

Industry assessment

Powertrain Solutions and Alloys & Metallics Components

Hero Motors Ltd

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Please Note: Year to be read as calendar year wherever the reference of year is given without fiscal / FY / financial year.

1 Macroeconomic overview of global and Indian economy

Overview of global economy

Review and outlook of global GDP

The global economy continues to recover from challenges heaped by the Covid-19 pandemic, geopolitical uncertainties in Europe and the Middle East, and considerable tightening of global monetary conditions to address elevated inflation. In fact, a return to the pre-pandemic growth rate was challenging, particularly in the case of emerging and developing economies, owing to the convergence of factors such as long-term fallout of the pandemic and increasing geoeconomic fragmentation. Other issues include elevated central bank policy rates in several emerging and developed economies to control inflation and withdrawal of fiscal support amid high debt levels, and extreme weather events.

Despite these challenges, the Indian economy saw strong growth momentum, with a major push fueled by investments and sectors such as information technology, services, agriculture and manufacturing.



Nominal GDP growth of key economies

CY - calendar year

Note: Euro area comprises 19 member countries of the EU

Source: International Monetary Fund (IMF; World Economic Outlook – April 2024 update), CRISIL MI&A Consulting

As per the International Monetary Fund's (IMF) World Economic Outlook:

• The global real GDP growth is estimated at 3.2% in the CY2024 with the forecast 0.1% higher than the previous estimates due to the upgrades for China, the United States (US), large emerging markets and developing economies. The forecast for CY2024 is however, below the historical (CY2000-2019) annual average of 3.8% due to elevated central bank policy rates to fight inflation, a withdrawal of fiscal support by major economies amid high debt weighing on economic activity and low underlying productivity growth.



- In the case of advanced economies which include the US, Japan and Euro area, growth is projected to rise from 1.6% in CY2023 to 1.7% in CY2024. A marginal upward revision of 0.2% for CY2024 compared with previous estimates of 1.5% is due to stronger growth momentum in the US that is partly offset by weaker growth in the Euro area.
- The growth rate in emerging market and developing economies which include China, India, Russia, Brazil, Mexico, and South Africa is expected to remain at 4.2% in CY2024, with a moderation in emerging and developing Asian countries such as India and China's growth offset mainly by rising growth for economies in Middle East, Central Asia and Sub-Saharan Africa. Emerging and developing economies are expected to experience stable growth through CY2024 and CY2025 albeit with some regional differences.

The real GDP growth rate of the US was revised down from 2.5% in CY2023 to 2.1% in CY2024. There was an upward revision of 0.6% for CY2024 from the previous estimates, largely due to stronger than expected growth outcome for 2023.

Growth for the Euro area is projected to recover from its low rate of an estimated 0.4% in CY2023 which was due to high exposure to the war in Ukraine, to 0.8% in CY2024. Stronger household consumption due to the decrease in energy prices and drop in inflation is supporting real income growth and is expected to drive the recovery. Growth for CY2024 is revised downward from the previous estimates, largely on account of carryover from the weaker than expected outcome for CY2023.

Among other advance economies, growth in the United Kingdom is projected to rise modestly from an estimated 0.1% in CY2023 to 0.5% in CY2024, due to the lagged negative effect of high energy prices. Growth in Japan is projected to slow from an estimated 1.9% in CY2023 to 0.9% in CY2024. This is due to fading of the one-off factors that supported growth in 2023, including surge in inbound tourism, depreciation of the Yen, pent up demand, and a recovery in business investment following earlier delays in implementing projects.

Growth in emerging and developing countries of Asia is expected to decline from an estimated 5.6% in CY2023 to 5.2% in CY2024. Growth in China is projected at 4.6% in CY2024 due to carryover from stronger than expected growth of 5.2% in CY2023 and increased government spending on capacity building against natural disasters. India is the fifth largest economy and among the fastest growing major economies. Growth in India is projected to remain strong at 6.8% in CY2024 and 6.5% for CY2025 with the strong growth led by continuing strength in domestic demand and a rising working age population.

Economic activity in major developed countries was also resilient, with economic momentum continuing in the US and the Euro area avoiding a contraction in the fourth quarter of CY2023. Growth picked up in the fourth quarter of CY2023 in China as well. However, the slowdown in the UK economy accelerated in the fourth quarter of 2023, with a recession now being recorded. Japan's economy too slowed down in the fourth quarter of CY2023.

Meanwhile, the global headline inflation is expected to fall from an average of 6.8% in CY2023 to 5.9% in CY2024 mainly due to expected decline in inflation in advanced economies by 2% in CY 2024. The fall in global inflation in CY2024 reflects a broad-based decline in global core inflation (all item except food and energy). This dynamic differs from that in CY2023, when global core inflation fell marginally on an annual average basis and headline inflation declined mainly on account of lower fuel and food price inflation. In CY2024, core inflation is expected to fall by 1.2% after contracting by 0.2% in CY2023. As in case of headline inflation, the fall in core inflation is faster for advanced economies. Diminished inflation reflects the fading of relative price shocks, notably in energy prices. In near term, inflation expectations have fallen in major economies with long term expectations remaining anchored.

	Q2-2022	Q3-2022	Q4-2022	Q1-2023	Q2-2023	Q3-2203	Q4-2023	Q1-2024
US	(0.6)	2.7	2.6	2.2	2.1	4.9	3.4	1.4
UK	0.1	(0.1)	0.1	0.2	0.0	(0.1)	(0.3)	0.6
Euro area	0.8	0.5	0.0	0.0	0.1	(0.1)	0.0	0.3
Japan	1.2	(0.2)	0.3	1.1	1.0	(0.9)	0.1	(0.5)
China	-2.1	4.0	0.8	1.8	0.5	1.8	1.2	1.6
India*	12.8	5.5	4.3	6.2	8.2	8.1	8.6	7.8

GDP growth (quarter-on-quarter seasonally adjusted, %)

*Note: Year-on-year annualized per cent for India

Source: Statistical Bureau, respective countries

Review and outlook of inflation in key economies

Meanwhile, inflation has declined faster than expected. Global headline inflation is expected to fall to 5.9 percent in 2024 and to 4.5 percent in 2025, with the 2025 forecast revised down as per IMF estimate. The global economy has been surprisingly resilient, despite significant central bank interest rate hikes to restore price stability.

However, there is regional divergence on inflation in the US. S&P Global Ratings, in its June,2024 release, expects inflation data is now on track to reach the Fed's 2% target in late 2025 and with more evidence of a cooling job market and decelerating consumer spending growth, thus anticipating a rate cut in September 2024. Also, the European Central Bank is growing increasingly confident that euro zone inflation can drop to its 2% target by the middle of 2025. In China, June 2024 reading marked the lowest inflation rate since March 2024 and undershot market expectations.

	Sep- 2023	Oct-2023	Nov- 2023	Dec-2023	Jan-2204	Feb-2024	Mar-2024	Apr-2024	May-2024	June- 2024
US	3.7	3.2	3.1	3.4	3.1	3.2	3.5	3.4	3.3	3.0
UK	6.7	4.6	3.9	4.0	4.0	3.4	3.2	2.3	2.0	2.0
Euro zone	4.3	2.9	2.4	2.9	2.8	2.6	2.4	2.4	2.6	2.5
Japan	3.0	3.3	2.8	2.6	2.2	2.8	2.6	2.5	2.8	NA
China	0.0	(0.2)	(0.5)	(0.3)	(0.8)	0.7	0.1	0.3	0.3	0.2
India	5.0	4.8	5.5	5.6	5.1	5.1	4.9	4.8	4.8	5.1

Consumer price inflation (on-year, %)

Source: Statistical Bureau, respective countries

US inflation inches up while unemployment decreases

• According to a Bureau of Economic Analysis (BEA), US GDP grew at 1.4% in the first quarter of CY2024, lower than 3.4% in the previous quarter. Compared to the fourth quarter, the deceleration in real GDP primarily reflected decelerations in consumer spending, exports, and state and local government spending, and a downturn in federal government spending. These movements were partly offset by an acceleration in residential fixed investment and accelerated imports.



- Total nonfarm payroll employment increased by 206,000 in June 2024, and the unemployment rate changed slightly at 4.1 percent for the same period. Job gains occurred in government, health care, social assistance, and construction.
- The consumer price index, a broad measure of costs for goods and services across the U.S. economy, declined 0.1% from May 2024, putting the 12-month rate at 3% for June 2024, around its lowest level in more than three years. The index for gasoline fell 3.8 percent in June 2024, after declining 3.6 percent in May 2024, more than offsetting an increase in shelter. The energy index fell 2.0 percent over the month, as it did the preceding month. The index for food increased 0.2 percent in June 2024.
- Goods and services trade deficit widened to USD 75.1 billion (seasonally adjusted) in May 2024, compared with USD 74.5 billion in April 2024. May 2024 exports were \$261.7 billion, \$1.8 billion less than April 2024 exports, whereas imports were \$336.7 billion in May 2024, \$1.2 billion less than April 2024 imports.

Economic activity revives in the Euro area, inflation eases

- In the first quarter of 2024, seasonally adjusted GDP increased by 0.3% in both the euro area and the EU, compared with the previous quarter, according to a flash estimate published by Eurostat, the statistical office of the European Union. In the fourth quarter of 2023, GDP had declined by 0.1% in the euro area and had remained stable in the EU.
- The seasonally adjusted HCOB Eurozone Composite PMI Output Index a weighted average of the HCOB Manufacturing PMI Output Index and the HCOB Services PMI Business Activity Index - saw its recent upward trend thwarted at the end of the second quarter as it decreased for the first time since October last year. Posting 50.9 in June 2024, the headline index posted above the 50.0 no-change mark for a fourth month in a row, signaling a sustained increase in euro area business activity. That said, the latest figure fell from 52.2 in May 2024, thereby indicating a slowdown in the expansion, and signaled a rise in output that was the softest in three months and only marginal overall.
- According to the flash estimate from Eurostat, inflation in the Euro area eased to 2.5% in June 2024 from 2.6% in May 2024, driven by moderation across most categories. Looking at the main components of euro area inflation, services is expected to have the highest annual rate in June (4.1% in June 2024, stable compared with May 2024), followed by food, alcohol & tobacco (2.5% in June 2024, compared with 2.6% in May 2024), non-energy industrial goods (0.7% in June 2024, stable compared with May 2024) and energy (0.2% in June 2024, compared with 0.3% in May 2024).
- The Governing Council decided to lower the three key ECB interest rates by 25 basis points. Accordingly, the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will be decreased to 4.25%, 4.50% and 3.75% respectively, with effect from 12 June 2024.
- The euro area exports of goods to the rest of the world in May 2024 were €241.5 billion, a decrease of 0.5% compared with May 2023 (€242.7 bn). Imports from the rest of the world stood at €227.6 bn in May 2024, a fall of 6.4% compared with May 2023 (€243.2 bn).

UK manufacturing begins to expand; inflation expands

 The seasonally adjusted S&P Global UK Manufacturing Purchasing Managers' Index (PMI) registered 50.9 in June 2024, down slightly from May 2024's 22-month high of 51.2 and below the earlier flash estimate of 51.4. The PMI has posted above the neutral 50.0 mark - signalling expansion in each of the past two months. Three out of the five PMI components were at levels consistent with improved operating conditions in June, as output and new orders expanded and suppliers' delivery times lengthened. In contrast, stocks of purchases and employment both decreased.

- UK gross domestic product (GDP) is estimated to have increased by 0.6% in Quarter 1 (Jan to Mar) 2024, following declines of 0.3% in Quarter 4 (Oct to Dec) and 0.1% in Quarter 3 (July to Sept) 2023. Compared with the same quarter a year ago, GDP is estimated to have increased by 0.2% in Quarter 1 2024. In output terms, services grew by 0.7% in Q1 2024 with widespread growth across the sector; elsewhere the production sector grew by 0.8% while the construction sector fell by 0.9% in the same period. In expenditure terms, there were increases in the volume of net trade, household spending and government spending, partially offset by falls in gross capital formation.
- The Consumer Prices Index (CPI) rose by 2.0% in the 12 months to June 2024, the same rate as the 12 months to May 2024. The largest upward contribution to the monthly change in CPI annual rates came from restaurants and hotels, where prices of hotels rose more than a year ago; the largest downward contribution came from clothing and footwear, with prices of garments falling this year having risen a year ago. Core CPI (excluding energy, food, alcohol and tobacco) rose by 3.5% in the 12 months to June 2024, the same rate as in May; the CPI goods annual rate fell from negative 1.3% to negative 1.4%, while the CPI services annual rate remained at 5.7%.
- Goods and services trade deficit widened by GBP 1.6 billion (seasonally adjusted) in May 2024 to GBP 9.2 billion driven by increased imports and decreased exports of goods.

Inflation accelerates in Japan

- Japan's GDP shrank 0.5% qoq in Q1 of 2024, matching flash data while reversing from an upwardly revised 0.1% growth in Q4. Private consumption, which accounts for more than half of the economy, fell for the fourth straight quarter (-0.7%, in line with the initial reading and market consensus, after a 0.4% drop in Q4), marking the steepest fall in 3 quarters as consumers continued to reduce their spending in the face of expensive costs of living and sluggish wages.
- Posting at the neutral mark of 50.0 in June 2024, the au Jibun Bank Japan Manufacturing Purchasing Managers' Index (PMI) – a composite single-figure indicator of manufacturing performance, indicated no change in the overall health of the sector. This followed a marginal improvement in operating conditions in May 2024, when the headline figure registered 50.4.
- The annual inflation rate in Japan accelerated to 2.8% in May 2024 from 2.5% in April 2024, pointing to the highest reading since February 2024. There was a steep upswing in electricity prices as energy subsidies fully ended (14.7% May 2024 vs -1.1% in April 2024), reversing declines in the prior 15 months. At the same time, prices rose further for food (4.1% May 2024 vs 4.3% April 2024). The core consumer price index in Japan, which excludes fresh food but includes fuel costs, increased by 2.5% year-on-year in May 2024, picking up from April 2024's 3-month low of 2.2% and marking the first rise since February amid a sharp jump in energy prices, notably electricity as the government fully removed subsidies.
- The central bank policy rate in Japan stood at 0.05 percent in June 2024. In March 2024 the Bank of Japan raised short-term interest rates for the first time in 17 years, ending its negative interest rate policy. From March 21, 2024 onwards, the Bank of Japan encourages the uncollateralized overnight call rate to remain between 0.0 and 0.1 percent.
- Japan's trade deficit decreased to JPY 1,221 billion in May 2024 from JPY 1,382 billion in the same month of the prior year, compared with market estimates of a JPY 1,300 billion shortfall. It was the second straight month of a trade gap, despite exports growing faster than imports. Outbound shipments jumped by 13.5% yoy, the sixth consecutive month of growth, beating forecasts of 13% and marking the strongest increase since November 2022, to JPY 8,276.63 billion, supported by robust sales to main trading partners, notably the US and China. Inbound shipments expanded 9.5%, the second successive month of rise and the strongest growth in 16 months, to a five-month peak of JPY 9,497.93 billion, due to higher purchases of mineral fuels.

Manufacturing remains stable in China

- China Q1 2024 GDP growth. China's GDP in the first quarter of 2024 reached RMB 29.63 trillion (US\$4.1 trillion) according to preliminary calculations. This is an increase of 5.3 percent from the previous year and an increase of 1.6 percent from the previous quarter when calculated at constant prices.
- The official National Bureau of Statistics (NBS) Manufacturing Purchasing Managers' Index stood at 49.5 in June 2024 unchanged from the previous month, indicating that the climate level of manufacturing industry was basically stable. In terms of enterprise size, the PMI for large enterprises was 50.1 percent in June 2024, a decrease of 0.6 percentage point from the previous month; the PMI for medium-sized and small enterprises was 49.8 and 47.4 percent respectively in June 2024, an increase of 0.4 and 0.7 percentage points from the previous month.
- Consumer inflation dropped to 0.2% in June 2024 from 0.3% in May 2024. June's reading marked the lowest inflation rate since March and undershot market expectations. Looking at subsectors, higher non-food prices outweighed lower food prices. Factors such as muted domestic demand, a weak housing market, massive domestic manufacturing capacity, and elevated competitive pressures in sectors such as electric vehicles have all contributed to keeping inflation low in recent months.
- China's trade surplus surged to USD 99.05 billion in June 2024, up from USD 69.80 billion a year earlier. Exports jumped 8.6%, the fastest in 15 months, while imports fell 2.3%. For the first half of 2024, China recorded a USD 435 billion surplus, with exports rising 3.6% to USD 1.71 trillion and imports growing 2.0% to USD 1.27 trillion.

India to post the fastest growth among large economies

- India's growth trajectory continued throughout fiscal 2024 wherein India's real GDP expanded at 7.8% in the first quarter of 2024, 7.6% in the second quarter and 8.4% in the third quarter. On the supply side, gross value added (GVA) growth at 6.3% in the first quarter of 2024 was much lower than the GDP growth in the fourth quarter. A strong growth in net taxes pushed the GDP growth higher than GVA.
- Inflation based on the Consumer Price Index (CPI) surged in June 2024, corroborating the central bank's position that the last mile of disinflation remains a challenge. The gauge printed at 5.1% for June 2024, compared with 4.8% in May 2024 as food prices remained high. Notwithstanding a supportive base effect from last year, food inflation surged to 9.4% in June 2024 on account of pricier vegetables, cereals, milk and fruits. Vegetables inflation, which has remained in double-digits for eight months now, is a major worry as is rigidity in foodgrains inflation. Non-food inflation eased for the 17th straight month, sliding to a record low of 2.3%.
- The Reserve Bank of India kept its benchmark policy repo at 6.5% for the eighth consecutive meeting in June 2024, as widely expected amid persistent price pressures and remaining economy resilient. The latest move came after annual inflation stood at 4.85% in April 2024, almost unchanged from March, staying within the RBI's 2-6% target range in the medium term.
- India recorded a trade deficit of \$20.98 billion in June 2024, \$1 billion more than the deficit recorded in June 2023, even as merchandise exports rose 2.56% year-on-year to reach \$35.2 billion during the month.
- As per CRISIL MI&A, India's economy is expected to grow at 6.8% in fiscal 2025 up from 6.5% projected earlier. This will be driven by expected easing of domestic financial conditions, disinflation leading to increasing purchasing power of consumers and growth in private capital expenditure.



Geopolitical pressures amid steady supply to keep Crude oil prices ~\$83-88 per bbl in 2024

In 2023, Crude oil prices witnessed a steady decline of 18% on-year supported by easing of geopolitical tensions coupled with recessionary pressures globally. In H1 2023 crude oil prices averaged \$80 per barrel resulting in a decline of ~25% on-year owing to deterioration in economic conditions globally such as banking crises in US and lower than anticipated Chinese demand revival. The decision of the OPEC+ in April-23 to cut 1.16 mbpd of output coupled with summer demand from the US resulted in overall prices to surge in H2 2023. Tight global supply resulted in declining inventories pushed prices upwards in Q3 2023. The deteriorating demand scenario stemming from Europe and Japan along with easing of Venezuelan oil sanctions global oil prices.

Moderating demand coupled with steady global supply are expected to keep crude oil prices to remain range bound in 2024. CRISIL MI&A Research expects overall crude oil prices to average around \$83-88 per bbl in 2024. However, the recent issues pertaining to the shipping along with the OPEC+ production strategy will be key monitorable driving prices in the current year.

On the demand front, total world oil demand grew by a healthy 1-2 million barrels per day (mbpd), reaching 98-99 mbpd in 2023. Driven by healthy growth in key consuming economies such as the United States (US), Europe, Middle East, and India.



Brent Crude prices (\$/barrel)

Sources: CRISIL MI&A Consulting

Global trade stabilises

The value of global merchandise trade has continuously declined since mid-2022. The decline in 2023 was primarily because of lower demand in developed countries and subdued trade in East Asia and Latin America. Lower commodity prices further contributed to lowering the value of international trade during the year.

In contrast, trade in services has sustained growth throughout most of the period. Among services, tourism and travel related services rebounded strongly.

In volume terms, trade was modest through **2023**. The slightly positive trend in the volume suggests resilient global demand for imported products. A weak US dollar also supported global trade volume in 2023.

However, on-quarter merchandise as well as services trade have stabilised. In 2024, global trade is projected to grow 3.3% on account of overall moderating global inflation and sustained growth of economies. That said, persistent geopolitical uncertainties and rising shipping costs, and high levels of debt weighing on economic activity in many countries may negatively impact further improvement in global trade.



IMF world trade growth projection

Advanced economies – US, Japan, Euro area; emerging market and developing economies – China, India, Russia, Brazil, Mexico, South Africa Note: Average annual % change of export and import trade in goods and services has been considered Source: IMF (World Economic Outlook – April 2024 update), CRISIL MI&A

Key events and their impact on global trade

Uncertainty in the Middle East

In the past few months, global trade has been affected by geopolitical uncertainty in the Middle East, leading to an increase in delivery times, and, thereby, disrupting supply chains. Also, a severe drought in the region of the Panama Canal has forced authorities to impose restrictions that have substantially reduced daily ship crossings, slowing down maritime trade through this key conduit, which typically accounts for 5% of global maritime trade. In the first two months of 2024, trade through the Suez Canal fell 50% from a year earlier and trade through the Panama Canal fell 32%.

