, which would have had an unmeasurable impact.

In response, on May 19, 2022, the Japan Automobile Manufacturers Association (JAMA) advocated the importance of a multi-path (i.e., the diversification of carbon-neutral fuels and powertrains) approach based on the following principles: "carbon is our enemy, not the internal combustion engine," "we must reduce CO₂ emissions in all processes of producing, transporting, and using energy," "there must be more than one route to reach carbon neutrality," and "regulations should not limit our choice of technologies."

In terms of energy production, Japan has few reserves of energy such as coal, oil, and natural gas, and relies almost entirely on imports. Although Japan has constructed a large infrastructure of renewable solar power generation systems, this leads to other issues such as the felling of trees and the construction of embankments. Ocean-based wind power systems have been practically adopted in Europe, but the height of waves in the seas around Japan presents technical issues for the adoption of similar systems. As a result, this approach requires more time. Methane hydrate is regarded as a potential treasure trove of energy and the development of extraction technologies is ongoing. The energy situation was also affected by the shutdowns affecting many nuclear power plants after the Great East Japan Earthquake. With surplus power generation capacity falling, a major cold snap might lead to rolling blackouts. Due to Japan's current dependency on energy from fossil fuels, it will be difficult to reduce CO₂ purely through national efforts re-

lated to production, especially as every effort is currently being expended simply on ensuring stable sources of energy.

In terms of transportation, Europe obtains most of its energy via pipelines, which would incur tremendous costs for an island nation such as Japan. The closest natural gas field to Japan is around the Sakhalin Islands and Japanese corporations have made major contributions to the building of plants in this region through the Sakhalin projects. However, these projects are subject to geopolitical risks and the potential for changes in Russian government policies, and plans to build a pipeline to Wakkanai have been suspended.

In conclusion, Japan has little choice but to rely on the transportation of coal, oil, and natural gas by marine vessels. In addition to transportation costs, this approach also requires energy and complicates efforts to reduce CO₂ emissions.

In terms of use, before the wider adoption of battery electric vehicles (BEVs), Japan was the first country in the world to produce hybrid electric (HEVs) and fuel cell electric vehicles (FCEVs) as a means to reduce CO₂ emissions. Recent years have also seen the development of hydrogen engines. The country may be regarded as slightly more advanced in addressing CO₂ emissions in energy usage than in production and transportation. However, Japan's power generation capacity is majorly insufficient to cope with the replacement of all gasoline and diesel vehicles by BEVs. Even if the proportion of renewable energy was increased, the amount of generation is greatly affected by the weather. With electricity also being difficult to store, serious concerns remain about how to ensure stable energy supplies. For this reason, an integrated and systematic approach that covers all aspects of production, transportation, and use will be necessary.

With this background, proactive measures have been taken to encourage the utilization of hydrogen as a new source of energy.

In 2017, the government formulated the Basic Hydrogen Strategy, followed in 2020 by the Green Growth Strategy Through Achieving Carbon Neutrality in 2050, demonstrating a strong intention to realize a hydrogen energy-based society.

Since hydrogen can be stored and emits only water when burned, it is regarded as a green fuel with high potential. However, the issue with hydrogen is produc-

tion. Although attention has focused on obtaining hydrogen through the electrolysis of water using renewable energy sources such as wind and solar power, it can also be extracted from fossil fuels.

One approach that is worthy of attention is the development of technology to extract hydrogen from cheap brown coal, which is abundant and in low demand. The CO₂ generated in the extraction process can be addressed by carbon capture and storage (CCS) treatments, enabling the production of cheap and clean hydrogen. CCS involves collecting CO₂ and burying it underground to prevent its discharge into the atmosphere. In this way, even fossil fuels can be utilized to achieve carbon neutrality. Japan (Tomakomai city in Hokkaido) and other countries around the world are engaged in field operational tests (FOTs) of CCS technologies, and the safety of this approach is currently being verified. Research is also being conducted into carbon dioxide capture, utilization, and storage (CCUS) technologies.

In the transportation field, the construction of dedicated hydrogen tankers is progressing. Since these tankers can also be driven using hydrogen energy, this approach has the potential to realize carbon-neutral transportation. In addition, technical development in the field of hydrogen liquification is also advancing with the aim of further increasing transportation efficiency.

Other examples of technical development include the building of large unmanned sailing vessels that generate

electricity using wind power and extract hydrogen by the electrolysis of sea water.

Hydrogen may also be used to generate power that can be supplied as electricity to BEVs or used as-is by FCEVs or in hydrogen engines. As such, hydrogen is an energy source that creates a wide range of choices for utilization. Aside from its potential uses in power plants and vehicles, the application of hydrogen energy to other industries and the home opens the way to major cost savings, which will encourage even greater development. In conclusion, technology is being gradually established to enable the clean transportation and use of cleanly produced hydrogen.

Hydrogen is only one example, and it will continue to be important for government, industry, and academia to work together in the development of pioneering technologies in the fields of energy production, transportation, and usage, lead the international standardization of this technology, and take on the challenge of its popularization across Japan and the world. Issues to be addressed for this purpose include building a consensus, providing support to technological development, as well as building infrastructure and other systems. It is imperative that Japan's core automotive industry places itself in the center of these processes.

References

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