Commodity price spikes amid geopolitical and weather shocks

The geopolitical uncertainty in the Middle East region, which accounts for ~35% of the world's crude oil exports and 14% of natural gas exports, could affect a wider region in case of further uncertainty. Geopolitical uncertainties in Europe are also leading to fresh supply shocks, with food, energy and transportation costs spiking. In fact, container freight cost increased sharply between October 2023 and January 2024. Geoeconomic fragmentation

could also constrain cross-border flow of commodities, causing additional price volatility. Extreme weather shocks, including floods and droughts, may lead to an increase in food prices as well, putting risk to global disinflation.

Tighter monetary policies

A slower-than-expected decline in core inflation in major economies, owing to persistent labour market tightness and supply chain disruptions, could impact interest rates and asset prices, thereby increasing financial stability risks, tighten global financial conditions, and strengthen the US dollar, with adverse consequence for trade and growth.

Key global central banks raised rates in quick succession in 2023, as several advanced economies confronted elevated inflation.

In the current cycle, the Fed and the Bank of England have each raised rates by 525 bps, while the European Central Bank has raised rates by 450 bps. In the past few months, however, these central banks have held interest rates steady as inflation moves closer to the targets. To be sure, the Fed has indicated that it will cut rates by a cumulative 75 bps in 2024.

Growth faltering in China

With a substantial share of several economies' exports absorbed by China, a weaker-than-expected economic recovery in China would have significant cross-border implications, especially for commodity exporters. Fixed investment has already weakened, indicating weakness in external demand. Unintended fiscal tightening in response to local government financing constraints is also possible, which will reduce household consumption as well. Risks to the outlook also include ongoing weakness in the Chinese real estate market, which could pose a larger-than-expected drag on growth and potentially lead to financial stability risks.

India-US trade

The US had communicated in August 2021 to India that it was not interested in a free trade agreement (FTA). India was pulled out of the US's Generalised System of Preferences that granted some tariff relief to its exports in 2019.

The government will now have to work on market access issues on both sides, lowering of non-tariff barriers, entering into mutual recognition pacts and adopting common quality standards, which could help Indian exports in the interim. There is even the possibility of providing domestic access to US agricultural products or easing import duties on automobiles, etc.

That said, the strong momentum in the India-US trade in goods and services has continued, with trade likely to have surpassed \$200 billion in 2023 despite the challenging global trade environment. This is almost doubled the level in 2014, showcasing the benefits to both countries, highlighted in the latest India-United States Trade Policy Forum in January 2024.

Beyond trade, India and the US have strong ties in various policy areas. The countries regularly collaborate on initiatives such as the Indo-Pacific Economic Framework for Prosperity (IPEF). The two nations have also resolved seven disputes at the World Trade Organization (WTO), underlining deepening cooperation.

Trade deficit narrows

The global economy is set to broadly expand at a steady pace in 2024. As per the IMF's World Economic Outlook January 2024 projection, the global economy will grow 3.3% in 2024 and 3.6% for 2025.



In 2023, major economies saw a downturn in merchandise trade, with Russia the notable exception, which saw imports rise 6%. However, this increase could be because of currency fluctuation on a very low base of 2022. In fact, Russian exports sharply declined during the year, largely tied to the energy markets. On the other hand, Brazil and the EU eked out growth.

On-quarter data, though, indicates a return to growth in some major economies, including China and India. Overall, a comparison of annual and quarterly trajectories suggest significant improvement in trends for several economies; however, at an overall level, the data still pointed to a negative for 2023.

The decline in global trade was more pronounced for developing countries. In 2023, imports and exports of developing countries declined 5% and 7%, respectively. Conversely, imports in developed countries decreased ~4% and in exports, 3%. On-quarter figures, though, indicated a positive trend for developing countries, while trade of developed countries remained stable.

Region-wise, South-South trade (developing countries, excluding East Asia) posted stronger-than-average on-year decline during much of 2023, with a reversal in the fourth quarter. In fact, on-quarter as well, trade in the fourth quarter rose \sim 3%.

Trade in most regions declined on-year in 2023, though. The exception was a significant increase in intra-regional trade for the African region. Also, the region comprising Russia and Central Asian economies registered sharp decrease in exports, but strong increase in imports. Trade in East Asian exhibited notable weakness as well, as was the case with intra-regional trade. Trade also was weak in Latin America during the last quarter and in the region comprising Russia and the Central Asian economies.

Conversely, trade grew for Africa and East Asia.

WTO negotiation: India secures multilateral victory

By January 2023, a total of 61 WTO members that were participating in the Joint Statement Initiative on Service Domestic Regulation had submitted requests for certification of their updated General Agreement on Trade in Services (GATS).

India, along with South Africa, has achieved a breakthrough in WTO negotiations on domestic service regulations. After objections to certification requests for updated GATS, India withdrew objections following consultations. India emphasised adherence to multilateral processes, ensuring non-discrimination principles.

India's key objective was reiterated during meeting and outlined in the revised certification requests of the WTO member involved. Working Party on Domestic Regulations agreed on the course of action for those WTO members aiming to include regulations on domestic matters in their GATS schedules as additional commitments. This outcome addressing a topic mandated by multiple parties within multilateral forum, reaffirmed India's commitment to preserving the multilateral nature of WTO.

Regional Comprehensive Economic Partnership

The Regional Comprehensive Economic Partnership (RCEP) is a multilateral FTA between Australia, China, Japan, New Zealand, South Korea and member states of the Association of Southeast Asian Nations (ASEAN, comprising Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam). The 15 countries account for ~30% of the world's population and nearly 30% of global GDP.



To be sure, RCEP is the world's largest FTA by members' GDP.

RCEP countries have agreed to progressively abolish 90% of all tariffs on goods between participating members. The agreement also simplifies customs procedures and rules of origin laws between countries. Rules of origin restrictions generally tend to constrain the development of regional supply chains, which means the new provision will reduce the potential regulatory friction for firms and countries in terms of trade.

On November 2019, India decided to opt out of RCEP. India has a trade deficit with 11 out of the 15 RCEP countries and the content of the RCEP deal did not provide protection for the Indian economy. India's reservations were related to tariff commitments, investments, electronic commerce, rules of origin and auto trigger mechanisms. Further, given the economic slowdown then, the Indian government faced tremendous pressure from different sections of the industry and political organisations to not join the RCEP. Various ministries such as agriculture, steel, chemical and MSME had also opposed the deal.

Joining the RCEP would have made India a part of the rule-making body of what was supposed to be the largest trade agreement in the world. The RCEP was also expected to push India to pursue much needed domestic reforms to make the manufacturing sector more competitive. India already had bilateral FTAs with ASEAN, South Korea, Japan and negotiations were underway with Australia and New Zealand. Also, the inclusion in the RCEP of China, with whom India had a trade deficit \$54.7 billion in 2018 – that accounted for half of the country's total trade deficit – was a cause of concern for India.

Overview of the Indian economy

Review of GDP growth over fiscals 2019-2024 and Outlook for fiscals 2024-2029

India ranks as the world's 5th largest economy and is the fastest growing among major economies. The Indian economy logged 4.3% CAGR between fiscals 2019 and 2024. This was a sharp deceleration from a robust 6.7% CAGR between fiscals 2017 and 2019, which was driven by rising consumer aspirations, rapid urbanisation, the government's focus on infrastructure investment and growth of the domestic manufacturing sector. Economic growth was supported by benign crude oil prices, soft interest rates and low current account deficit. The Indian government also undertook key reforms and initiatives, such as implementation of the Goods and Services Tax (GST), Insolvency and Bankruptcy Code, Make in India, financial inclusion initiatives, and gradual opening of sectors such as retail, e-commerce, defence, railways, and insurance for foreign direct investments (FDIs).

A large part of the lower growth between fiscals 2018 and 2023 was because of the economy contracting 5.8% in fiscal 2021 owing to the fallout of Covid-19. The pandemic's impact was more pronounced on contact-sensitive services and social distancing norms-affected services such as entertainment, travel, and tourism, with many industries in the manufacturing sector also facing issues with shortage of raw materials/components as lockdown in various parts of the world upended supply chains.

Over the period, India's economic growth was led by services, followed by the industrial sector, while in part impacted by demonetisation, the non-banking financial company (NBFC) crisis, slower global economic growth, and the pandemic.

As lockdowns were gradually lifted, economic activity revived in the second half of fiscal 2021. After a steep contraction in the first half, owing to rising number of Covid-19 cases, GDP moved into positive territory towards the end of fiscal 2021. Subsequently, in fiscal 2022, India's real GDP grew 9.7% from the low base of fiscal 2021.



India's gross domestic product (GDP) exceeded expectations during first three quarters of fiscal 2024. According to the National Statistics Office's (NSO) second advance estimates (SAE), real GDP growth accelerated to 8.4% year-on-year in the third quarter of fiscal 2024 from 8.1% in the second quarter. Growth of the past two quarters were revised up (second quarter was revised to 8.1% from 7.6%, and first quarter to 8.2% from 7.8%)

NSO now pegs GDP growth at 7.6% in fiscal 2024 compared with 7.3% as per the first advance estimates. Based on this second advance estimate, growth in the fourth quarter of this fiscal is estimated to slow to 5.9%. Additionally, the estimate for fiscal 2023 was revised to 7.0%, while for fiscal 2022 it was revised to 9.7%.

Growth surpassed forecasts in the second quarter of fiscal 2024, driven by strong government spending and a sharp rise in manufacturing and construction growth. Globally, growth in major economies such as the US and China beat estimates, contributing to better export earnings for India.

After a strong GDP estimate in the past three fiscals, CRISIL MI&A expects GDP growth to moderate to 6.8% in fiscal 2025. Fiscal consolidation will reduce the fiscal impulse to growth. Rising borrowing costs and increased regulatory measures could weigh on demand. Exports could be impacted due to uneven growth in key trade partners and any escalation of the Red Sea crisis. On the other hand, another spell of normal monsoon and easing inflation could revive rural demand.

Reducing the fiscal 2024 deficit will reduce the government's direct support for economic growth, but investing in high-quality spending could still boost investment and rural incomes. CRISIL MI&A anticipates a return to normal levels of indirect tax impact on GDP. However, uneven economic growth in major trade partners like the US and EU, along with escalating tensions in the Red Sea, may hinder exports.



India's GDP growth trend and outlook

Note: P - projected

Source: National Statistical Office (NSO), International Monetary Fund (IMF), CRISIL MI&A Consulting estimates

In the third quarter of fiscal 24, fixed investments posted year-on-year growth of 10.6% while private consumption (3.5%), despite a modest uptick, remained sluggish. The drag from net exports eased in the third quarter. From the supply side, growth was highest for manufacturing (11.6%), followed by construction (9.5%) and services (7.0%), while growth in agriculture contracted in the third quarter (-0.8%).



Similarly, growth in the fiscal year 2024 till Q3 has been driven by fixed investments (10.2% growth), while private consumption at 3.0% trailed overall GDP growth. On the supply side, industry grew the most (9%), followed by services (7.5%), while agriculture (0.7%) lagged.

Near-term review and outlook on GDP

India transition to the world's fifth largest economy and fastest growing among major economies has been on the back of services, industry and agriculture sectors firing.

Services sector key growth driver

In fiscal 2020, the services sector accounted for 55.3% share of India's GDP vs 52.4% in fiscal 2015. However, in fiscal 2021, its share had dipped to 53.6%, owing to the onset of the pandemic, with marginal improvement in fiscal 2022 following gradual normalisation of market operations.

The industrial sector, which logged a 7.1% CAGR between fiscals 2015 and 2019, was the second-largest contributor, at ~31% share of GDP. As was the case with services, the contribution of industrial declined in GDP declined in fiscal 2021 as well, with slowdown in economic growth. Before the slowdown in overall economic activity in the fiscal, India's industrial sector output growth was supported by the government's Make in India initiative, rising domestic consumption and implementation of GST. The initiatives improved India's position on the World Bank's Ease of Doing Business index to 63 in fiscal 2019 from 142 in fiscal 2014.

To be sure, the pandemic and subsequent lockdown exacerbated the economic slowdown in fiscal 2021, with the services segment the worst affected, declining 8.2% on-year, mainly because of decline in trade, hotels, transport and communication services (THTC) by 19.7% as well as decline in public administration, defence and other services by 7.6%. The industrial sector followed, declining 0.9% on-year. Agriculture was the only sector that grew 4.1% on-year, thereby restricting a further contraction in GDP.

In fact, during the fiscal, the agriculture sector's share in GVA (gross value added) at constant prices expanded, while the share of the services and industrial sectors contracted.

In fiscal 2022, agriculture GVA rose 3.5% and the industrial sector, 12.0%, on a low base of fiscal 2021, whereas the service sector grew 8.8%. This primarily supported a 9.7% rise in GDP.

In fiscal 2023, agriculture GVA continued to grow at a steady 4.0%, thereby its share in GDP continued to expand. The share of industrial sector in GDP also rose 4.0% on a high base, mainly because of utility services, which rose the sharpest among the industrial components, by 8.0%. Other growth segments were mining (grew 5.0%) and manufacturing and construction (grew marginally). The services sector grew 9% in fiscal 2023. Trade, hotels, transport, and communication services (THTC) saw strong on-year growth of 14% in fiscal 2023.

Share of sector in GVA at constant prices



E - estimated

Source: RBI; CRISIL MI&A Consulting

In fiscal 2024, the agri sector is estimated to have expanded \sim 0.7% on-year, thereby contributing to 14.4% of the GVA. The services sector, though, is expected to remain the economy's engine, growing 7.5%, with its share in GVA at 54.7%, whereas industry will maintain a 30.8% share.

In fact, services growth picked up (7.0% in the third quarter vs 6.0% in the second quarter). Within the space, growth in THTC accelerated (6.7% vs 4.5%), spurred by the festive season. Financial, real estate and professional services also picked up 7.0% from 6.2%, supported by an acceleration in services export growth (5.5% vs 4.6%) and favourable base effect. Financial services benefited as well from healthy credit momentum. And public administration, defence and other services grew 7.5% vs 7.7%.

Meanwhile, agriculture and allied GVA contracted 0.8% in the third quarter of last fiscal (compared with 1.6% growth in the second quarter). While partly the result of a highly unfavourable base, it was also because of a fall in kharif output as per the government's second advance estimates. Hence, owing to the higher growth in services, CRISIL estimates that the contribution of the agri sector to have lost ground.

Manufacturing leads growth in third quarter of fiscal 2024

Among the major producing sectors, the highest growth in the third quarter of fiscal 2024 was manufacturing, at 11.6% on-year, though the rate of increase was a moderation from 14.4% growth in the previous quarter. Construction GVA grew at a healthy pace despite some slowdown (9.5% vs 13.5%) and was supported by continued government capital expenditure (capex) in infrastructure.

Real GDP growth over fiscals 2024 to 2029

For the fiscal 2025, India's gross domestic product (GDP) growth is expected to moderate to 6.8% after a betterthan-expected 7.6% expansion in fiscal 2024, given that high interest rates and lower fiscal impulse (from reduction in fiscal deficit to 5.1% of GDP) would temper demand and the net tax impact would normalize.

Additionally, uneven economic growth of key trading partners and escalation of geopolitical uncertainties can lower exports. But there will be support from other areas. Continued disinflation will prop up the purchasing power of consumers. Healthy rabi sowing and good kharif output (assuming another spell of normal monsoon is ahead) will



bolster agricultural incomes. Further, a gradual pick-up in private capital expenditure (capex) will make investment growth more broad-based. The government has also provided budgetary support to rural incomes and infrastructure spending.

The lowering of fiscal deficit will mean curtailed fiscal impulse to growth, but good quality of spending would provide some support to the investment cycle and rural incomes. CRISIL also expects a normalisation of the net indirect tax impact on GDP witnessed in the current fiscal. Uneven economic growth in key trade partners such as the United States (US) and the European Union, and an escalation of the ongoing Red Sea tensions can act as drag on exports.

Risks to growth

Weak monsoon

Rainfall in the country during June to September 2023 was 94% of the long period average (LPA). To be sure, deficient rainfall has a significant impact on the rural demand.

Inflation pressure

Inflation data released in April 2024 showed Consumer Price Index (CPI) inflation eased to a 5-month low of 4.9% in March from 5.1% in February. While core inflation declined to a record low of 3.3%, fuel inflation declined to 3.2% on the back of lower domestic fuel prices. The worry, though, remains on persistently high food inflation, at 8.5%.

External drag on growth

Global growth is likely to slow down this year because of higher interest rates. Central banks in key advanced economies have maintained policy interest rates in their latest meetings. However, improving inflation outlook will allow the RBI to initiate rate cuts in fiscal 2025. Geopolitical uncertainty, though, will continue to disrupt global trade.

Impact of higher interest rates

The transmission of past rate hikes by the RBI's Monetary Policy Committee (MPC) is still playing out amid tight liquidity conditions, which suggests a further rise in market lending rates in the near term. This will moderate domestic demand. The RBI's move to increase the risk weights on consumer credit exposure of banks and NBFCs is also expected to mildly affect overall credit growth this fiscal.

India to remain a global outperformer

Despite slowdown in the near term, India's economy is expected to outperform over the medium run. CRISIL MI&A expects GDP growth to average 6.8% between fiscals 2025 and 2029 vs 3.2% globally, as estimated by the IMF.

India is one of the fastest growing economies (GDP growth, % year-on-year)





E – estimated; P – projected

Note: GDP growth based on constant prices

Source: IMF (World Economic Outlook - April 2024 update), CRISIL MI&A Consulting

Drivers for India's economic growth

- Capital will continue to be the biggest contributor to growth. However, as the government pursues fiscal consolidation, its role in boosting overall capex will partly diminish compared with the past few years.
- Also, strong domestic demand is expected to drive India's growth over peer economies in the medium term.
- Investment prospects are optimistic, given the government's capex push, progress of the Production Linked Incentive (PLI) scheme, healthier corporate balance sheets, and a well-capitalised banking sector with low nonperforming assets.
- India is also likely to benefit from its diversification of the supply chain for incoming FDI flows, as global supply chains get reconfigured with focus shifting from efficiency towards resilience and friend shoring.
- Further, rising employment and notable increase in private consumption, buoyed by growing consumer confidence, are poised to drive GDP growth in the coming months.
- The government's future capex is expected to be supported by tax buoyancy, simplified tax structures with lower rates, reassessment of the tariff structures and digitalisation of the tax filing process.
- Medium-term growth is anticipated to be bolstered by increased capital spending on infrastructure and asset development projects, thereby translating into enhanced growth multipliers.

Near-term review and outlook on inflation

Consumer price inflation (CPI) eased to a 5-month low of 4.9% in March 2024 from 5.1% in February 2024. While core inflation declined to a record low of 3.3%, fuel Inflation declined to 3.2% on the back of lower domestic fuel prices. The food inflation is high, at 8.5%. Higher cereals inflation, erratic vegetable inflation and elevated pulses



inflation are a cause of concern given the India Meteorological Department's (IMD) prediction of higher-thannormal temperatures between April and June.

Although headline inflation eased to 5.4% on-year in fiscal 2024 from 6.7%, food inflation surged to 7.5% from an already high 6.6% in fiscal 2023. The March 2024 reading of 8.5% food inflation creates some disquiet given the prediction of higher-than-average temperatures over the next few months that can stress vegetable production and some of the rabi crop that is yet to be harvested. Beyond that, we expect food inflation to ease a tad on the back of the prediction of a favourable monsoon (above normal rains as per the IMD), some benefit from a high food inflation base and an expected seasonal downturn in pulses inflation.

We expect non-food inflation to remain comfortable, supported by softness in consumer demand, a pass-through of the previous year's oil price decline to domestic fuel (petrol and liquefied petroleum gas (LPG)) prices and an expectation of benign crude prices. Under these assumptions, we expect CPI inflation to average 4.5% in FY25. Intensification/persistence of geopolitical concerns and weather shocks, if any, pose an upside risk. Meanwhile, the government's budget is slimmer, which means the fiscal impulse to growth is also leaner and, therefore, less inflationary. All these factors contribute to the favourable conditions for interest rate reductions during this fiscal year, provided that potential hindrances such as food inflation or geopolitical escalations do not intervene and defer this decision.

Food inflation remains high

Food inflation rose to a six-month high of 9.4% year-on-year in June 2024 from 8.7% the previous month. Vegetables inflation rose for the first time in four months to 29.3% year-on-year in June 2024 from 27.4% in February 2024 despite a supportive base. On a seasonally adjusted basis, vegetable prices rose 3.4% on-month. Unlike the last three months, the rise in vegetables inflation was broad-based with both TOP (tomatoes, onions, potatoes) and non-TOP vegetables inflation rising. TOP inflation surged to 48.4% in June 2024, driven by onions (58.5% in June 2024 vs 38.1% in May 2024) and potatoes (57.6% in June 2024 vs 55.3% in May 2024). Despite an on-month uptick in prices (seasonally adjusted) tomato inflation eased to 26.4% in June 2024 from 41.3% in May 2024 owing to the high base of last year. Non-TOP vegetables saw inflation harden to 19.7% in June 2024 from 18.8% in May 2024 driven by leafy vegetables, brinjal, lady's finger, pumpkin, etc.

Foodgrain inflation was rigid at 10.2% year-on-year in June 2024, though 20 bps lower than the previous month. Cereals inflation inched up to 8.8% in June 2024 from 8.7% in May 2024, mostly owing to non-PDS wheat (6.7% in June 2024 vs 6.5% in May 2024). Pulses inflation eased a tad to 16.1% in June 2024 from 17.1%- in May 2024. While inflation in arhar dal declined sharply (26.9% in June 2024 vs 32.1% in May 2024), other pulses such as split gram (18.5% in June 2024 vs 14.8% in May 2024) saw a rise in inflation.

Inflation in milk rose for the first time in 13 months on account of a price hike by major milk producers (3% in June 2024 vs 2.6% in May 2024)

Edible oils inflation continued to log lower disinflation for the fifth consecutive month to -2.7% in June 2024 from - 6.7% in May 2024.

Fuel inflation falls further

Fuel prices fell 3.7% year-on-year in June 2024, remaining in deflation for the 10th straight month. Although global oil prices remain under pressure, the government subsidy for LPG has kept fuel inflation negative. Prices of liquefied petroleum continued to deflate year-on-year in June 2024 (-24.8%). Electricity inflation moderated to 8.8% in June 2024 from 10.9% in May 2024 owing to a supportive base.

Core inflation eases to a record low

Core inflation inched down to a record low of 3.1% in June 2024. Inflation slid in the essential categories of education to 3.6% in June 2024 from 4.1% in May 2024. On the other hand, inflation picked up in personal care and effects to 8.2% in June 2024 from 7.7% in May 2024, led by rising gold prices to 19.7% in June 2024 as compared to 10.2% in previous month. Services inflation eased 10 bps to a record low of 2.9% in June 2024, while core goods inflation was steady at 3.2%.

WPI inflation accelerates

Wholesale Price Index (WPI)-linked inflation accelerated for the fourth straight month to a 16-month high of 3.4% in June 2024 from 2.6% in May 2024. WPI food inflation rose for the sixth consecutive month to 8.7% from 7.4%, led by soaring vegetable inflation (38.8% vs 32.4%). Onions were the main reason for the higher WPI vegetable inflation, with the inflation rate rising to 93.4% from 58.0%. Inflation also rose in potatoes (64.1% vs 66.4%). A high base, though, lowered tomato inflation; still, it remained high (57.8% vs 64.6%). Foodgrain inflation was relatively steady, rising just 20 bps to 11.6%. Non-food inflation crept up as well, though it was still benign (1.2% vs 0.7%). Crude petroleum inflation rose to 14.0% from 11.1%. Fuel and power inflation was broadly unchanged at 1.0% vs 1.3% in the previous month. Inflation in manufactured products, which accounts for nearly a third of the WPI, rose to 1.4% from 0.8%, driven by manufactured foods (4.3% vs 2.7%), basic metals (1.1% vs 0.3%) and chemicals (-1.1% vs -2.7%).

Outlook on inflation

While headline Consumer Price Inflation (CPI) eased to 5.4% year-on-year in fiscal 2024 from 6.7%, food inflation surged to 7.5% from a high of 6.6% in fiscal 2023. The June 2024 reading of 9.4% food inflation raises concerns, particularly with the prediction of higher-than-average temperatures in the coming months, which could strain vegetable production and some yet-to-be-harvested rabi crops. Looking ahead, we anticipate a slight easing in food inflation, driven by favorable monsoon predictions (above-normal rains according to the IMD), some relief from a high base of food inflation, and an expected seasonal decline in pulses inflation.

We anticipate non-food inflation to remain manageable, supported by subdued consumer demand, the impact of previous year's oil price declines on domestic fuel prices (petrol and LPG), and expectations of stable crude prices. Based on these assumptions, we project CPI inflation to average 4.5% this fiscal year. However, intensification or persistence of geopolitical tensions and weather-related shocks pose an upside risk to this forecast. Moreover, with a leaner government budget, the fiscal impulse to growth is diminished, which could alleviate inflationary pressures. These factors create a conducive environment for potential rate cuts this fiscal year, unless challenges such as food inflation or geopolitical tensions intervene and delay such decisions. Hence, CRISIL expects CPI inflation to average 4.5% in fiscal 2025 against an estimated 5.4% in fiscal 2024.

CPI trendline



Source: Ministry of Statistics and Programme Implementation (MOSPI), CRISIL MI&A Consulting

Cooling domestic demand, assumption of a normal monsoon along with a high base for food inflation should help moderate inflation this fiscal. A non-inflationary Interim Budget 2024-25 that has focused on asset creation rather than direct cash support also bodes well for core inflation. However, an unusual weather event could reverse the easing. Similarly, recent geopolitical uncertainties in the Middle East and a fading low base effect for commodity prices could put some upside pressure on core inflation, and would, therefore, need monitoring.

Nevertheless, we believe slowing inflation, a smaller fiscal deficit and an imminent turn in the Fed's policy rates will lay the ground for the RBI's MPC to start cutting rates. However, we believe more clarity on the path of disinflation could push this decision at least to June 2024, if not later. While CPI inflation has remained in the RBI's tolerance band of 2-6% since August, it is still shy of the 4% target, thereby keeping the MPC on guard.

Factors having direct bearing on auto demand

Fluctuations in crude oil prices and the rupee-dollar exchange rate directly affect automobile demand as these two factors increase fuel costs and import costs, respectively. Also, monsoons, which have a direct bearing on crop yields and food prices, in turn, impact auto demand as it shapes consumer spending behaviour and economic trajectory. Auto finance rates are pivotal in determining affordability. Moreover, private final consumption expenditure (PFCE) and per capita income provide a lens into consumer purchasing power, influencing affordability and, thereby, automobile demand.

Elevated recessionary fears to impact crude oil prices

Crude oil prices have largely risen since end-2021 by ~24% till fiscal 2024. Prices rose further following geopolitical uncertainty in Europe, with prices averaging \$100 per barrel (bbl) in 2022. In fact, prices rose to \$106 per bbl in the first half of 2022 as the geopolitical uncertainty resulted in a significant shift in the crude oil supply chain. However, increasing recessionary fears stemming from elevated inflation, along with interest rate hikes globally, considerably affected consumption and economic growth, dragging crude oil prices towards \$94 per bbl, or a decline of 11%, in the second half of 2022. In 2023, with the rebalancing in global crude oil trade, prices slipped to \$82.6 per bbl.

In 2024, CRISIL MI&A Consulting expects prices to remain range-bound at \$75-80 per bbl. However, any decision by OPEC to cut production as well as a further decision on a ban of Russian crude oil are key factors to be monitored.





Crude oil price and passenger vehicle trend

E - estimated

Notes:

1) Price data is for calendar yea

2) PVs Growth is for Financial Year and For FY24 the growth rate is based on actual number.

Source: Industry, CRISIL MI&A Consulting

In 2022, global crude oil supply rose a healthy 4 million barrels per day (mbpd), reaching 94 mbpd. Incremental growth in supply was driven by the US, Saudi Arabia, the UAE and Iraq, accounting for ~80% share. Crude oil supply, though, continued to be impacted in certain regions. Production-led challenges in Norway, Libya and Nigeria led to a 10% decline in output during the year. Supply chain and gas leak issues in Kazakhstan resulted in muted output from the country as well.

In 2023, ramping up of newer fields in Norway and increased production in North America led to healthy supply of crude oil. Higher drilling activities, along with lower logistical issues from the Permian Basin and Eagle Ford Basin, resulted in healthy supply growth in the US. However, incremental production cuts by OPEC and Russia continued to impact global crude oil supply during the year.

To be sure, rising crude oil prices typically lead to higher fuel costs, directing customer preference towards more fuel-effective vehicles. Increased production cost for automakers and potential shift in consumer spending due to inflation and economic conditions further influence automotive demand.

That said, certain factors will dictate long-term crude oil demand, such as slowing global GDP growth, structural changes, aggressive push towards electric vehicles (EVs), significant increase in vehicle efficiencies, and an ageing population, which has the propensity to consume less crude oil-based products and services, thereby translating into likely weakening in automobile demand.

Rupee-dollar exchange rate in 2024

The rupee appreciated slightly against the dollar in February 2024, to Rs 82.96/\$, from Rs 83.12/\$ in January 2024 on strong capital inflows. This was despite the dollar index strengthening and India's trade deficit widening. In fact, on a monthly average basis, the rupee appreciated 0.2% compared with January.

The rupee remained one of the better-performing emerging market currencies in the first two months of 2024. The on-year rate of depreciation was also lower at 0.4% on average during the two months.

CRISIL expects the rupee to average to Rs 83.5/\$ by March 2025 compared with ~Rs 83/\$ in fiscal 2024. While a narrower current account deficit is expected to support the local currency, volatile external financing conditions could exert some pressure.

As mentioned, the rupee-dollar exchange rate impacts auto demand as it affects import costs. A weaker rupee raises input costs and fuel prices, which reduces domestic demand while enhancing export competitiveness. While increase in fuel prices directly impacts the consumer demand, rise in input costs may not always have a direct impact, as original equipment manufacturers do not always pass these costs to consumers. Any price increase that is passed on by OEMs directly affects the consumer's purchasing decision, though.



Rupee-dollar exchange rate

E – estimated

Source: RBI, CRISIL MI&A Consulting

Agri variables

Small and marginal farmers dominate the Indian agricultural landscape, comprising 86% share of land holdings. These farmers rely on the monsoon for irrigation; hence, its timely arrival and adequacy are needed for a good crop. Any negative impact on crop supply owing to low rainfall has a cascading effect on the Indian economy, as it leads to higher food prices and subsequently lower discretionary spending.

Monsoon has been favourable over the past few years with deviation within the acceptable range; As per the India Meteorological Department (IMD), monsoon deviation was 6% in fiscal 2023. However, fiscal 2024 witnessed an uneven spread of rainfall during the initial months. But rabi output was favourable, supporting farmer income during the early months of fiscal 2024. Also, while kharif sowing was initially delayed owing to a delay in arrival and spread of the monsoon, sowing picked up thereafter. Moreover, higher minimum support price (MSP) in the fiscal and good prices at the mandis maintained on-ground positivity.

Rainfall deviation trend



Note: When rainfall average across the country is within ±10% from its long period average (LPA) or 90-110% of LPA, the rainfall is considered "normal". The LPA for June-September was 868.6mm.

Source: IMD, CRISIL MI&A Consulting

Steep hike in auto finance rates

The sharp rise in repo rates from 2020 onwards has increased financing rates across automobile segments. Equated monthly installments in the passenger vehicle (PV) segment is currently witnessing interest rates of nearly 10%. Interest rates have reached the pre-pandemic levels and are expected to remain firm in the short term. Demand for cars- durable goods most often purchased on credit and higher interest rates makes auto loans more expensive, impacting the purchasing decisions of customers.

Average auto finance rates offered by banks



Source: Industry, CRISIL MI&A



Private consumption remains tepid

Private Final Consumption Expenditure (PFCE) reflects overall consumption patterns and spending capacity of households within an economy. When PFCE increases, it often translates to higher demand for various goods and services.

PFCE remained sluggish, though rising to 3.5% on-year in the third quarter of fiscal 2024 compared with 2.4% in the previous quarter. Rural demand indicators were mixed, with demand for work under Mahatma Gandhi National Rural Employment Guarantee Act (NREGA) slowing in the quarter while sales of two-wheelers surged. However, growth in consumer non-durables, production slowed considerably in the third quarter. But urban demand appears to have sustained some momentum in the quarter, with pick-up in the growth of passenger vehicle sales and consumer durables production, as well as continued double-digit growth in retail credit (18.1% vs 18.3% in the previous quarter). The latter indicates that the impact of past rate hikes and regulations on unsecured lending are still pending.



India's PFCE quarterly trend

Source: Industry, CRISIL MI&A Consulting

Per capita income

Per capita income (per capita net national income) is estimated to have grown 6.8% in fiscal 2024 vs 5.7% in fiscal 2023. This is in contrast to fiscal 2021, wherein per capita income declined 8.9%, owing to GDP contraction amid the pandemic's impact. In fiscal 2022, per capita income rose 7.6% on a lower base of fiscal 2021.

According to the IMF's estimates, India's per capita income (at current prices) is expected to grow at 8.8% CAGR over 2023 to 2028.

Rising income levels signify economic growth, urbanisation and changing lifestyles. As per capita income increases so does the demand for cars in India increases. As per data from World Road Statistics 2023-International Road Federation, in fiscal 2022, there were 24 cars per 1,000 people in India and the per capita income was \$2,390. In the case of China, cars per 1,000 people was 183 in in 2021 and the per capita was \$11,930.



Policies impacting automobile industry

Improving infrastructure raises efficiencies in logistics

The government's capex push has been focused largely on transport-related sectors such as roads, railways and urban infrastructure. This is complemented with policies geared towards improving and integrating different segments of the logistics ecosystem. All these are expected to reduce bottlenecks and improve competitiveness of domestic production and trade via reduced logistics costs and improved connectivity.

- National Infrastructure Pipeline (NIP): The government has set targets for infrastructure development between fiscals 2019 and 2025. CRISIL MI&A Consulting expects aggregate (government plus private) spending on infrastructure to double by 2030, i.e. from ~Rs 67 trillion over fiscals 2017-2023 to ~Rs 143 trillion during fiscals 2024-2030, driven by spends on core infrastructure, i.e. roads, railways, airports, ports, urban infrastructure, irrigation, warehouses and telecom.
- **PM Gati Shakti National Master Plan for Multi-modal Connectivity**: The multi-modal connectivity plan was unveiled in October 2021, with an objective of reducing logistics costs by coordinating the infrastructure creation activity of different government entities. The key characteristics of the scheme are:
 - Digital platform for coordination across 16 ministries, including roadways and railways
 - The Gati Shakti platform will subsume the infrastructure projects announced under NIP (valued at Rs 111 trillion)
 - Existing infrastructure schemes across ministries such as Bharatmala (roads), Sagarmala (ports), UDAN (air), inland waterways, dry ports, etc will be incorporated in the platform
 - The platform will also provide spatial data and implementation status for different projects
 - Eleven industrial corridors and two defence corridors are also planned under the scheme, covering clusters for textile, pharmaceutical, fishing, electronics, agriculture, etc
- Key targets set for different heads under the scheme are:
 - Ports: Capacity of the major ports to be increased from 1,282 million tonne in fiscal 2020 to 1,759 million tonne in fiscal 2025
 - National waterways: Cargo movement to be ramped from 74 million tonne in fiscal 2020 to 95 million tonne in fiscal 2025
 - Railways: Target of 1,600 million tonne by fiscal 2025 vis-à-vis 1,210 million tonne in fiscal 2020
 - MMLPs: The Indian Railways will set up 500 multimodal cargo terminals by fiscal 2025
 - Others: Gas pipeline length to be doubled from 17,000 km to 34,500 km within the country, incremental renewable capacity of ~150 GW, power line capacity target of ~452,000 circuit km by fiscal 2025

An integrated platform to monitor the progress of projects and logistics initiatives by different ministries will aid in increasing coordination and planning infrastructure creation and connectivity.

• National Logistics Policy (NLP): Launched in September 2022 to complement PM GatiShakti National Master Plan (NMP), NLP addresses the soft infrastructure and logistics sector development aspect, including process reforms, improvement in logistics services, digitisation, human resource development and skilling. NLP aims to: (i) reduce the cost of logistics in India, (ii) improve the Logistics Performance Index ranking – to be among top 25 countries by 2030 (India was ranked 38 out of 139 countries in 2023), and (iii) create data-driven decision support mechanism for an efficient logistics ecosystem. A Unified Logistics Integrated Platform has



been set up under this, which, as of September 2023, had integrated 34 logistics portals/digital systems across 33 ministries/ departments, and had over 600 industry players registered. Twenty-one states have also notified their own logistics policies, in line with the NLP.

The infrastructure policies will enhance the logistical efficiency, thereby strengthening the supply chain for automobiles and auto components. These initiatives will lower the logistical cost and the lead time in components/automobile transit. In the case of raw materials, this allows various stakeholders in the ecosystem to have a clear understanding of raw material availability and necessary logistics for the same. Thus, these policies augment efficiency in production and supply.

Decoupling of global supply chains

As traditional supply chains are threatened by large-scale global events, rising trend in protectionism and wage inflation, there is a greater need for rethinking supply chain models to remain competitive. In the wake of global disruptions such as Covid-19, geopolitical crises, environmental disruptions, etc, significant decoupling of supply chains is underway to bring key supply links closer home.

To establish collective supply chains that would improve their resilience in the long term, 18 economies, including India, the US and the EU unveiled a roadmap in July 2022, which included steps to counter supply chain dependencies and vulnerabilities. This was done as a part of the ongoing supply chain derisking strategy of global companies/multinationals, wherein global companies are diversifying their businesses away from their reliance on a single large supplier, to alternative destinations. Beijing's Zero-Covid policy and the resultant disruptions to global supply chains, container shortage and higher lead times have served as an impetus to this strategy.

This reorientation has benefitted other Asian economies in southeast Asia and India. India can take advantage of the same as the enormous quantum of Chinese exports coupled with India's cost advantage in manufacturing

, would serve as a highly lucrative opportunity for Indian manufacturers. Realising this opportunity, the government has introduced many reforms and incentive schemes to increase domestic manufacturing and attract global manufacturing firms to India.

Lowering supply chain dependency

India and other countries are actively pursuing strategies to reduce supply chain dependency on a single country in the wake of the pandemic and growing geopolitical tensions.

This includes diversifying the supply chain by sourcing inputs from various countries to reduce the risk of over relying on a single country for sourcing and manufacturing. Furthermore, India is trying to strengthen the domestic manufacturing environment through various policy initiatives. Key strategies adopted by India to diversify the supply chain include:

- Foreign investments: India is attracting multi-national companies that are actively seeking to diversify their manufacturing base. Government stimulus includes tax benefits and incentive schemes. India has also regulated the FDI to attract investments from various countries across sectors
- Domestic manufacturing: The government is pushing domestic companies to develop products to reduce dependence on any one country. Booster initiatives include schemes such as Make in India, Atmanirbhar Bharat, China plus one, PMP and PLI.
- Trade diversification: India is actively engaging in trade pacts and FTA to diversify its trade partners. Strengthening trade ties with developing and developed economies offers alternatives to sourcing of goods and technology

To reduce dependency on China and prepare for potential future supply chain challenges, 14 nations under the Indo-Pacific Economic Framework (IPEF) (including the US, Japan and India) have reached an agreement to augment supply chain resilience and diversification. The agreement involves sharing information with each other and coordinating responses during the time of crises. Under the agreement, the participating countries would establish an IPEF supply chain council, supply chain crisis response network, and labour rights advisory network that will provide a framework to strengthen supply chains and prevent potential disruptions.

Supply derisking

Companies are encouraged to minimise their supply chain dependency on China by diversifying the sourcing of raw materials/inputs to other countries. The goal is to reduce the risk of over-relying on a single country for sourcing and manufacturing.

Many western countries, including the US, have heavily relied on China for outsourcing their manufacturing. Low labour and production costs are one of the major reasons for this, as well as factors like China's strong domestic market, supply chain, infrastructure, free trade and tax agreements, and high growth potential. Regardless of the reasoning behind the reliance, global dependency on China became a risk as early as 2008.

By establishing additional sourcing and manufacturing locations outside China, companies have found a way to mitigate business risks, access new consumer markets, and explore other innovation and technology, while keeping their operations cost-effective.

Today, geopolitical and economic factors drive much of the urgency behind businesses, implementing supply derisk approach. The approach gained traction due to the US-China trade war in 2018. As tensions escalated during Donald Trump's presidency, businesses became uncertain about how their supply chain and operations would be affected. Additionally, the Covid-19 pandemic exposed vulnerabilities in global supply chains, especially for those who relied on China alone. Other issues, such as rising labour costs in China and various Chinese political movements, have also contributed to the rise of supply derisking in recent years.

Make in India

The Make in India initiative was launched in September 2014 to boost manufacturing in India and encourage FDI in manufacturing and services. The key objective was to increase the share of manufacturing in GDP to 25% by 2020 by boosting investments, fostering innovation and intellectual property. The other objective was to build best-inclass infrastructure for manufacturing across sectors, including, but not limited to automobile, auto components, aviation, biotechnology, chemicals, construction, defence manufacturing, electrical machinery, electronic systems, food processing, mining, oil and gas, pharmaceuticals, renewable energy, thermal power, hospitality and wellness.

To achieve this objective, a dedicated Investor Facilitation Cell was set up to assist investors get regulatory approvals, offering hand-holding services through the pre-investment phase, execution and after-care support. Key facts and figures, policies and initiatives and relevant contact details were made available through print and online media. Indian embassies and consulates proactively disseminated information on the potential for investment in the identified sectors in foreign countries while domestically, regulations and policies were modified to make it easier to invest in India.

FDI inflows have received an impetus, as India jumped to the 8th rank in the list of the worlds' largest FDI recipients in 2020 from the 12th position in 2018, according to the World Investment Report 2022. FDI to India almost doubled to \$ 83.6 billion in fiscal 2022 from \$ 45.15 billion in fiscal 2015. However, in fiscal 2023, FDI inflow decreased to \$ 71 billion (provisional figure). According to the Ministry of Commerce & Industry, FDI inflow in the past nine fiscals (2014-2023: \$ 596 billion) has increased 100% over the fiscals 2005-2014 (\$ 298 billion) and is nearly 65% of the total FDI reported in the past 23 years (\$ 920 billion).



However, the share of manufacturing in GDP has not attained the intended levels of 25%. Hence, additional policies were announced, and targets rolled forward initially to 2022 and then to 2025. Domestically, multiple steps were taken to make sectors more attractive and to ease the investment processes. Some of the major steps taken included announcement of the NIP and reduction in corporate tax. Various sectors such as defence manufacturing, railways, space and single brand retail have been opened for FDI. Measures to boost domestic manufacturing were also taken through Public Procurement Orders (PPO), Phased Manufacturing Programme (PMP) and PLI schemes. Many states launched their own initiatives along similar lines to boost manufacturing in their respective states.

FDI

FDI plays a pivotal role in economic growth, aiding development and shaping of the economic landscape. Through the FDI route, international corporations can invest in India, capitalising on the country's investment incentives such as tax incentives and relatively competitive labour costs. This fosters job creation and offers various additional advantages along with facilitating the acquisition of technological expertise from global peers.

India has opened two FDI routes: automatic and government. The automatic route allows foreign investors to invest in sectors without requiring prior approval from the Indian government. Under this route, investors are only required to notify the RBI within a specified time frame. In contrast, the government route mandates prior approval from the Indian government or relevant authorities for investments in India. In April 2020, the DPIIT amended the FDI Policy, that the countries which share a land border with India (i.e. China, Bangladesh, Pakistan, Bhutan, Nepal, Myanmar and Afghanistan) can invest only under the government route. Shortly, it will be mandatory to obtain government approval for investments from these countries. FDI proposals from these countries must go through tight scrutiny and the government has set up an inter-ministerial panel to review these proposals. All ministries and departments have been recommended to have dedicated FDI cells to process these proposals quickly. This policy, thus, restricted entry and expansion of Chinese OEMs, including MG and Great Wall Motors, in India by restricting them to invest or raise funds from China.

Sector	FDI Cap	Route
Automobile	100%	Automatic
Airports - greenfield projects	100%	Automatic
Satellites - establishment and operation, subject to the guidelines of Department of Space/ISRO	74%	Government
Hospitals sector	100%	Automatic
Defence	49% +	Government up to 100% of local defence ventures after obtaining approval

Summary of FDI in key Indian sectors

Source: DPIIT, CRISIL MI&A Consulting

Atmanirbhar Bharat Campaign

Atmanirbhar Bharat Abhiyan or the self-reliant India campaign was launched in May 2020 amid the Covid-19 pandemic, with a special and comprehensive economic package of Rs 20 trillion, equivalent to 10% of the country's GDP.

The scheme was launched with the primary intent of fighting the pandemic and making the country self-reliant based on five pillars: economy, infrastructure, technology-driven system, demography and demand. The stimulus package announced by the government under the scheme consisted of five tranches, intended to boost businesses (including micro, small and medium enterprises or MSMEs), help the poor (including farmers), boost agriculture,



expand the horizons of industrial growth, and initiate governance reforms in the business, health and education sectors.

The mission emphasises the importance of encouraging local products and aims to reduce import dependence through substitution. It also aims to enhance compliance and quality requirements to meet international standards and gain global market share.

The government has also rolled out other reforms — supply chain reforms for agriculture, rational tax systems, simple and clear laws, capable human resources and a strong financial system — to further promote business, attract investments and strengthen the Make in India initiative.

PLI scheme boosts industrial investments in the short to medium term

The PLI scheme's primary objective is to make manufacturing in India globally competitive by removing sectoral obstacles, creating economies of scale and ensuring efficiency. It is designed to create a complete component ecosystem in India and make the country an integral part of the global supply chain. Furthermore, the government hopes to reduce India's dependence on raw materials imported from China. The scheme is expected to boost economic growth in the medium term and create more employment opportunities, as many of the sectors covered under the scheme are labour-intensive. It will be implemented over fiscals 2022 to 2029.

The PLI scheme is a time-bound incentive scheme by the government, which rewards companies in the 5-15% range of their annual revenue based on the companies meeting pre-decided targets for incremental production and/or exports and capex over a base year. The stronger-than-expected pick-up in demand and larger companies gaining share over smaller companies led to revival of capex in fiscal 2022. The rise of capital in fiscal 2024 was on account of the expansion plans by India Inc.

Construction spends across industrial investments are seen rising 6-8% in fiscal 2024, driven by expansion in the oil and gas and metals segments. Growth is on a low base of fiscal 2023, when the sector faced a slight bump owing to geopolitical issues in the previous two fiscals. However, the PLI scheme is expected to provide the necessary boost to the sector.

Based on an analysis of eight key sectors, CRISIL MI&A Consulting projects construction investment in the industrial segment at Rs 4.0-4.1 thousand billion between fiscals 2023 and 2027, up 1.3 times over spends between fiscals 2018 and 2022. The rise in investments is projected on account of inclusion of the PLI scheme in the capex of the industrial sector.

Budgeted	incentives	for	each	sector	under	the	PLI	scheme
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Sector	Segment	Budgeted	(Rs bn) *	
Automobilo	Advance chemistry cell (ACC) battery		751 /	
Automobile	Automobiles and auto components	570.4	/51.4	
	Mobile manufacturing and specified electronic components	409.5	545.15	
Electronics	Electronic/technology products/IT hardware	73.25		
	White goods (ACE and LED)	62.4		
	Critical key starting materials/drug intermediaries and active pharmaceutical ingredients	69.4		
Pharma and medical equipment	Manufacturing of medical devices	34.2	253.6	
	Pharmaceutical drugs	150.0		

Sector	Segment		l (Rs bn) *
Telecom	Telecom and networking products	122.0	122.0
Food	Food products	109.0	109.0
Textile	Textile products: man-made fibre (MMF) and technical textiles	106.8	106.8
Steel	Speciality steel	63.2	63.2
Energy	High-efficiency solar PV modules	240.0	240
Aviation	Drones and drone components	1.2	1.2
Total			2,192

*Note: Approved financial outlay over a five-year period

ACE: Appliance and consumer electronics; LED: Light-emitting diode

Source: Government websites, CRISIL MI&A

The Union budget 2024-25 allocated Rs 751.4 billion for automobiles, auto components and ACC:

- Rs 570.4 billion allotted for enhancing India's manufacturing capabilities or the automobile and auto component industry - Advanced Automotive Products (AAT). The scheme has two components: Champion OEM Incentive Scheme and Component Champion Incentive Scheme. A total of 95 applicants have been approved under this PLI scheme.
- Rs 181 billion under the National Programme on Advanced Chemistry Cell (ACC) Battery Storage for achieving manufacturing capacity of 50 Giga Watt Hour (GWh) of ACC. Four companies have been selected till date for incentives under the PLI scheme for ACC battery storage.

PLI scheme for the automotive industry: The PLI scheme for the automotive industry intends to promote hightech green manufacturing -- ATT vehicles such as electric and hydrogen fuel cell vehicles. This scheme excludes conventional petrol, diesel and CNG segments (internal combustion engines), as they have sufficient capacities in India. In the auto components category, more than 100 ATT components (including hydrogen fuel cells, hydrogen injection systems, EV motors and lightweight cryogenic cylinders) are eligible for PLI.

The PLI scheme for auto parts includes the following component schemes:

- Champion OEM Scheme: It is a sales value-linked plan, applicable to battery electric and hydrogen fuel cell vehicles of all segments.
- Component Champion Incentive Scheme: It is a sales value-linked plan for advanced technology components, complete- and semi-knocked down (CKD/SKD) kits, vehicle aggregates of two-wheelers, three-wheelers, passenger vehicles, commercial vehicles and tractors, including automobiles meant for military use and any other advanced automotive technology components prescribed by the Ministry of Heavy Industries depending on technical developments

PLI scheme for the automotive and ACC: The policy on ACC battery storage was approved by the Government of India on May 2021 with budgetary outlay of Rs 1,81,000 million for setting up manufacturing facilities with a total manufacturing capacity of 50 GWh. This policy will strengthen the ecosystem for EVs and battery storage in the country.

GST structure for the industry

The two taxes charged to the end consumer on cars and bikes previously were excise and VAT, with an average combined rate of 26.50% to 44% which is higher than the GST rates of 18% and 28%. Therefore, there has been less burden of tax on the end consumer under GST since 2017. Importers/dealers can cheer as they would be able

to claim the GST paid on goods imported/sold whereas previously, they were ineligible to claim the excise duty and VAT paid.

GST on cars and bikes is kept under the 28% bracket and a list of cesses to be levied on different kinds of automobiles has also been declared by the Indian government which is ranging from 1% to 22%.

GST and cess rate on automobiles based on fuel type

Vehicle category	GST rate (%)	Compensation cess (%)
EVs	5	Nill
Hydrogen fuel cell vehicles	12	Nill
Passenger vehicles (petrol, CNG, LPG) up to 4m in length and up to 1200 cc engine	28	1
Passenger vehicles (diesel) up to 4m in length and up to 1500 cc engine	28	3
Passenger vehicles (up to 1500 cc engine)	28	17
Passenger vehicles (above 1500 cc engine)	28	20
Passenger vehicles popularly known as SUVs (above 4m in length, above >1500 cc engine and >170 mm ground clearance)	28	22
Hybrid passenger vehicles		
(up to 4m and up to 1200 cc engine petrol) or (up to 4m and up to 1500 cc engine diesel)	28	Nill
Hybrid passenger vehicles (Above 4m or above 1200 cc engine petrol or above 1500 cc engine diesel)	28	15

Source: SIAM, CRISIL MI&A

Import duty on cars

Import duty (also known as import tax, import tariff or customs duty) is an indirect tax levied by Indian authorities on goods purchased from a foreign country. Through import taxes, the price of imported goods increases and demand decreases. This propels domestic market growth, demand for indigenous products and protects Indian OEMs from foreign competitors.

Customs duty on automobiles based on fuel type

Criteria	Engine capacity	Fuel type	Import duty (%)
Used car import	Any	Any	125
Care CPU to where CIE value is more than \$ 40,000	>3000 cc	Petrol	100
	>2500 cc	Diesel	100
Care CPU is where CIE value is less than \$ 40,000	<3000 cc	Petrol	70
Cars CDOS whose CIF value is less than \$ 40,000	<2500 cc	Diesel	70
ICE vehicle SKD: CKD containing engine or gearbox or transmission mechanism in a pre-assembled form but not mounted on a chassis or a body assembly	Any	Any	35

Criteria	Engine capacity	Fuel type	Import duty (%)
ICE vehicle CKD: CKD containing engine, gearbox and transmission mechanism not in a pre-assembled condition	Any	Any	15
EV SKD: Pre-assembled battery pack, motor, motor controller, charger, power control unit, energy monitor contractor, brake system, electric compressor not mounted on chassis	NA	Electric	30
EV CKD: Disassembled battery pack, motor, motor controller, charger, power control unit, energy monitor contractor, brake system, electric compressor not mounted on chassis	NA	Electric	15

Note: CIF: Cost, insurance and freight, CBU: Completely built-up, SKD: Semi-knocked down, CKD: Completely knocked down Source: <u>SIAM</u>, CRISIL MI&A

The government recently launched a scheme to promote electric passenger cars in India under which import duty concession is offered for OEMs who have set up domestic manufacturing facility in India with a minimum investment of \$ 500 million. Under this scheme, the imported vehicles would attract a reduced customs duty of 15% with maximum CIF value of \$ 35,000.

Corporate Average Fuel Efficiency/Economy norms

Corporate Average Fuel Economy (CAFÉ) norms aim to reduce fuel consumption by vehicles (or improve fuel efficiency) by lowering carbon dioxide (CO₂) emissions, hence reducing reliance on oil and regulating pollution. Implemented in India on April 1, 2017, CAFE norms apply to petrol, diesel, LPG and CNG fuelled vehicles. In phase 1 (2017-2022), CAFE norms required average corporate CO₂ emissions to be less than 130 g/km by fiscal 2022 and below 113 g/km thereafter (CAFE II), i.e. vehicles needed to be 10% more fuel-efficient by fiscal 2022. CAFE II norms came into effect on April 1, 2023. This is expected to incentivise the shift towards greener technologies such as hybrids and EVs. The Energy Conservation Bill requires carmakers to pay Rs 25,000 per unit if their fleet's CO₂ emissions exceed the intended CAFE score of 0-4.7 g/km, and Rs 50,000 per unit if they exceed by more than 4.7g/km.

National Green Hydrogen Mission

The National Green Hydrogen Mission is a comprehensive action plan for establishing a green hydrogen ecosystem in India. The policy is aimed at making India a leading producer and supplier of green hydrogen in the world, thereby creating export opportunities for green hydrogen and its derivatives. The policy, which promotes hydrogen as a clean energy source, was approved by the Indian government with an outlay of Rs 1,97,000 million in January 2023. Of this, Rs 1,74,900 million is allotted for the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme, Rs14,660 million for pilot projects, Rs 4,000 million for research and development (R&D) and Rs 3,880 million for other mission components. Under the SIGHT programme, the government offers incentives for manufacturing of electrolysers and production of green hydrogen. By 2030, the government wants to increase its annual hydrogen production capacity to 5 million tonne. The National Green Hydrogen Mission aims to reduce India's dependence on fossil fuels imports, lower greenhouse gas emissions, transition the economy to low carbon intensity and make the country a leader in this new industry. The government plans to achieve this by setting up green hydrogen plants and encouraging R&D in the sector. The government has also invested Rs 350 billion in the energy transition to attain the goal of net-zero carbon emissions by 2070.



Ethanol blending in India

The government is promoting the use of ethanol as a renewable and environment-friendly fuel in petrol. The ethanol blending programme is aimed at reducing the import dependence of fuels, savings in foreign exchange, boosting the domestic agriculture sector and associated environmental benefits. The Roadmap for Ethanol Blending in India 2020-25 lays out an annual plan to increase domestic ethanol production in line with the target of National Policy on Biofuels (2018) to reach a blending of 20% of ethanol in petrol (E20) by 2025-2026. The roadmap aims at phased rollout of ethanol blended fuels in India with E10 fuel by April 2022, and phased rollout of E20 from April 2023 to April 2025. The government is ambitious of attaining 20% ethanol-blended petrol by fiscal 2025 and 30% by fiscal 2030. Further the policy mandates the rollout of vehicles that are E20 material-compliant and E10 engine-tuned vehicles from April 2023. Further, it mandates the production of E20-tuned engine vehicles from April 2025. OMCs (oil marketing companies) have already rolled out E20 fuel in a phased manner in April 2023 but are yet to achieve widespread availability.

BS-IV to BS-VI transition

Bharat Stage (BS) emission standards are issued by the central government to regulate the output of air pollutants from motor vehicles. In January 2016, the government decided to skip BS-V and instead implemented BS-VI norms directly after BS-IV. It fixed the deadline of April 1, 2020 for the introduction of BS-VI emission norms.

•				
Type of Vehicle	Unit	BS IV	BS VI	Change
Diesel				
HC	gm/km	0.3	0.17	-43%
NOx	gm/km	0.25	0.08	-68%
PM	gm/km	0.025	0.0045	-82%
Petrol				
NOx	gm/km	0.08	0.06	-25%
PM	gm/km	-	0.0045	Newly added

BS-VI regulations demand major reduction in PM and NOx levels

NOx: Nitrous oxide

Source: CRISIL MI&A

Prices of BS-VI-compliant PVs increased 2-4% as devices and systems were added to reduce emission levels. The price hike was higher for diesel vehicles as these require additional exhaust parts.

Addition of devices and sub-systems in BS-VI-compliant vehicles

Pollutant	Devices / Subsystems to be included to reduce the Pollutants
NOX- Nitrous oxide	 Exhaust Gas Recirculation Selective Catalytic Reduction 3 way catalyst Lean NOx Trap
HC- Hydrocarbons	 Secondary Air Injection 3 way catalyst Diesel Oxidation Catalyst Purge Control Valve Canister
PM- Particulate matter	 Diesel Particulate Filter Gasoline Particulate Filter

Source: CRISIL MI&A



In November 2022, the European Commission presented a draft proposal on Euro 7 Emission Norm to the European Parliament. According to the same, Euro 7 pollution standards for new cars and vans will be implemented from July 2025, and for buses and lorries from 2027. India follows the matured European market for framing and implementation of policies and adapts it to suit Indian conditions. Provided Euro 7 comes into force from 2025, India is highly likely to propose BS-VII regulation by the end of this decade.


2 Review and outlook of the global auto industry

Global two-wheeler industry

Review (2019-2023)

The global two-wheeler industry underwent major transformation over 2019-2023. A confluence of factors fuelled tremendous growth, while unforeseen challenges reshaped the landscape. Urbanisation, particularly in developing economies, created a surge in demand for affordable and efficient transportation. According to the United Nations (UN) Department of Economics and Social Affairs, nearly 68% of the world's population will live in urban areas by 2050. Two-wheelers, with their manoeuvrability and fuel efficiency, have emerged as the perfect solution for navigating congested city streets. Furthermore, the rise of a strong middle class with increased disposable income fuelled the desire for personal mobility, propelling two-wheeler sales.

Rising fuel prices pushed consumers towards two-wheelers, known for their superior mileage compared with cars. Manufacturers responded by continuously refining engine technology to deliver even better fuel efficiency, attracting cost-conscious buyers. The explosion of e-commerce and last-mile delivery services created a massive demand for two-wheelers as the ideal solution for urban deliveries. This sector's reliance on two-wheeler mobility presented a lucrative opportunity for manufacturers, leading to the development of specialised delivery-oriented vehicles.

The emergence of electric two-wheelers, particularly in China and Europe, challenged the dominance of traditional ICE two-wheelers. Global crude oil prices and currency exchange rate affect gasoline prices worldwide as various economies import fuel from Gulf countries. Electric two-wheelers do not rely on fuel price fluctuations, making them an efficient alternative to gasoline-fuelled vehicles. Government subsidies for EVs, growing environmental awareness, and more financing options specifically tailored to these vehicles are emerging, with some lenders offering lower interest rates or extended repayment terms to incentivise adoption, all these factors have contributed to increased adoption of electric two-wheelers.

On the type front, motorcycles have been gaining increased preference in developed economies due to their expanding appeal of leisure riding and recreational activities, particularly among younger demographics seeking adventure and thrill. The versatility of motorcycles, suitable for both urban commuting and long-distance travel, further contributes to their popularity among riders looking for versatile transportation options. Scooters have been the major driving force in ASEAN region, where factors such as increased congestion, affordability and tourists' rentals have strengthened their demand.

Challenges such as inflation, interest rates fluctuations and regulatory changes will continue to influence the twowheeler market to an extent but the interplay of established motorcycles/scooters, emerging electric alternatives, and evolving consumer preferences will shape the future of this dynamic market as far as global demand is concerned.



Historic production development (2019-2023)





Note: Above figures comprise sales in the US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

Over 2019-2023, developing economies, particularly Southeast Asia, led the charge in the two-wheeler market with a surge in sales fuelled by affordability, a growing middle class and rapid urbanisation.

Globally, consumer preferences shifted to fuel-efficient options such as scooters and smaller motorcycles. Userfriendly automatic scooters also gained popularity, especially in congested cities. The emergence of electric twowheelers has offered an exciting eco-friendly alternative with potentially lower running costs. Economic downturns impacted sales globally, while stricter emission regulations posed challenges for manufacturers, particularly those in developing regions. Safety concerns remained a major hurdle, especially where traffic infrastructure lagged.

Between 2019 and 2021, the industry witnessed a CAGR of (7.3)% due to the pandemic as demand from all the geographies were hit. Demand revived at a CAGR of 5.7% between 2021 and 2023, with sales touching 15.88 million units in 2023. Overall, between 2019 and 2023, the industry witnessed a CAGR of (1)%, with volumes in 2023 still not reaching the pre-pandemic number of 16.5 million units.





Review of global two-wheeler sales volume by vehicle segmentation

Note: Above figures comprise of sales for the US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

The global two-wheeler market, comprising motorcycles and scooters, witnessed a period of contrasting fortunes between 2019 and 2023. Developed economies have seen a slowdown, particularly for larger engine motorcycles. Rising fuel prices and a growing focus on fuel efficiency are the likely culprits. However, in developing economies, a surge in disposable income has fuelled the demand for higher cc motorcycles, catering to a desire for touring and recreational riding. The motorcycle industry witnessed a CAGR of (6.2)% between 2019 and 2021, CAGR of 8.4% between 2021 and 2023, and an overall growth of 0.8% between 2019 and 2023.

In contrast, demand for scooters has been stable. Their user-friendliness, fuel efficiency and manoeuvrability have remained key drivers, especially in urban areas with stop-and-go traffic. The growing number of young riders and those seeking convenient transportation have further cemented the scooter's dominance. Scooters have been on a rising trajectory since 2021 with respect to volumes, however it has still not reached its pre-Covid levels due to reasons like – rise of ride-sharing specially in ASEAN and Europe; limited spectrum of needs compared to motorcycles and increasing gradual acceptance in electric scooters that has potentially impacted its ICE counterparts. The scooter industry witnessed a CAGR of (3)% during 2019-2023, driven by decline of 8.5% during 2019-2021, followed by a slight uptick during 2021-2023 (CAGR of 2.8%).



Motorcycles

Review of global motorcycles sales volume by displacement type



Note: Above figures comprise sales in the US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

While fuel efficiency reigns, demand for higher cc motorcycles is rising globally, even in developing economies. Soaring disposable income fuels a desire for adventure riding, and improved infrastructure makes larger bikes more practical. Younger riders prioritise power and performance, while some cultures associate large motorcycles with freedom and status. Global demand for higher cc (>600 cc) motorcycles increased from ~10% in 2019 to ~13% in 2023.

Industry challenges include rising fuel costs and stricter emissions, but manufacturers who cater to adventure riding, offer engine variety, and prioritise efficiency and compliance will be well-positioned for the promising future of higher cc motorcycles.

Volume wise, in 2019, motorcycles with less than 600 cc segment recorded 7.3 million units and subsequently 0.8 million units for motorcycles greater than 600 cc segment. In 2023, the volumes for both categories reached 7.41 million units (CAGR of 0.4%) and 1.08 million units (CAGR of 7.3%) respectively.



Review of global motorcycles sales volume by propulsion type



Note: Above figures comprise sales in the US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

ICE motorcycles have been the undisputed leaders for decades. Gas stations are plentiful, offering convenient refuelling and eliminating range anxiety on long journeys. Additionally, established technology translates to a wider variety of models with proven performance. Traditionally, affordability has been another edge for ICE motorcycles. However, their reign faces an environmental challenge. ICE motorcycles are significant contributors to greenhouse gas emissions and air pollution. Rising fuel costs add another layer of uncertainty, impacting long-term running expenses.

Electric motorcycles offer a clean alternative, with zero tailpipe emissions and a potential reduction in running costs. Electric penetration in the motorcycle segment is still in the nascent stages; its share increased from ~0.4% in 2019 to ~1.4% in 2023. Electricity can be cheaper than gasoline, and electric motorcycles require less maintenance. Yet, electric motorcycles are not without hurdles. Limited range and lack of charging infrastructure, especially outside cities, make long journeys daunting. Upfront costs are currently higher due to battery technology, and performance might not match some gas-powered models in terms of power and acceleration. Thus, electric motorcycles remain niche and ICE variants will continue to dominate unless EV charging infrastructure improves significantly across geographies.

Scooters



Review of global scooters sales volume by displacement type

Note: Above figures comprise sales in the US, Europe and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

Sub-125 cc scooters reign supreme in bustling cityscapes. Their unmatched fuel efficiency, user-friendliness and nimbleness make them ideal for navigating stop-and-go traffic and tight city streets. This dominance is fuelled by a booming rider base of young demographics and those seeking convenient transportation. Their affordability compared with larger scooters or motorcycles makes them a budget-conscious choice. Additionally, licensing requirements or limitations for larger engines in some regions favour the use of sub-125 cc scooters.

In contrast, larger-engine scooters have not seen widespread adoption. However, there is potential for growth in specific regions with well-developed highway networks. These scooters offer more muscle for tackling highway speeds and provide a more comfortable experience for longer distances. Advancements in electric scooters could be a game-changer, offering impressive power and acceleration while potentially eliminating the price disparity with



smaller counterparts. Additionally, these scooters could embrace features such as improved suspension and infotainment for enhanced comfort and safety. In Southeast Asia, for example, larger scooters might be more prevalent due to factors such as road infrastructure and cultural acceptance as family vehicles.

Volume wise, in 2019, scooters with less than 125 cc segment recorded 4.1 million units and subsequently 3.77 million units for scooters greater than 125 cc segment. In 2023, the volumes for both categories reached 3.42 (CAGR of -4.38%) and 3.08 million units (CAGR of -4.95%) respectively.



Review of global scooters sales volume by propulsion type

Note: Above figures comprise sales in the US, Europe and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

Gas-powered scooters are facing a fresh challenge from electric upstarts. The industry has played a big role in this battle. On the ICE side, manufacturers leverage the existing network of gas stations, keeping refuelling convenient for these scooters. Additionally, established technology allows them to offer a wider variety of affordable models, appealing to budget-conscious riders.

The electric scooter industry counters with a focus on environmental responsibility, highlighting their clean operation. They are also working on paring upfront costs to make electric scooters a more attractive option. However, the lack of widespread charging stations and the higher initial price tag compared with gas-powered models are still hurdles. The share of electric scooters has significantly increased from ~4% in 2019 to ~11% in 2023, driven by ASEAN countries, where scooters are accepted as a family vehicle and e-scooters have been managing to vouch on that trend with wider acceptance and increasing spending powers in these countries.

Looking ahead, both options will likely share the road. The industry's efforts to improve battery range and expand charging infrastructure will be key for electric scooters to gain wider acceptance. Additionally, government policies promoting cleaner transportation could give electric alternatives a significant edge.

The electrification of scooters presents a more feasible proposition than that of motorcycles, due to considerations of both cost and technological integration. Smaller battery packs suffice for scooters to achieve adequate range, translating to lower upfront costs compared to electric motorcycles which require more powerful and expensive batteries. Additionally, the simpler powertrain architecture of scooters, often featuring a single rear-mounted electric motor, facilitates a more straightforward electrification process. Motorcycles, on the other hand, necessitate complex gearboxes and multiple motors to deliver the performance expected by riders, posing a greater engineering challenge. Consequently, electric scooters emerge as a more natural and cost-effective platform for the initial stages of electrification within the two-wheeled vehicle segment.



Two-wheeler sales by geography

Review of global two-wheeler sales volume share by geography

Demand for two-wheelers is led by ASEAN countries (75-85% share) for the past 5 years, ahead of Europe (15-20%) and the US (3-5%). Factors such as rising disposable income, growing middle-class segment, government support and significant rise in tourists' rental preferences for commute have contributed to the increased demand for two-wheelers in this region.

The US



Review of two-wheeler sales volume in the US

Source: Mordor Intelligence, CRISIL MI&A

Source: Mordor Intelligence, CRISIL MI&A

The two-wheeler market in the US is experiencing robust growth due to several key drivers such as rising demand for cost-effective and fuel-efficient transportation. Additionally, increasing urbanisation and congestion in cities have prompted individuals to opt for nimble and agile two-wheelers as convenient means of commuting. Moreover, an increase in disposable income has elevated the purchasing power of consumers, fostering a heightened interest in owning personal vehicles, particularly two-wheelers. Furthermore, the growing awareness of environmental concerns has led to a shift towards eco-friendly modes of transportation, boosting the market for electric two-wheelers. In tandem, technological advancements in the industry, such as improved fuel efficiency, safety features, and connectivity options, have attracted a broader consumer base.

The US market is predominantly a motorcycle market, with a ~95%+ share in sales. In fact, within motorcycles, the premium models are the most preferred. Two-wheelers are viewed as lifestyle vehicles in these countries rather than a primary mode of transport.

Recent developments/launches

- In May 2024, Ryvid Anthem, a leading manufacturer headquartered in Southern California, unveiled its latest addition to its electric motorcycle lineup, the Ryvid Outset. Building upon the success of the Ryvid Anthem, this new model offers affordability and highway capability, priced competitively at \$ 5,995
- In March 2023, Honda Motors revealed important next steps for its EV hub in Ohio, marking a significant milestone in the company's journey towards electrification in the country. Honda initially announced in October 2022 the decision to invest \$ 700 million in retooling its existing auto and powertrain plants
- In January 2024, VinFast Auto, the Vietnamese automotive manufacturer, announced the launch of its new Dragonfly electric bike in the US. The new model consists of a high-capacity lithium-ion battery and claims an impressive range of up to 102 km on a single charge
- In October 2023, Kawasaki Motor launched its first electric motorcycles, the Ninja e-1 and Z e-1, in the US. Both are equipped with a 1.5 KWh lithium-ion battery and have a range of 65 km on a single charge
- In November 2023, Evoke Motorcycles introduced a new grand tourer (GT) electric motorcycle named 6061-GT in North America. It has a range of over 600 km (370 miles) on a single charge, making it the longest-range electric motorcycle available in the market



Review of motorcycles sales volume by displacement type

Source: Mordor Intelligence, CRISIL MI&A

The real workhorses of the US motorcycle market are smaller motorcycles, typically below 600cc. Their affordability and fuel efficiency make these ideal for city riding and budget-conscious buyers. In contrast, motorcycles



exceeding 600cc cater to riders who prioritise power, performance and touring capability. These motorcycles offer a sense of freedom and individuality for some riders, solidifying their place in the market. The US markets have been able to fetch predominant demand for higher cc vehicles due to reasons such as shift in youth preferences, increased spending capacities and improved road infrastructure over the years. Between 2019 and 2023, the US witnessed some stability with respect to the share of ICE <600cc and ICE >600cc. However, the share of electric motorcycles rose from ~1% in 2019 to ~3% in 2023.



Review of scooters sales volume by displacement type

Source: Mordor Intelligence, CRISIL MI&A

Electric scooters have not quite taken off yet, with sales mainly concentrated in urban areas. While they offer an eco-friendly option, a higher price tag and limited charging network keep them from widespread adoption.

The table toppers of the US scooter market are the smaller, fuel-efficient models under 125cc with ~52% market share as of 2019. Their affordability, nimble size and good gas mileage make them ideal for navigating city streets and conquering short commutes. In contrast, larger scooters, exceeding 125cc, have not gained much traction as far as volumes are concerned. However, in the overall scooter segment, they have been able to hover in the range of 40-45% between 2019 and 2023.

Europe

Review of two-wheeler sales volume



Source: Mordor Intelligence, CRISIL MI&A

There has been a surge in the popularity of two-wheelers in the region due to a growing need for efficient and timely last-mile delivery services. This has resulted in an increased demand for these vehicles, which offer a convenient and cost-effective mode of transportation for small deliveries and other similar requirements.

Major countries in Europe, including Germany, the UK, Spain, France, Italy and Norway, experienced an increase in motorcycle and scooter sales. In 2023, Europe observed a rise in motorcycle sales, with ~2.56 million units sold, up 24.2% on-year. Demand for motorcycles and scooters is on the rise in crowded urban areas due to the convenience of commuting on two-wheels rather than four. With increased pollution levels and decreased air quality in Europe, demand for electric scooters and motorcycles has jumped.

Stricter emission standards by authorities will necessitate innovation in design and technology to meet compliance requirements. Manufacturers' investments in R&D to produce cleaner and more fuel-efficient models, increased raw material prices and dependency of a few geographies on imports have potentially increased production costs. This has led to higher prices for consumers. Additionally, regulatory pressure has encouraged the adoption of alternative propulsion technologies such as electric or hybrid systems, prompting industry players to pivot their strategies and offerings. For instance:

- From January 1, 2020, all new type-approved motorcycles and mopeds sold in the European Union (EU) and the European Free Trade Area (EFTA) must meet the new Euro 5 environmental standard that replaced the current Euro 4 specification
- Under the new Euro 5 standard, emissions from tailpipes of mopeds, motorcycles, tricycles and quadricycles must not exceed specific limits. These include 1,000 mg/km of carbon monoxide (CO), 100 mg/km of total hydrocarbons (THC), 68 mg/km of non-methane hydrocarbons (NMHC), 60 mg/km of NOx and 4.5 mg/km of particulate matter (PM)

Owing to this, several European countries are encouraging the adoption of electric two-wheelers by providing incentives, building charging stations and implementing regulations to facilitate their use. The two-wheeler industry in Europe clocked a CAGR of 4.1% between 2019 and 2021, driven by the motorcycle segment. Between 2021 and 2323, the industry witnessed a CAGR of 1.2% with volumes reaching 2.56 million units in 2023. Overall, the industry logged 2.6% CAGR between 2019 and 2023.

Recent developments/launches

- In March 2024, Ultraviolette Automotive, an Indian EV manufacturer, presented its F77 electric motorcycle at an event in Turkey. The F77 is a high-performance electric bike with impressive speed and acceleration, making it a popular choice among motorbike enthusiasts
- In March 2024, French electric motorcycle startup Motowatt launched a modular dual-motor electric motorcycle and scrambler with a dual-motor traction system (two-wheel drive) capable of 25,000-watt peak power and 340 Nm torque



Review of motorcycles sales volume by displacement type

Source: Mordor Intelligence, CRISIL MI&A

The German motorcycle industry experienced a positive start in 2023, becoming the third largest in Europe. Despite facing challenges in delivering products to clients due to short supply, the industry witnessed a 5% on-year increase, marking one of the highest sales peaks in the past 15 years. Germany is renowned for its highly developed automotive sector, housing numerous distinguished brands like BMW Motorrad, MZ, DKW, Horex, Kalex, that manufacture and distribute vehicles globally. However, motorcycles constitute only a small portion of Germany's transportation manufacturing industry.

In 2023, according to the European Association of Motorcycle Manufacturers (ACEM), new motorcycle registrations in the five largest European markets - France, Germany, Italy, Spain and the UK - reached a total of 1.05 million units, marking a notable on-year increase of ~10.5%. The surge was particularly prominent in Italy, with registrations reaching 0.32 million units, up 18% on-year. Similarly, Spain saw a significant rise of 13.6% to 0.2 million units.



Review of scooters sales volume by displacement type

The European scooter market underwent a dramatic shift from 2019 to 2023, with a surge in demand for electric alternatives. Traditionally, scooters have thrived in Europe due to their practicality and affordability. Their manoeuvrability makes them ideal for navigating congested city streets and tight parking spaces.

However, electric scooters are rapidly changing the landscape. A few of the reasons for that are – regulatory landscape in Europe that focuses on stringent emission regulations, favourable financial support programs like for e.g., subsidies on purchase price, tax breaks, and even free scooter registration in some regions significantly reduce the barrier to entry for e-scooter adoption, and they also provide fleet operator support wherein some of the European cities provide financial backing to e-scooter fleet operators, encouraging them to expand their services and making e-scooters more readily available.

Another major reason for rapid electrification in this segment is urban planning and infrastructure in Europe. European urban planning often prioritizes pedestrians, cyclists, and micromobility¹ options like e-scooters. This translates into dedicated parking spaces, designated lanes, and even traffic signal optimization to favor e-scooters. The share of electric scooters in the overall scooter volume increased from ~21% in 2019 to ~32% in 2023.

Recent developments/launches

- In January 2024, Scorpio Electric, a leading motorcycle manufacturer startup, collaborated with BYD Motor to manufacture electric two-wheelers in Singapore and expand its product portfolio in the coming years
- In March 2023, Gogoro, a global leader in battery-swapping technology for light EVs, expanded its operations to Singapore to bring innovative technology to the city-state
- In May 2024, Harley-Davidson launched three new models and 21 classics in Malaysia

ASEAN

The ASEAN region is another sizeable contributor to overall global two-wheeler sales. Two-wheelers are the primary mode of transportation for a sizeable portion of the customer base within the ASEAN region. During 2019-23, two-wheeler sales in the ASEAN region shrunk at 1.9% CAGR with major contributors witnessing a

Source: Mordor Intelligence, CRISIL MI&A

¹ Micromobility refers to small, lightweight vehicles like e-scooters, bicycles, and e-bikes used for short-distance travel in urban areas. These environmentally friendly and cost-effective options enhance urban mobility, reduce traffic congestion, and sometimes operate via shared use models.



contraction—Indonesia (1% CAGR fall), Vietnam (6.2% CAGR drop), Philippines (2.3% CAGR decline). Thailand, on the other hand, clocked a 2% CAGR growth compared with 2019 levels.

These ASEAN countries were hit significantly during the pandemic. From the reduced base of the pandemicaffected 2020, a gradual growth was witnessed in two-wheeler sales, supported by improvement in the macroeconomic scenario, pent-up demand, increased need for mobility and launch of feature-rich vehicles. The increased need of two-wheelers for the flourishing ride hailing as well as food delivery applications amidst increasing congestion is another key factor which aided the growth of the two-wheeler industry. However, for most ASEAN countries, two-wheeler sales in recent times could not reach pre-Covid levels.





In the ASEAN region, scooters are the leading contributors and enjoy high customer preference given their competitive pricing, ability to carry load, manoeuvrability and preference from women riders. However, during 2019-2023, scooter sales contracted at a faster pace of 2.9% CAGR compared with a 0.7% CAGR decline witnessed by motorcycles. Motorcycles clocked a faster pick-up after the pandemic-induced hiatus in some large contributing countries such as Indonesia and Thailand, thereby restricting the drop in overall motorcycle sales, whereas scooter sales contracted because of slower pick-up in Indonesia and the Philippines coupled with near-steady sales in Vietnam and Thailand.

Source: Mordor Intelligence, CRISIL MI&A





Review of ASEAN motorcycle sales volumes by displacement type

Source: Mordor Intelligence, CRISIL MI&A

Following are some of the region-wise trends seen in the motorcycles industry in the ASEAN region:

- Singapore boasts of a thriving motorcycle industry with a notable presence of renowned manufacturers such as Yamaha Motor Co. Ltd, Triumph Motorcycles, Honda Motor, Piaggio, and others. These manufacturers have established an extensive network across the country, offering a diverse range of high-quality motorcycles to cater to the varying needs and preferences of residents and visitors alike.
- In Indonesia, motorcycles and scooters are in high demand because of the country's culture. Although
 there are high taxes and regulations, the Indonesian market still has demand for imported high-end
 motorcycles, especially for popular brands such as Harley-Davidson, Ducati, and BMW. These motorcycles
 are primarily targeted at affluent Indonesians who are ready to pay extra for luxury and high performance.

The motorcycles industry in the ASEAN region is heavily driven by motorcycles with smaller engines (<600 cc) with ~98% share in the overall market, which has remained constant for the past five years. EV penetration is much lower in motorcycles, although it has grown from 0.1% in 2019 to 0.6% in 2023.



Review of ASEAN scooters' sales volumes by displacement type

Source: Mordor Intelligence, CRISIL MI&A



Although overall scooter sales declined at a CAGR of 2.9% from 2019 to 2023, e-scooters clocked a healthy 26.9% CAGR growth, led by lower operating costs, expanding portfolio and continued government support. Healthy growth in e-scooter sales supported EV penetration within scooters—from 3% in 2019 to 9% in 2023.

For instance, in Thailand, where two-wheelers are the most popular mode of transportation, electric motorcycles and scooters are making a significant impact. These electric scooters are relatively inexpensive, costing about 84,000 Thai Baht or USD 2,500 in Bangkok.

Major global two-wheeler manufacturers

BMW AG

BMW AG, founded in 1916, is a German multinational company that specialises in the manufacturing of luxury automobiles, motorcycles and engines. BMW AG is involved in producing and marketing cars and motorbikes. Its four business segments are Automobiles, Motorcycles, Financial Services and Other Entities. BMW produces a wide range of vehicles, including sedans, coupes, convertibles, SUVs and electric vehicles.

BMW has a global presence with manufacturing plants and sales networks in various countries worldwide. They have production facilities in Germany, the US, China, South Africa, and other locations.

Key focus

BMW has a strong presence in the large touring motorcycle segment with models such as the R 1250 RT and the K 1600 Grand America. In recent years, BMW has invested significantly in electric mobility for two-wheelers, introducing models such as the CE 04 electric scooter. In 2023, BMW's motorcycle division made a total sale of EUR 3,214 million, up 1.2% from 2022.

BMW operates over 30 production sites around the world and has a global sales network. The company offers its products and services under its brands BMW, MINI, Rolls-Royce, and BMW Motorrad. The company invests heavily in R&D for the development and improvement of its portfolio. In 2023, BMW spent EUR 7.5 billion on R&D. In 2023, BMW reported sales of 209,100 motorcycles worldwide.

Recent launches/collaborations

- BMW has recently launched its BMW R 1300 GS adventure tourer for the Indian market. The new R 1300 GS replaces the R 1250 GS globally with extensive upgrades and tech to make it all the more capable when going off-road.
- BMW Motorrad and TVS Motor Company Ltd unveiled the EV 2-wheeler CE-02, their first jointly designed and developed product. The CE-02 is being manufactured in India by TVS at the company's plant in Hosur, Tamil Nadu. The product is scheduled to be launched by 2024.

Harley-Davidson Inc

Founded in 1903 and based in Milwaukee, Wisconsin, Harley-Davidson is one of the most iconic motorcycle brands globally. It is renowned for its heavyweight motorcycles tailored for cruising on highways. Harley-Davidson's business is segmented into three main areas: the Harley-Davidson Motor Company, which includes the design, manufacture, and sale of cruiser, touring, and other styles of motorcycles; the LiveWire segment, which focuses on electric motorcycles; and the Harley-Davidson Financial Services, offering financing, insurance, and other services to dealers and customers. It has manufacturing facilities in the United States, Brazil, India, and Thailand, which allow it to support its global operations.

Key focus

Recently, Harley-Davidson introduced new models and entered into partnerships to enhance its product line-up and market reach. For example, in 2024, LiveWire introduced the S2 Mulholland motorcycle and the company unveiled a new credit offering with Tymit in Europe. Harley offers many financing solutions for new and used H-D motorcycle purchases. In 2023, Harley sold 1,62,771 units of motorcycles globally, compared to the sales of 1,78,451 units in 2022.

Harley-Davidson reported a revenue of USD 5,836.47 million in fiscal 2023. The company shipped 179,984 units of motorcycles globally in 2023.

Recent collaboration

• In July 2023, Harley Davidson launched its most affordable motorcycle, the X440, in the 440cc segment in collaboration with Hero MotoCorp for the Indian market. Harley has, for the first time, launched a bike that was "achievable" for a broader market segment. The bike is priced at INR 2,40,00 to 2,80,00 (exshowroom).

Ducati Motor Holding SPA

Ducati Motor Holding SPA, founded in 1926, is an Italian motorcycle manufacturer owned by the German automotive group Audi through its subsidiary Lamborghini. Ducati is renowned for its high-performance motorcycles featuring powerful engines, innovative design and advanced technologies. The company's product line-up includes a range of motorcycles, such as the Monster, Multistrada, and Panigale, alongside a growing segment of electric bikes and accessories. Ducati operates on a global scale and has a significant presence in both developed and emerging markets. Ducati closed 2023 with 58,224 motorcycles delivered to its customers worldwide. A result that places the past year as the third best in the Company's history in terms of sales, albeit marked by a slight decrease of 5% compared to 2022 (61,562).

Key focus

Ducati produces premium motorcycles with exclusive Italian design, distinctive features and superior performance. The company is devoted to capturing the electric two-wheeler category. Ducati produced V21L, its first electric bike, which incorporates unique technical solutions for the battery pack, motor and inverter. In 2023, Ducati introduced an extended deactivation concept for motorcycles. Extended Deactivation is a unique technological innovation designed for long-distance travelers. This technology allows the rear cylinders to be switched off when idle when the bike is stationary and the entire rear bank to be deactivated even when moving at low speeds.

The company is an official partner of the Volkswagen Group and is fully owned by Audi AG. Ducati also has 10 subsidiaries that represent the company all over the world. Each subsidiary develops its reference market and coordinates a wide-reaching sales and customer support network covering 92 countries. The company has a total of 790 dealers and service points spread across the globe. Till 2023, Ducati was the sole official supplier of bikes competing in the FIM Enel Moto World Cup, the electric class of the MotoGP World Championship.

Recent collaboration/recognitions

• In December 2023, Ducati and Bentley jointly announced a new, limited-edition motorcycle, the Ducati Diavel for Bentley. In Diavel V4, Ducati has integrated many style-characterising elements of the Bentley Batur, a limited-series model handcrafted by Bentley



Yamaha Motor Corporation

Established in 1955, headquartered in Iwata, Shizuoka, Japan and originally known for musical instruments, Yamaha Motor Co. Ltd is a major Japanese manufacturer of motorcycles, marine products and other motorised products. Yamaha Motor's extensive product range includes motorcycles, outboard motors, ATVs, personal watercraft, snowmobiles, boats, industrial robots and unmanned helicopters. It also provides financial services such as financing and leasing for its products. Yamaha Motors has been spreading its presence worldwide significantly. In fiscal 2023, net sales were 2,414.8 billion yen (an increase of 166.3 billion yen or 7.4% compared with the previous fiscal year) and operating income was 250.7 billion yen (an increase of 25.8 billion yen or 11.5%)

Yamaha has a total of 127 consolidated subsidiaries across the globe. Asia houses 69 subsidiaries (21 in Japan alone), while North America and Europe have 26 and 8 subsidiaries, respectively. The year 2022 was a milestone year for the company as it surpassed its longstanding goal of achieving JPY 2 trillion in net sales. In terms of overall motorcycle sales in 2023, Yamaha sold 4.83 million units, a year-on-year increase of 1.1%.

Key focus

Yamaha's R-Series of motorcycles is led by the flagship YZF-R1 superbike, with the line-up including the YZF-R7, R3, R25, R15 and R125. The R-series is the most vivid reflection of Monozukuri based on Yamaha's Jin-Ki Kanno development philosophy.

Moreover, for 2023, Yamaha laid out four high-priority themes and launched four corresponding company-wide projects, such as the Motorcycle Electrification Project and the New Mobility Project.

Honda Motor Co Ltd

Honda Motor Co Ltd is a manufacturer of automobiles and motorcycles. Apart from motorcycles and automobiles, the company also makes power products, including tillers, generators, snow throwers, outboard engines, lawnmowers, aircraft and jet engines.

Honda offers a diverse line-up of vehicles, including cars, SUVs, commercial vehicles, motorcycles, and power equipment. Honda has operations spread across different geographies, including Asia and Oceania, the Americas, Europe, Africa and the Middle East.

Key focus

Honda is a premier two-wheeler manufacturer with a global network of over 30,000 dealers and 35 manufacturing bases for finished products. The overall global sales for their motorcycle business stood at 18.75 million units for FY23, compared to 17 million units in FY22. On electric fronts, by 2026, Honda intends to globally introduce a total of 10 or more electric motorcycle models, with the goal of achieving annual sales of 1 million units. The company aims to expand the line-up further by 2030 and target sales of 3.5 million units. In fiscal 2024, Honda reported a combined revenue of JPY 20,428.8 billion for all segments of businesses.

Recent launches

- In November 2023, Honda Motorcycle & Scooter India (HMSI) introduced an all-new retro classic CB350 offering a timeless classic design with a superior blend of technology and refined performance. The model comes with a 10-year warranty period.
- In December 2023, Honda Global announced its plan to launch an electric motorcycle equivalent to 110-125 cc commuters in India in 2024. The announcement was a part of Honda Motor Co's new motorcycle electrification strategy where it intends to invest USD 3.4 billion by 2030 on new products and development.



Outlook of the global two-wheeler industry (2024 to 2029)

Outlook of two-wheeler sales volumes by vehicle type



Source: Mordor Intelligence, CRISIL MI&A

Overall two-wheeler volumes are anticipated to clock a CAGR of 3-5% between 2024 and 2029, reaching 17-22 million units in 2029 from 14-19 million units in 2024.



Outlook of motorcycles sales volumes by cc segmentation

Source: Mordor Intelligence, CRISIL MI&A

Motorcycles lesser than 600 cc are anticipated to clock a CAGR of 2-4% between 2024 and 2029 whereas higher cc motorcycles (greater than 600 cc) are anticipated to clock a growth of 7-9% between the same period.





Outlook of scooter sales volumes by cc segmentation

Source: Mordor Intelligence, CRISIL MI&A

Scooters less than 125 cc are anticipated to clock a CAGR of 1-3% between 2024 and 2029 whereas higher cc scooters (greater than 125 cc) are anticipated to clock a similar growth of 1.5-3.5% between the same period.

Outlook of EV penetration in the global two-wheelers industry (2024 to 2029)

Environmentally conscious consumers and burgeoning urban populations are demanding cleaner, more manoeuvrable transportation options, thus making way for electric two-wheelers in the market. Governments are responding with subsidies and infrastructure investments, while on the financing front, fintech companies are creating financing solutions such as low-interest loans and battery leasing to make electric two-wheelers more accessible. For instance, the Thai government has taken a step toward promoting battery manufacturing by announcing a reduction in excise duty. This move is aimed at supporting the domestic production of batteries and encouraging the use of EVs in the country.





Source: Mordor Intelligence, CRISIL MI&A



EV penetration in motorcycles shall globally witness an upward trajectory from 2-3% in 2024 to 8-9% in 2029. With scooters taking the charge in terms of electrification, EV penetration in motorcycles will remain in the single digits. Increasing affordability and focusing on providing more options shall remain the key pointers for major OEMs to drive the motorcycles industry.



Outlook of overall EV penetration in global scooters industry

EV penetration in the scooters industry globally shall witness a significant increase from 10-14% in 2024 to 26-30% in 2029. Technological advancements and government support shall remain the key growth drivers for this segment. However, macroeconomic trends in major geoagraphies will bear watching for this industry to flourish in coming years.

By geography type

US

Outlook of two-wheeler sales volumes in the US by vehicle type



Source: Mordor Intelligence, CRISIL MI&A

Source: Mordor Intelligence, CRISIL MI&A

Two-wheeler volumes in the US are anticipated to clock a CAGR of 2-3% between 2024 and 2029, reaching 0.4-0.8 million units in 2029 from 0.3-0.7 million units in 2024. Factors such as congestion in major cities, popularity of adventure touring and evolution of electric alternatives shall remain the key drivers for the two-wheeler industry in the US.



Outlook of motorcycles sales volumes in the US by displacement type

Source: Mordor Intelligence, CRISIL MI&A

Electric motorcyles, though lower in volumes, are expected to clock a CAGR of 28-32% between 2024 and 2029, followed by growth in the premium motorcycles segment (>600 cc), which logged a CAGR of 0.5-1% during the period. Motorcycles with smaller engines (<600 cc) shall remain stagnant in terms of volumes for the next five years with sales hovering at 0.1-0.5 million units.





Source: Mordor Intelligence, CRISIL MI&A



Scooter volumes in the US are anticipated to clock a CAGR of 4-5% between 2024 and 2029 with electric scooters dominating in terms of growth, logging a CAGR of 30-35% in the same period with volumes reaching 0.008-0.01 million units. Higher cc scooters are anticipated to witness stability in terms of volume growth duirng the period. However, lower cc scooters will see a decline of 1-2% in the same period.

Europe



Outlook of two-wheeler sales volumes in Europe by vehicle type

The two-wheeler industry in Europe is anticipated to log a CAGR of 4-5% between 2024 and 2029, with motorcycles cloccking a CAGR of 4-4.5% and scooters registering a CAGR of 5-5.5% for the same forecast period. The two-wheelers segment, including electric scooters and motorcycles, is gaining popularity owing to its agility and eco-friendliness. Manufacturers who cater to the varied needs of European riders, offering a range of choices in size, power, environmental impact and affordability, will be the ones leading the pack. Sustainability and innovation will hold the key to growth going ahead, with electric options likely gaining significant ground alongside established motorcycles.

Source: Mordor Intelligence, CRISIL MI&A





Outlook of motorcycle sales volumes in Europe by displacement type



The motorcycles industry in Europe is expected to post a CAGR of 4-5% between 2024 and 2029 with electric alternatives dominating growth at a CAGR of 35-40% during the period. Volumes of electric motorcycles are anticipated to reach 0.2-0.6 million units. Higher cc motorcycles will witness a growth of 1-2% during the period as the European market observes an increasing trend in premium and luxury purchases. Lower cc motorcycles shall also witness a growth of 1-1.5% during the period.



Outlook of scooter sales volumes in Europe by displacement type

European scooter sales will likely log a CAGR of 4.5-5.5% during 2024 to 2029, mainly led by growth in the electric scooters segment. E-scooters will witness a growth of 15-20% with volumes reaching 0.1-0.4 million units in 2029, approximately 2x of where the industry stands in 2024. ICE alternatives shall see a decline in the coming years as electric evolution in the scooters segment takes charge.

Source: Mordor Intelligence, CRISIL MI&A



ASEAN



Outlook of two-wheeler sales volumes in the ASEAN region by vehicle type

The two-wheeler market in the ASEAN region is likely to clock a CAGR of 3-4% during 2024 to 2029 with the scooters segment holding the majority share (~59%). Scooters shall continue to dominate two-wheeler markets in the ASEAN region as congestion in cities, tourist preferences for two-wheeler commute and cultural acceptance of the two-wheeler as a family vehicle shall remain key drivers for the industry.





Source: Mordor Intelligence, CRISIL MI&A

Affordability and limitations in tech advancements (compared to scooters) shall keep the demand for electric motorcycles under certain limits. ICE alternatives shall log a CAGR of 3-4% during the period with the <600 cc segment dominating volumes.

Source: Mordor Intelligence, CRISIL MI&A





Outlook of scooter sales volumes in ASEAN region by displacement type

The scooters segment in the ASEAN region will clock a CAGR of 3-4% during 2024 to 2029 with e-scooters dominating the segment in terms of growth. E-scooters shall grow at a CAGR of 20-25% during the period. Factors such as feature-rich scooters, affordable options and government support have been keeping demand for electric scooters on a roll. ICE alternatives shall continue to remain dominant in the market in terms of volumes owing to their established legacy and increasing affordability over the time. However, their growth shall remain stagnant with higher cc scooters logging a CAGR of 0-1%, and lower cc scooters witnessing a modest decline of 0-(1)% during the period.

Global passenger vehicle industry

Review of the global PV industry (2019 to 2023)

The global passenger car industry saw many ups and downs from 2019 to 2023, characterised by soaring highs, plummeting lows and a cautious shift towards a new normal. This period witnessed a pre-pandemic boom, fuelled by rising disposable incomes and technological advancements, followed by a pandemic-induced slump that challenged the industry's very foundation. As the dust settles, a nascent recovery is underway, intertwined with the transformative rise of EVs.

The year 2019 marked a pinnacle moment for the global passenger car industry, driven by a confluence of factors. Rising disposable incomes, particularly in developing economies such as China and India, empowered a growing middle class to invest in personal vehicles. Easy access to credit further facilitated car purchases, fuelling demand across all segments. Additionally, advancements in automotive technology, such as improved fuel efficiency and the introduction of driver-assistance features, attracted consumers seeking a blend of performance and safety. This period painted a rosy picture for the industry, with manufacturers optimistic about sustained growth trajectories.

However, the sudden emergence of Covid-19 in 2020 proved to be a major disruption. Lockdowns and social distancing measures severely impacted consumer confidence and led to a drastic decline in sales. This was further exacerbated by disruptions in global supply chains, which caused critical component shortages, particularly for

Source: Mordor Intelligence, CRISIL MI&A



semi-conductors. These chip shortages continued to be a major challenge throughout 2022 and 2023, hindering carmakers' ability to meet production targets and fulfil existing orders.

Despite these headwinds, the industry also witnessed the rise of a promising trend—the increasing popularity of EVs. Driven by factors such as rising fuel prices and growing environmental concerns, consumers showed a significant shift in interest towards EVs. This was further bolstered by government incentives and subsidies offered in many countries to promote EV adoption. As a result, the EV segment experienced remarkable growth during this period, emerging as a bright spot in an otherwise challenging market. This trend suggests a potential long-term shift in consumer preferences towards more sustainable and fuel-efficient vehicles.

Overall, the global passenger cars industry has undoubtedly undergone a period of significant transformation from 2019 to 2023. The pandemic's impact was undeniable, but the industry has demonstrated resilience and is adapting to a new reality. As the market recovers, electrification and advancements in autonomous driving technologies are poised to become the driving forces shaping the future of the passenger cars industry. This is not just a recovery; it's a shift in gears towards a more sustainable and technologically advanced automotive landscape. The road ahead remains riddled with uncertainties, but the industry is positioned to navigate them with a renewed focus on innovation, resilience and commitment to a cleaner future.

Historic production development (2019-2023)



Review of global PV sales volumes

Note: Above figures comprise of sales for United States, Europe, and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

Passenger car sales boomed globally in 2019, then plummeted during the pandemic (2020-2021). A tentative recovery began in 2022-2023 as the markets started opening up gradually after the pandemic abated. Between 2019 and 2021, the global passenger vehicles industry logged a CAGR of (9.7)%. Further, between 2021 and 2023, the industry clocked a CAGR of 3.7% with volumes reaching up to 31.44 million units. Between 2019 to 2023, the industry logged a CAGR of (3.2)% on account of a mix of major downturns and gradual upticks.

While the challenges posed by the pandemic were immense and put the industry in a spot, there were also a few drivers that kept it moving. The rise of a strong middle class with growing disposable income fuelled a surge in demand for new cars, particularly SUVs, owing to their perceived practicality and status symbol appeal.



Automakers focused on cost-effective ways to improve fuel efficiency and safety features, catering to budgetconscious consumers in both developed and emerging markets. This led to a rise in the popularity of smaller, more efficient cars and advancements in in-vehicle technology such as navigation, entertainment systems, and driverassistance features became a key differentiator for carmakers, attracting tech-savvy consumers.



Review of global PV sales volumes based on transmission type

Note: Above figures comprise sales for US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A





Note: Above figures comprise sales for US, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A



The ICE may have dominated the roads for over a century, but the way it delivers power to the wheels has evolved over time. Once relegated to a niche segment, automatic transmission is experiencing a global surge in popularity, driven by a fundamental shift in consumer preferences.

Automatic transmission has witnessed a significant uptick, escalating from contributing 29% in 2019 to 37% in 2023. This surge is attributed to worsening traffic conditions, increasing affordability and growing consumer preference for comfort. Notably, in the premium segment, there is a discernible shift towards smoother driving experiences, fuelling the demand for automatic transmission, continuously variable transmission (CVT) and dual clutch transmission (DCT) technologies.

For decades, manual transmission reigned supreme, particularly in markets where fuel efficiency was paramount. Its simple design and direct connection between the driver and engine offered exceptional control and minimised energy loss. However, several factors have led to a change in this scenario.

The rise of urbanisation: The constant stop-and-go driving of urban environments is far less suited to the constant clutch modulation and gear changes required by manual transmission. Automatic transmission with its seamless operation offers a far more comfortable and less stressful driving experience in these conditions.

The comfort factor: Consumer preferences are tilting towards convenience and a smoother driving experience. The ease of use and minimal driver intervention offered by automatic transmission is increasingly valued, especially by a growing demographic of older drivers who may find the physical demands of manual transmission less appealing.

Technological advancements: Automatic transmissions have not remained stagnant. Advancements in technology have led to significant improvements in their fuel efficiency, making them a more viable option for ecoconscious drivers. Additionally, the development of new automatic transmission types, such as CVT and DCT, offers a wider range of driving experiences, catering to both comfort-seeking individuals and performance enthusiasts. CVTs, due to their focus on fuel efficiency, smooth driving experience, and ease of operation, that aligns well with the needs of many car buyers, have gained considerable momentum over the years. Its overall share increased from 15% in 2019 to 20% in 2023, marking its strong existence amongst the other transmission counterparts.



Review of global PV sales volumes based on powertrain type



Note: The above figures comprise sales for United States, Europe and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*



Review of global PV sales volumes based on powertrain type (% wise share)

Note: The above figures comprise sales for United States, Europe and ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

The global passenger cars industry is undergoing a seismic shift, fuelled by a growing urgency to address environmental concerns and achieve sustainable transportation solutions. The once-dominant ICE is facing increasing competition from a diverse range of alternative powertrains, fundamentally altering the landscape of the industry.

For over a century, ICE vehicles reigned supreme. Their established infrastructure of gas stations and familiarity to consumers offered unmatched convenience and freedom of movement. This dominance fuelled a global car manufacturing industry focused on optimising ICE technology for performance, efficiency and affordability. However, the tide began to turn with growing scientific consensus on the detrimental impact of greenhouse gas emissions from fossil fuel combustion. Stringent emission regulations and rising public awareness about climate change forced the industry to confront the environmental cost of its core product.

The electric revolution

Review of electrification trend in global PV sales (BEVs dominance in the electric alternatives lot)





Note: EV penetration is the percentage of overall sales

Source: EV-volumes.com, CRISIL MI&A

Battery electric vehicles (BEVs) emerged as the vanguard of the electric revolution. Their zero-tailpipe emissions and silent operation offered a compelling alternative to polluting ICE vehicles. Governments around the world started offering subsidies and incentives for BEV purchases, further accelerating their adoption. This spurred significant investments from car manufacturers in research and development, leading to advancements in battery technology, range improvement and charging infrastructure development. While initial concerns about driving range and charging availability remain hurdles, the industry is actively addressing them through advancements in battery density and the expansion of charging networks. Major car manufacturers are now dedicating a significant portion of their resources to BEV development, recognising their potential as the future of personal transportation.

Hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs) offer a bridge between the familiar ICE technology and the future of electric mobility. HEVs combine an electric motor with a gasoline engine, allowing for electric-only driving at low speeds and utilising the gasoline engine for longer journeys. PHEVs operate similarly but boast of larger battery packs that can be charged from an external source, enabling an extended electric-only driving range as compared to HEVs. These hybrid options cater to consumers who are hesitant to fully commit to BEVs due to range anxiety but still desire the environmental benefits of electric propulsion. The industry is constantly refining hybrid technology, focusing on improving electric range and reducing dependence on gasoline engines.

Fuel cell electric vehicles (FCEVs) present a long-term vision for clean transportation. They use hydrogen fuel cells to generate electricity, emitting only water vapour. While FCEVs boast of extended range and rapid refuelling times similar to ICE vehicles, their widespread adoption faces significant challenges. The lack of widespread hydrogen refuelling infrastructure and the high cost of FCEV technology are major hurdles. Nevertheless, the industry continues research and development efforts to bring down costs and build hydrogen infrastructure, recognising FCEVs' potential for long-distance travel and heavy-duty applications.

The future of passenger car powertrains is unlikely to be dominated by a single technology. Instead, a multipronged approach catering to diverse needs and regional priorities is expected.

Global passenger car sales by geography type



Review of global PV sales volume share by geography type

Source: Mordor Intelligence, CRISIL MI&A

The narrative of global passenger car sales from 2019 to 2023 unfolds differently depending on the region. However, a common thread across all regions is the anticipated surge in EV adoption. Government incentives and growing environmental concerns are likely to accelerate EV sales, shaping the future of the global passenger car market. While the pace of this shift might vary by region, EVs are expected to be a dominant force in the years to come.

US



Review of PV sales volumes in the US

Source: Mordor Intelligence, CRISIL MI&A

The US passenger vehicles industry has experienced a period of significant fluctuation between the years 2019 and 2023. The year 2019 was a period of unprecedented prosperity for the industry, with sales exceeding 17 million units. Consumer confidence thrived on a robust economy and advantageous interest rates. Easy access to affordable financing further stimulated demand, with a particular emphasis on SUVs, which dominated sales figures.

Consumer preferences moved decisively towards SUVs, fuelled by practicality and perceived safety. This coincided with a growing interest in EVs owing to rising fuel prices, environmental concerns, and a wider range of options. The pandemic led to a dip in sales in 2020, and chip shortages throughout 2022 and 2023 limited inventory and potentially inflated prices. Automakers responded by prioritising production of high-demand SUVs and trucks, while also investing heavily in developing new EV models to stay competitive. The luxury car market remained relatively stable, and the impact of these trends varied slightly across different regions within the US. The US government has been promoting the use of EVs through various incentives and subsidies, which has led to a surge in demand for these vehicles.

Between 2019 and 2021, the industry witnessed a CAGR of (5.9)% because of the impact of the pandemic, which later relatively improved to a CAGR of 1.7% between 2021 and 2023 with volumes reaching up to 15.6 million units. Overall, between 2019 and 2023, the industry witnessed a CAGR of (2.2)% with volumes still not matching 2019 levels of 17 million units.



The US is one of the major transmission technology markets; therefore, players are extensively focusing on enhancing their offerings through integrating innovative transmission technology. For instance,

- In February 2024, ZF announced that it intends to invest \$500 million in Gray Court, US, establishing its inaugural North American flex manufacturing site for traditional ICE and e-mobility technologies.
- In June 2023, Lucid Motors, a United States-based electric vehicle manufacturer, announced a long-term agreement worth \$450 million with luxury brand Aston Martin to supply EV transmission powertrain and battery systems for the British sports car maker's new EV platform.
- In June 2023, Toyota announced that it had filed a patent application in the US to launch its flagship fake manual transmission for electric cars to provide an add-on feature for people who like shifting gears in their gasoline-powered cars.



Review of PV sales volumes in the US by transmission type

The US passenger car industry has witnessed a significant shift in transmission preferences over the past five years (2019-2023). Here are the details:

Automatic dominance: Automatic transmission (AT) reigned supreme in 2019, capturing majority of the market share. Its ease of use, comfort, and growing adoption in SUVs solidified its position. Manual transmission continued its decline, accounting for a small but loyal segment, typically sought after by driving enthusiasts or budget-conscious buyers. On the other hand, Intelligent Manual Transmission (iMT) was a nascent technology in 2019, with minimal adoption in the US market.

The Covid-19 pandemic disrupted the entire industry, with transmission trends mirroring overall sales fluctuations. Manual transmission continued its downward trajectory, with sales hovering around 2% of the market share. The convenience of automatic transmission and lower gas prices during this period further marginalised manual transmission.

Source: Mordor Intelligence, CRISIL MI&A



CVT saw a steady rise in popularity, particularly in smaller and fuel-efficient cars. Its smooth driving experience and potentially better fuel efficiency in city driving resonated with some consumers. DCT transmission remained a niche player, primarily featured in performance-oriented vehicles due to its sporty driving feel and faster gear changes. However, its higher cost and complexity limited wider adoption. iMT saw limited growth during this period. While it offered a potential bridge between the convenience of automatic transmission and the engagement of manual transmission, its lack of widespread adoption by major manufacturers restricted its market share. However, 2022 onwards, iMT saw an increase in its share, which continued in 2023 as well. On the other hand, AMT remained as one of the low contributors in the overall market owing to some challenges in its widespread adoption in the US markets.



Review of PV sales volume share in the US by powertrain type

Source: Mordor Intelligence, CRISIL MI&A

The US passenger car market witnessed a dramatic shift towards electrification between 2019 and 2023. This transformation, driven by a confluence of factors, reshaped the landscape and challenged the dominance of traditional ICE vehicles.

Environmental concerns and regulations: Growing awareness of climate change and its link to transportation emissions spurred a global movement towards cleaner alternatives. This pressure pushed governments to implement stricter emission regulations, incentivising automakers to develop and offer EVs.

Technological advancements: Significant advancements in battery technology led to increased range, reduced charging times and lower battery costs. This addressed range anxiety–a major concern for consumers–and made EVs a more viable option.

Electrification has fared differently in different powertrains. Amongst them, BEVs have emerged as a major player, fuelled by advancements in battery technology that addressed range anxiety. Government incentives and rising gas prices have further accelerated their adoption. The share of BEVs increased from 1% in 2019 to 7% in 2023 which clearly indicates the shift in consumer preferences. HEVs remain another popular choice, offering a compromise for range-anxious consumers who still desire some electric driving benefits. HEVs saw their share increasing from 2% in 2018 to 7% in 2023. Plug-in hybrids (PHEVs) have seen moderate growth, but their dependence on charging infrastructure limits their appeal compared to BEVs. Finally, fuel cell electric vehicles (FCEVs) remain a niche segment due to the lack of widespread hydrogen refuelling stations and high cost of technology. This evolving



landscape signals transitioning of the market towards EVs, with BEVs leading the charge, HEVs offering a familiar option, and PHEVs and FCEVs struggling to gain significant traction in the current environment.

Europe



Review of PV sales volumes in Europe

Source: Mordor Intelligence, CRISIL MI&A

The European passenger cars market has resembled a rollercoaster over the five years between 2019 and 2023, experiencing a pre-pandemic boom, a pandemic-induced slump, and a hesitant recovery, riddled with uncertainties.

2019 marked a golden year for European carmakers, with sales exceeding a remarkable 15 million units. Consumer confidence thrived on a robust economy. Favourable financing options further enticed buyers, leading to a surge in demand, particularly for SUVs and crossovers, which continued their dominance in the market. The outbreak of Covid-19 in 2020 disrupted the entire European car market. Lockdowns implemented to curb the spread of the virus forced dealerships and production lines to shut down. Disruptions in global supply chains further exacerbated the situation. Consumer confidence plummeted due to economic uncertainty, leading to a sharp decline in car purchases. Sales figures nosedived to a low of around 11.7 million units in 2021.

The industry witnessed a further marginal slump in 2022, with sales hovering around 11.3 million units. Recovery in volumes started from 2023 with sales volumes touching 12.85 million units, backed by revival in demand and new launches in the industry. The recovery path was uneven across Europe. Major Western European markets such as Germany and France saw a slower rebound compared to their Eastern European counterparts with less established automotive industries. This disparity can be attributed to factors such as varying levels of government support and pre-existing economic conditions. Overall, between 2019 and 2023, the industry witnessed a CAGR of (5)%, mostly due to a major slump in numbers during the pandemic, followed by gradual recovery with sales still lagging 2019 levels.





Review of PV sales volume in Europe by transmission type

Source: Mordor Intelligence, CRISIL MI&A

The European passenger cars industry experienced changes in transmission preferences from 2019 to 2023, reflecting fluctuations in overall sales volume. In 2019, manual transmission was popular due to its cost-effectiveness, engaging driving experience, and fuel efficiency. Automatic transmission with torque converters gained traction in larger vehicles such as SUVs and crossovers, offering convenience and a smoother driving experience. DCT was niche and found in performance-oriented and premium vehicles, appealing to drivers seeking sportiness and faster gear changes. CVT had limited presence owing to the perception that it offers a less-engaging driving experience. Automatic manual transmission and intelligent manual transmission had limited presence in the European market. The pandemic disrupted production and sales, impacting all transmission types.

The leading automakers in Europe are engaging actively to launch vehicles equipped with automatic transmission systems to gain a competitive edge in the industry while catering to the increased demand of consumers. In October 2023, Audi announced the launch of the special edition of the Tourist Trophy, equipped with an all-wheel drive system through a seven-speed, dual-clutch automatic transmission and a turbocharged 2.0-litre gasoline engine.



Review of PV sales volume share in Europe by powertrain type

Source: Mordor Intelligence, CRISIL MI&A

The European passenger cars market underwent a significant shift in powertrain preferences from 2019 to 2023. ICE vehicles dominated the market in 2019 owing to well-established infrastructure and consumer familiarity. BEVs were still in the early stages of adoption, facing concerns about range anxiety, limited charging infrastructure and higher upfront costs.

However, the pandemic caused a decline in car sales for all powertrain types in 2020-2021. Interestingly, BEVs showed resilience during this period, benefiting from government incentives and increased focus on sustainability. Advancements in battery technology, expanding charging infrastructure, and government incentives contributed to the significant growth of BEVs between 2021 and 2023. HEVs maintained a steady market share, appealing to consumers who were hesitant about fully committing to BEVs. PHEVs had modest growth owing to their reliance on charging infrastructure and higher price point compared to HEVs. FCEVs remained a niche player in the market because of the lack of hydrogen refuelling infrastructure and high cost.

Various international auto manufacturers are investing heavily in R&D activities to launch new car models in the European market, driven by growing customer needs. For example, Citroen plans to introduce an electric model with a base price of less than $\leq 25,000$ ($\leq 26,717$) in the French and European markets by 2024.


ASEAN

Review of ASEAN PV sales volumes



Source: Mordor Intelligence, CRISIL MI&A

The passenger car industry in the Association of Southeast Asian Nations (ASEAN) witnessed robust growth in 2019, which was later hit by the pandemic. There was a de-growth of 11.1% between 2019-21.

The region offers competitive labour costs, a robust infrastructure, and access to major global markets through trade agreements such as the RCEP. With a population exceeding 650 million and a growing middle class, it presents a substantial consumer base. Combined with a long history of political stability and well-established legal systems, which are conducive to foreign investment, the cost competitiveness and substantial OEM consumption opportunities resulted in a faster post-pandemic recovery.

Sales figures might not have crossed pre-pandemic levels in 2023, however, there were signs of improvement compared with the pandemic years. The industry witnessed a CAGR of 12.1% between 2021-2023. The ASEAN car market was shifting gears. While SUVs and crossovers remain popular for practicality, a new wave was emerging. Growing environmental concerns and government incentives were driving the rise of electric vehicles (EVs) in the region. Chinese automakers are also making a splash with competitive prices and tech-focused models. To ensure sustainable growth, government policies promoting cleaner vehicles and investments in charging infrastructure are crucial.





Review of ASEAN PV sales volumes by transmission type

Source: Mordor Intelligence, CRISIL MI&A

The ASEAN car market experienced significant changes in transmission preferences between 2019 and 2023. In 2019, manual transmissions (MTs) were popular due to their affordability and fuel efficiency. However, automatic transmissions (ATs), especially those with torque converters, were gaining traction in higher-end car segments for their smoother driving experience. Other transmission options such as CVTs, AMTs, iMTs, and DCTs were in the early stages of adoption.

In 2020, the COVID-19 pandemic disrupted the car industry, leading to a decrease in overall sales across all transmission types. As the market gradually recovered in 2022, so did the popularity of automatic transmissions (ATs). They saw an increase in share from 21.9% in 2019 to 27% in 2023. Factors such as consumer demand for comfort and convenience, dominance of sedans and hatchbacks, and additional features such as automatic emergency braking contributed to the increased demand for ATs. Continuously variable transmission (CVT) have remained stable over the past three years, maintaining their share between 26-27% of the overall passenger cars market. Manual transmissions are expected to remain a niche choice for budget-conscious buyers and those seeking a connected driving experience, but their market share is likely to continue to decline gradually.



Review of ASEAN PV sales volume share by powertrain type

Source: Mordor Intelligence, CRISIL MI&A

The ASEAN passenger car industry has undergone a major transformation in powertrain technology, with a shift towards alternative fuel vehicles. In 2019, internal combustion engine (ICE) vehicles were dominant due to factors such as infrastructure and affordability. However, there was a growing interest in alternative fuel technologies, with hybrid electric vehicles (HEVs) and battery electric vehicles (BEVs) gaining traction among environmentally conscious buyers. Higher upfront costs limited their adoption, while plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs) were scarce due to infrastructure limitations and high costs. The COVID-19 pandemic caused a decline in car sales, but as it eased in 2022-2023, a shift towards fuel-efficient alternatives such as HEVs was observed. ICEs that dominated the passenger cars market till 2021 started seeing some competition by other alternate fuel counterparts with BEVs and HEVs taking the lead among others. Each accounted for around 3% of the overall market, which is expected to grow further in the coming years as consumer preferences and automakers' plans align with signs of support for clean transport in the ASEAN region.

Adoption of BEVs remained limited due to charging infrastructure and upfront costs, while PHEVs and FCEVs also faced challenges. Governments in ASEAN countries are promoting EV adoption through subsidies and infrastructure investment. For instance, the Indonesian government extended the deadline for qualifying for EV incentives, while Thailand approved a new phase of the EV package to support the growth of the EV industry.

Outlook of global PV industry (2024 to 2029)

Outlook of overall global PV sales volume



Note: Figures above include sales for the United States, Europe, and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

The global passenger car market is expected to experience moderate growth from 2024 to 2029 at a slower pace than before the pandemic. This can be attributed to factors such as global economic uncertainty and ongoing supply chain issues. In addition, shifting consumer preferences towards electric vehicles and alternative ownership models could put a dent in traditional car sales. However, rising demand in emerging markets, advancement in EV technology, and government incentives promoting clean transportation could counter these trends. The future of the passenger car market hinges on a complex interplay of these forces.

On an overall level, global PV market is expected to witness a CAGR of 3-4% between 2024-2029 with volumes reaching up to 36-39 million units in 2029.



Outlook of overall global PV sales volume by transmission type

Note: Figures above include sales for the United States, Europe, and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*



The global passenger car market by transmission type is poised for a shift between 2024 and 2029. Automatic transmissions, particularly torque converters, is expected to hold strong due to their comfort. ATs are expected to witness a CAGR of 4-5% between 2024-2029 and reach 13-15 million units by 2029.

However, manual transmissions are expected to decline by 2-3% between 2024-2029, as consumers prioritise comfort and advancement make automatics more fuel-efficient. Continuously variable transmissions (CVTs) are expected to rise significantly in popularity for their smooth and potentially fuel-efficient driving experience along with seamless acceleration. In addition, in the wake of growing concerns regarding climate change and fuel consumption, there is an increasing emphasis on enhancing fuel efficiency in vehicles. CVT enables optimized engine performance, achieving higher fuel efficiency and reduced carbon footprint. Dual-clutch transmissions (DCTs) on the other hand might see a niche increase in performance cars. The biggest change is expected to be the rise of electric vehicles, which will reduce the need for traditional transmissions altogether. This presents a strategic advantage for DCT technology, positioning it favorably for substantial penetration growth in the passenger vehicle segment in the forthcoming years.



Outlook of overall global PV sales volume by powertrain type

Note: Figures above include sales for the United States, Europe, and ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

The global passenger car market by powertrain type is poised for a dramatic shift between 2024 and 2029. ICE vehicles, which were a significant player initially, will face increasing pressure from cleaner alternatives, particularly BEVs. BEVs are expected to log a CAGR of 35-37% to reach approximately 14-16 million units by 2029. Rising fuel costs, stricter emission regulations, and advancement in battery technology will incentivise consumers to move towards BEVs. Government support for BEVs and investment in charging infrastructure will further accelerate this transition.

Hybrid electric vehicles (HEVs) are expected to maintain a steady presence, offering a middle ground for those hesitant to fully commit to BEVs due to charging limitations thus clocking a CAGR of 3-5% between 2024-2029. However, PHEVs and FCEVs are likely to remain niche players due to charging infrastructure limitations (PHEVs) and the high cost and limited refuelling stations (FCEVs). The future of car powertrains will be a fascinating interplay of adaptation and innovation, with BEVs leading the charge towards a cleaner and more sustainable transportation landscape.



Outlook of global PV industry by geography

United States





Source: Mordor Intelligence, CRISIL MI&A

The future of the US passenger car market promises to be a fascinating dance between tradition and innovation from 2024 to 2029. ICE vehicles are likely to remain strong in the near term, but growing concerns will challenge their dominance. Rising fuel costs and anxieties about climate change could push consumers towards cleaner alternatives, particularly EVs. Government incentives and investments in charging infrastructure could significantly accelerate this shift towards a more sustainable transportation landscape. Advancement in battery technology, offering greater range and faster charging times, is expected to encourage consumers to embrace EVs. However, the overall pace of change will depend on consumer sentiment. While some may eagerly adopt EVs, others might be hesitant due to factors such as range anxiety or upfront costs. HEVs could carve out a comfortable niche, providing a bridge for those who are cautious about fully committing to EVs. This interplay of economic considerations, environmental concerns, technological advancement, and consumer behaviour will shape the US car market's trajectory. The future is likely to see a cautious but steady rise of EVs alongside the presence of traditional options, paving the way for a more diversified and sustainable transportation landscape in the coming years.

The US PV market is expected to witness a CAGR of 3-4% between 2024-2029, with volumes reaching up to 16-18 million units in 2029, from around 14-16 million units in 2024.



Outlook of PV sales volume in United States by transmission type

Source: Mordor Intelligence, CRISIL MI&A

The US car market for transmissions is poised for a period of cautious change from 2024 to 2029. Automatic transmissions (ATs), particularly torque converters, are likely to remain the dominant choice due to their established presence, comfort, and growing fuel efficiency. ATs are expected to witness a CAGR of 1-2% between 2024-2029, with volumes reaching up to 6-8 million units in 2029.

CVTs might see a modest increase in popularity, particularly in smaller and more fuel-conscious car segments. Their smooth, uninterrupted power delivery and potential for improved fuel economy could appeal to a specific set of buyers. CVTs may witness a growth of 6-7% between 2024-2029. On the other hand, DCTs may witness a growth of 5-6% between 2024-2029. The future of US car transmissions will depend on a complex interplay of factors such as consumer preferences for comfort and fuel efficiency, advancement in both traditional and EV drivetrain technologies, and ultimately, the pace of EV adoption.





Source: Mordor Intelligence, CRISIL MI&A



The US passenger car market for powertrains is predicted to undergo a gradual green shift, with battery electric vehicles at the forefront, between 2024 and 2029. While ICE vehicles might hold strong initially, their dominance is likely to be challenged by a surge in popularity of BEVs. ICE vehicles shall witness a decline in volumes, with a degrowth of 9-11% between 2024-2029. Stringent environmental regulations, coupled with advancement in battery technology and potential government incentives, are expected to significantly accelerate the adoption of BEVs. This shift towards a more sustainable future is expected to help BEVs become a mainstream choice for many American car buyers, particularly with expansion in charging infrastructure. BEVs are expected to witness a significant jump in volume, up to 6-8 million units in 2029, at a CAGR of 35-37% over the same period.

Hybrid electric vehicles (HEVs) could find a steady niche, offering a comfortable compromise for those hesitant to fully embrace BEVs due to range limitations. HEVs could witness a steady rise in volume, at a CAGR of 14-16% between 2024-2029. Plug-in hybrid electric vehicles and fuel cell electric vehicles are likely to remain niche players due to the limitations in charging infrastructure for PHEVs and the high cost and limited refuelling stations for FCEVs. The US car market is poised for a measured transition, with BEVs leading the way towards a cleaner and more eco-friendly transportation landscape in the coming years.

Europe



Outlook for total PV sales in Europe



The European passenger car market is expected to move towards electrification from 2024 to 2029. Stringent emission regulations and growing consumer preference for eco-friendly options is expected to drive a surge in electric vehicle (EV) sales. Government incentives and expanding charging infrastructure will further accelerate this shift. However, traditional ICE vehicles might see a slower decline compared with global trends, due to a strong preference for gasoline and diesel options in some European regions. Overall, the market is poised for a transformation towards cleaner mobility solutions.

The European PV market is expected to witness a CAGR of 3-4% between 2024-2029, with volumes increasing from around 12-14 million units in 2024 to up to 14.5-16.5 million units in 2029.



Outlook of PV sales volume in Europe by transmission type

Source: Mordor Intelligence, CRISIL MI&A

The European passenger car market for transmissions is forecast to undergo a metamorphosis between 2024 and 2029. While automatic transmissions, lauded for their convenience and smooth driving experience, are likely to retain their dominant position, a paradigm shift towards EVs will undoubtedly reshape the landscape. Manual transmissions, once a mainstay for their affordability and driver engagement, may witness a gradual decline at a CAGR of 2-4%. This is due to a confluence of factors: the aforementioned comfort preference for automatics, coupled with advancement in automatic transmission technology that are rendering them increasingly fuel-efficient, diminishing a key advantage of manuals, ATs shall witness a CAGR of 7-9% between 2024-29 and may remain the dominant one in the coming years with more people opting for comfort and seamless driving experience.

CVTs might experience a modest increase in popularity, especially in smaller and fuel-conscious segments, due to their ability to deliver a seamless driving experience and potentially enhance fuel efficiency. CVTs shall witness a CAGR of 3-5% between 2024-29 with volumes reaching up to 2-4 million units in 2029. However, the most significant disruption is likely to be caused by the burgeoning adoption of electric vehicles. Unlike traditional gasoline-powered cars, EVs completely eliminate the need for conventional transmissions altogether, with electric motors directly propelling the wheels.





Outlook of PV sales volume in Europe by powertrain type

Source: Mordor Intelligence, CRISIL MI&A

The European passenger car market for powertrains is poised for a green revolution between 2024 and 2029. While ICE) vehicles might hold some ground initially, their dominance is expected to be challenged by a surge in popularity of cleaner alternatives, particularly battery electric vehicles (BEVs). ICE vehicles may witness a downturn in sales with a declining CAGR of 8-10% between 2024-2029, while some of the declining sales are expected to be filled by the BEV category, with volumes reaching up to 6-8 million units with a CAGR of 33-36% between 2024-2029.

Stringent emission regulations, coupled with advancement in battery technology and government support for EVs, are expected to significantly accelerate the adoption of BEVs. This shift towards a more sustainable future is expected to aid BEVs become a mainstream choice for European car buyers. Hybrid electric vehicles (HEVs) could remain steady, offering a compromise for those hesitant to fully embrace BEVs due to charging limitations. HEVs shall witness a CAGR of 1-3% between 2024-2029. However, PHEVs and FCEVs are likely to remain niche players due to limitations in charging infrastructure for PHEVs and the high cost and limited refuelling stations for FCEVs. The European car market is on the cusp of a thrilling transformation, with BEVs leading the charge towards a cleaner and more eco-friendly transportation landscape.



ASEAN

Outlook of ASEAN overall PV sales volume



Source: Mordor Intelligence, CRISIL MI&A

The ASEAN passenger car market is expected to grow moderately at a CAGR of 4-6% from 2024 to 2029, with volumes reaching about 3-5 million units in 2029. Economic uncertainties and supply chain challenges might cast a shadow, but rising demand in emerging Southeast Asian nations could offer a counterbalance. The electrification wave is likely to sweep across the region, with a rise in EVs driven by government incentives and falling battery costs. However, ICE vehicles are likely to remain a mainstay in the near future, with HEVs potentially playing a bridging role.



Outlook of ASEAN PV sales volume by transmission type

Source: Mordor Intelligence, CRISIL MI&A



The ASEAN car market's transmission landscape is expected to evolve between 2024 and 2029. While automatic transmissions (ATs) are likely to remain dominant due to their comfort and convenience, technical advancement is expected to make them more fuel-efficient. ATs are expected to witness a CAGR of 10-13% between 2024-2029.

Continuously variable transmissions could gain ground for their smooth driving experience, particularly in ecoconscious segments. Though the volumes may not see a significant jump and may witness a CAGR of 1-3% between 2024-29. Manual transmissions (MTs) could see a gradual decline with a CAGR of 1-2% as affordability becomes less of a deciding factor and automatics become more accessible. The rise of electric vehicles (EVs) will be a significant factor, as they eliminate the need for traditional transmissions altogether. This interplay between traditional options and the EV revolution will shape a more diversified transmission landscape in the ASEAN market in the coming years.



Outlook of ASEAN PV sales volume by powertrain type

Source: Mordor Intelligence, CRISIL MI&A

The ASEAN car market is expected to see a powertrain transformation from 2024 to 2029. While internal combustion engines (ICE) will remain prevalent, their dominance is likely to weaken. Between 2024-2029, they are expected to witness a CAGR of 4-6% with volumes declining up to 1-3 million units in 2029 from 2-4 million units in 2024. Rising fuel costs and government incentives will propel electric vehicles (EVs), particularly BEVs, forward. BEVs may witness a CAGR of 48-50%, though volumes may remain lower than that of ICE, still a healthy CAGR indicates a potential transmission shift as far as demand is concerned.

HEVs might hold steady, catering to those cautious about full EV adoption. PHEVs and FCEVs are likely to see limited growth due to infrastructure challenges and high costs. This shift towards cleaner options will shape a more sustainable ASEAN car market in the coming years.

3 Review of the Indian automobile industry

Indian two-wheeler industry

Review of Indian domestic two-wheeler industry (fiscals 2019 to 2024)

India is the largest motorised two-wheeler market in the world, with domestic sales of 18.4 million units in fiscal 2024. Two-wheeler sales constituted 73% of the total automobile market, which includes two-wheelers, three-wheelers, passenger vehicles (PVs), commercial vehicles (CVs) and tractors by volume in fiscal 2024. The passenger vehicle segment contributed about 17% to the Indian automobile industry, while CVs contributed about 4% and three-wheelers and tractors contributed 3% each.

The two-wheeler segment sees a healthy demand in India and is preferred over four-wheelers by the majority of the Indian population, especially for their regular commute. This is primarily due to the lower acquisition cost, higher mileage, lower maintenance cost, ease of navigation especially during rush hours, hassle-free parking and suitability of two-wheelers on rough roads.

In the past 15 years, the domestic two-wheeler industry has clocked a CAGR of 6.2% to reach a volume of 18.4 million in fiscal 2024. In fact, until fiscal 2019, the industry has accelerated at a much faster pace of 11.1% CAGR and reached a historic high of volumes of 21.2 million.

During fiscal 2009 to fiscal 2019, India's GDP as well as private final consumption expenditure grew at a healthy pace of 7% CAGR. Moreover, inflation levels were on a tapering trend reaching ~3% levels in fiscal 2019. This favourable macro-economic environment led to an increase in disposable incomes and gave a thrust to the industry growth over the decade. In addition, the expansion in vehicle portfolio by OEMs, the accelerated growth in the scooter segment and the healthy growth of the premium motorcycle (=>125 cc) sub-segment provided an additional support to the industry growth over the decade. Moreover, vehicle prices rose at a nominal level of 3-5% over the period limiting the rise in acquisition costs for the customers.

These favourable factors helped the two-wheeler industry reach a historic high of 21.2 million volumes in fiscal 2019. These record sales were despite the higher-than-normal price rise (due to BSIV implementation in fiscal 2018) as well as the GST implementation (fiscal 2018) and demonetisation (fiscal 2016) that limited growth of the industry.

However, over the next four years, from fiscal 2019 to fiscal 2022, the industry witnessed a contraction at a CAGR of 13.6% as the pandemic, nationwide lockdowns, reduced mobility, unfavourable macroeconomic scenario, closure of schools, colleges and offices, and work from home impacted the demand for two-wheelers.





Domestic two-wheeler sales volume trend – fiscals 2019 to fiscals 2024

Note: Figures in bracket to be read as negative (E.g. (10) to be read as minus 10), data for ICE and EVs; EV retail data from VAHAN have been considered.

Source: SIAM, VAHAN, CRISIL MI&A

From the reduced base of fiscal 2022, two-wheeler sales rebounded in fiscal 2023 and recorded a healthy growth of 19%, driven by improving demand sentiments and the normalisation of economic activities and increased mobility. The pent-up demand due to the postponement during the pandemic period and a sharp rise in scooters demand with restarting of colleges and offices provided a boost to the industry demand. Despite the normalisation of public transport, improved frequency of intracity bus and railway services, the demand for the last mile mobility, and in turn the demand for two-wheelers remained buoyant during the year.

In addition, the retail sales of the two-wheeler segment almost tripled during the year, providing an additional boost to the overall sales in fiscal 2023.

However, the higher interest outgo with increased repo rates and further increase in vehicle prices restricted the growth of the two-wheeler industry sales in fiscal 2023.

In fiscal 2024, the two-wheeler industry's sales grew by a further 13%, supported by further improvement in the macroeconomic scenario, rural support, continued traction for premium motorcycles as well as scooters. In addition, continued demand for electric two-wheelers despite the subsidy cut² supported the growth in fiscal 2024. The new launches, especially in the premium segments provided an added support to the demand. The commuter motorcycle segment also witnessed some improvement during the year after consecutive contractions aided by limited rise in operating costs as well as increased customer incentives.

² The Ministry of Heavy Industries (MHI) had decided to slash the FAME II subsidy of electric two-wheelers (effective from June 2023) to Rs 10,000 per Kwh from the Rs 15,000 per Kwh. Apart from reducing the per Kwh incentive by Rs 5,000, the ministry also reduced the maximum subsidy cap of 40 per cent of the ex-factory price of the vehicle to 15 per cent.





Domestic two-wheeler sales volume trend (ICE vs EV)

Source: SIAM, VAHAN, CRISIL MI&A

y-o-y growth	FY19	FY20	FY21	FY22	FY23	FY24	FY19-24 CAGR
ICE	5%	-18%	-13%	-11%	16%	13%	-4%
EV	1394%	-4%	67%	464%	188%	29%	102%

Source: SIAM, VAHAN, CRISIL MI&A





Note: Only high-speed electric two wheelers have been considered for the analysis

Source: SIAM, SMEV, VAHAN, CRISIL MI&A

Over the past five years, the electrification within the industry has provided a boost to the industry sales. During these years (since FY19), when the ICE vehicle sales declined, the sharp rise in EV retails restricted the drop in industry sales volumes. From fiscal 2019 to fiscal 2024, the ICE segment contracted at a CAGR of 3.7% and EV retails skyrocketed at a CAGR of 101.7%, albeit from a lower base, which arrested the drop in the industry sales.

Segment wise domestic sales trend

Motorcycles dominate the domestic two-wheeler industry sales with more than 60% contribution to the annual domestic sales. However, their contribution has gradually contracted over the years, from 78% in fiscal 2009 to 63% in fiscal 2024.

On the other hand, the scooter segment expanded its presence over the long-term horizon, from 15% in fiscal 2009 to 34% in fiscal 2024. The moped segment also lost some ground to scooters over the years, from around 6% share in fiscal 2009 to ~3% in fiscal 2024.





Note: Data includes ICE and EVs; EV retail data from VAHAN have been considered. *Source: SIAM, VAHAN, CRISIL MI&A*

CAGR for Domestic two-wheeler sales segmental trend – fiscals 2019 to 2024

y-o-y growth	Motorcycle	Scooter	Moped
FY19-24 CAGR	-3.0%	-4.3%	-11.4%

Note: Data includes ICE and EVs; EV retail data from VAHAN have been considered. *Source: SIAM, VAHAN, CRISIL MI&A*

Scooters

Over the past five years, the share of scooters increased from 31.7% in fiscal 2019 to 34.2% in fiscal 2024. The share of the scooter segment increased on the back of strong demand from new model launches (such as the Dio 125, Avenis, upgrades of Activa, Jupiter as well as e-scooters), increasing use of scooters by working women in urban areas (due to high convenience) and a growing preference as a second vehicle in households. There has been an increase in multiple vehicle ownership, including a passenger vehicle, and multiple two-wheelers in a single family, driving demand.



The scooter also gained acceptance in rural areas as road penetration increased and it became a utility vehicle. Earlier, the scooter was positioned primarily as an urban vehicle. Now, it has gradually evolved to become a preferred means of commuting for women in rural areas as well.

During the industry slowdown from fiscal 2019 to fiscal 2024, the overall scooter segment contracted at the slowest pace of 1.3% CAGR, compared with 3% CAGR contraction for motorcycles and 11.4% CAGR contraction for mopeds. A sharp rise in e-scooter sales and new model launches, especially in the premium (=> 125cc) scooter segment restricted the drop in scooter sales.

During the pandemic, the reduced need for mobility due to lockdowns, closure of schools/ colleges and offices impacted the scooter demand significantly. Sales of scooters (ICE+ EV) witnessed a sharp drop of 19% in fiscal 2021 and a further drop of 6% in fiscal 2022. However, scooter sales rebounded in fiscal 2023, led by the reopening of offices, schools and colleges. The pent up demand from the past two years provided a boost to the sales of scooters. In addition, the increased retails of e-scooters also gave an additional boost to the scooter sales. The scooter segment grew at a faster pace of 32% year-on-year, compared with 14% growth witnessed in motorcycles, thus backing the share expansion of scooters in fiscal 2023. In fiscal 2024, both motorcycles and scooters increased at a healthy pace of around 14% keeping the share near steady.



ICE vs EV split within domestic scooter sales – fiscals 2019 to 2024

Note: EV retail data from VAHAN have been considered. Source: SIAM, VAHAN, CRISIL MI&A

Within the scooter segment, EV scooters witnessed growth at an accelerated pace and contributed a sizeable share of 14.7% to the overall scooter sales in fiscal 2024. The launch of new models, government incentives, rising awareness, increased acquisition and operating costs of the ICE equivalents gave a boost to the EV sales during fiscal 2019-2024. The EV scooters clocked a CAGR of 101% in the past five years, and their penetration within the scooter segment rose from 0.4% in fiscal 2019 to 14.7% in fiscal 2024.

On the other hand, the ICE scooter segment witnessed contraction amid the reduced mobility, increased vehicle prices (due to BSVI compliance), higher operating costs (fuel price hike), increased interest outgo as well as increased competition from EVs. From fiscal 2019 to fiscal 2024, ICE scooter sales contracted at a CAGR of 4.3%.

Even within ICE scooters, the dominant 110 cc scooter segment (80% share in fiscal 2019) saw a sharp decline at a CAGR of 11.5%. The customer base of 110 cc scooters is relatively price conscious. Increased ownership and



operating costs as well as reduced usage requirements during the pandemic years, led to a significant postponement of purchases by this customer segment. In addition, the shift towards premium ICE scooters (=>125 cc) as well as EVs exacerbated the situation for the 110 cc ICE scooters. In turn, their share within the ICE scooter segment, slid from ~80% in fiscal 2019 to 53% by fiscal 2024.

In contrast, the premium scooter (=>125 cc) segment, clocked a 12% CAGR over the period, albeit from a smaller base. A relatively price agnostic customer base, feature-rich attractively designed vehicles, young buyers who prefer high performance and advanced features, auto OEM focus, multiple vehicle launches and premiumisation trend aided the growth of this segment. The share of premium scooters in the ICE scooter segment rose from about 20% in fiscal 2019 and to 47% in fiscal 2024.

Motorcycles

In the overall domestic sales, motorcycles have maintained their leading position in the past five years, but lost some ground to scooters in the same period. During the pandemic (fiscal 2021 and fiscal 2022), the reduced requirement of scooters and the continued requirement of motorcycles, especially for daily commuting in the absence of public transport, supported the demand for motorcycles and limited their decline.

During the pandemic, the availability of public transportation was limited, even the shared mobility options, including office buses and taxis were restricted making personal vehicles, including motorcycles, the primary option for daily commute, especially for the blue-collar workers and rural customer base. Relatively prosperous customers, women commuters especially from urban background took advantage of the work-from-home option or their four-wheeled vehicles limiting the need for scooters during this period. This aided the moderate market share expansion during fiscal 2021. Post pandemic, improving mobility and gradual rise in demand for scooters caused the share of motorcycles to contract in the next three fiscals, reaching 63% by fiscal 2024.



ICE vs EV split within domestic motorcycles sales - fiscals 2019-2024

Note: EV retail data from VAHAN have been considered. Source: SIAM, VAHAN, CRISIL MI&A

Unlike scooters, the EV penetration within motorcycles has remained insignificant due to a lack of EV options. A few OEMs, such as Revolt, offered EV motorcycles from fiscal 2020. Manufacturers such as Tork and Ultraviolette also introduced their e-bikes/ motorcycles in the next two to three years. However, given the limited vehicle options, even in the premium motorcycles category, higher acquisition costs, larger range anxiety concern due to higher



daily running for motorcycles; the adoption of EVs within motorcycles was only gradual and reached only 0.1% of overall motorcycle sales by fiscal 2024. Moreover, the ICE variants continue to dominate the motorcycle sales. However, even within the ICE motorcycles, the premium motorcycle segment (=>125 cc) has witnessed a CAGR of 3% during fiscal 2019-2024 period while the commuter motorcycle segment (<=110 cc) contracted at a rapid pace of 8% CAGR.

The price-sensitive commuter segment (62% share in fiscal 2019) has been under pressure amid the sharp rise in vehicle prices due to emission and safety norms, increased insurance costs, hike in fuel prices, escalated interest costs, coupled with pressure on the incomes of this customer segment, especially during the pandemic. The commuter motorcycle segment witnessed three years of consecutive contraction between fiscal 2020 to fiscal 2022 (16% CAGR drop till fiscal 2022).

On this lowered base, the commuter motorcycle segment saw some growth in fiscals 2023 and 2024 aided by the pent-up demand and added support from OEMs in the form of discounts and other incentives. However, for the complete five-year period, the commuter motorcycle segment witnessed contraction at 8% CAGR.

On the other hand, the premium motorcycle segment logged a CAGR of 3%, backed by lower impact of the pandemic on the financially stable customer base, higher OEM focus with increased vehicle launches, feature-rich and attractive vehicle introductions, and entry of global players such as Harley, and Triumph with India-focussed models into the premium motorcycle segment. High performance tech-enabled vehicles see higher acceptance among the rising younger buyer base who view vehicle as an extension of their personality. Thus, the share of premium motorcycles, within the ICE motorcycles, increased from 38% in fiscal 2019 to 52% in fiscal 2024.

Segment	FY19-FY24 CAGR	FY19 share	FY24 share
Motorcycles	(3.0) %	64.1%	63.2%
ICE	(3.1) %	64.1%	63.1%
EV	NM	0.0%	0.1%
Scooters	(1.3) %	31.7%	34.2%
ICE	(4.3) %	31.6%	29.2%
EV	101.3%	0.1%	5.0%
Mopeds	(11.4) %	4.2%	2.6%
Total	(2.8) %	100%	100%

Segmental growth within the industry in the past five years

Note: NM: Not meaningful; Figures in bracket to be read as negative (Eg. (10) to be read as minus 10), EV retail data from VAHAN have been considered.

Source: SIAM, CRISIL MI&A

The smallest segment of mopeds witnessed a contraction during fiscal 2019-2024, amid the increasing adoption of scooters in the semi-urban and rural markets — historically major markets for the moped —led to a loss of market share for mopeds. Limited product portfolio and no new launches also impacted the sales of this segment. Moreover, the pressure on the income of the bottom of the pyramid customer base of mopeds as well as increased operating expenses due to increased fuel costs, higher interest outgo; demand for the segment got impacted. As a result, the share of mopeds dropped from 4.2% in fiscal 2019 to 2.6% in fiscal 2024.

Competitive landscape of the domestic two-wheeler industry

India's two-wheeler industry is an oligopolistic market with the top four players contributing more than 80% of the annual sales. However, over the years, the competition has intensified within the industry, especially, with the entry of new age startups such as Ola, Ather, and Okinawa, catering to the fast-expanding segment of EVs. In fact, the contribution of the top four OEMs has decreased from 89% in fiscal 2019 to 83% in fiscal 2024.

Hero MotoCorp (HMCL) continues to lead the market, although HMCL's contribution has declined from ~36% in fiscal 2019 to 29.3% in fiscal 2024. The increased traction for scooters, including e-scooters as well as premium motorcycles, coupled with pressure on commuter motorcycles sales – where HMCL dominates – have impacted its share. The second largest contributor, Honda Motorcycle & Scooter (HMSI), has also lost some ground to other players, especially the e-scooter manufacturers.



OEM wise contribution to overall two-wheeler domestic sales - fiscals 2019 to 2024

Note: Data includes ICE and EVs; EV retail data from VAHAN have been considered. *Source: SIAM, VAHAN, CRISIL MI&A*

With the continued traction of its premium motorcycles and scooters, especially Jupiter, coupled with the growing adoption of its e-scooter model iQube, TVS has gained further ground in the market during the period. Bajaj has successfully maintained its ~12% share over the past five years. Multiple launches in the premium motorcycle segment and increase in production and sales of its Chetak e-scooters have aided its sales. Rising sales of premium scooters backed Suzuki's share expansion, while multiple launches in the growing premium motorcycle segment led to share expansion for Royal Enfield.

Recent entrants such as OIa and Ather have also grabbed notable share from the legacy OEMs led by the rising electrification within the domestic two-wheeler market. As of fiscal 2024, OIa and Ather contributed 2% and 1%, respectively to two-wheeler annual domestic sales.



OEM wise contribution to domestic motorcycle sales - fiscals 2019 to 2024

Note: Data includes ICE and EVs; EV retail data from VAHAN have been considered. *Source: SIAM, VAHAN, CRISIL MI&A*

The overall motorcycle segment is dominated by HMCL, which is also the leader in the commuter motorcycle segment. However, given the pressure on sales of the commuter motorcycle segment and intensifying competition in premium motorcycles, HMCL lost some ground to TVS, HMSI and Royal Enfield from an initial high base. Although HMCL witnessed some contraction in commuter motorcycles, the increased traction for its premium models such as the XPulse, Xtreme as well as demand for its recent launches such as the Karizma, Harley X440 in the premium motorcycle segment restricted the contraction in its share.

Bajaj maintained its second position in the market in the past five years with continued traction for its motorcycles, especially for its Pulsar range, and increased demand for its latest launches, including the Triumph vehicles. HMSI has expanded its presence in the motorcycles market amid continued demand for its models such as Shine 125, SP 125 coupled with its entry into the 100 cc category with Shine 100. The launch of the SP160 model also aided its share expansion in fiscal 2024.

In line with HMSI, TVS has also grabbed additional share in the motorcycle segment supported by high demand for its Raider 125 model coupled with increased push from its recent launch, the Ronin, in the premium segment. TVS also witnessed a contraction in the commuter segment due to lower demand for the segment and the premiumisation trend in the two-wheeler industry.

Royal Enfield, with its entire focus on the premium motorcycle segment continued to strengthen its presence further with faster growth in the premium segments. Moreover, increased support from the competitively priced model the Hunter 350 aided its growth in the past two years.



OEM wise contribution to domestic scooter sales - fiscals 2019 to 2024

Note: Data includes ICE and EVs; EV retail data from VAHAN have been considered. *Source: SIAM, VAHAN, CRISIL MI&A*

HMSI leads the scooter segment with its Activa model. Amid intensifying competition, the company has lost ground to TVS, Suzuki as well as the recent entrants OLA and Ather. However, an increase in demand for the premium variants of its scooters Activa 125 and Dio 125 helped the company limit its share contraction.

Increased traction for its iQube e-scooter and additional support from the premium variant of its popular Jupiter model helped TVS expand its share in the scooter segment.

Suzuki is primarily focussed on the premium scooter segment. Premiumisation within the industry as well as healthy demand for its recent launch, the Avenis, aided Suzuki's share expansion in the scooter segment.

Amid the electrification trend, especially in the scooter subsegment, OLA and Ather gained a foothold in the overall scooter segment for a short span. With its leading contribution in the e-scooter subsegment OLA gained a significant share of 5.2%, and Ather contributed ~2% to the overall scooter segment in fiscal 2024. (The EV segment is covered in detail in later chapters).

Over the past five years, Yamaha has maintained its share in 3-5% range led by continued demand for its RayZR series. The recent launch of the Aerox scooter range has helped Yamaha expand its presence and regain some lost ground in fiscal 2024.

For the moped segment, TVS contributes the entire sales. TVS is the only OEM offering mopeds in the domestic market.

Exports

Between fiscals 2019 and 2024, two-wheeler exports logged a moderate 1% CAGR reaching 3.5 million in volume. Currently exports account for 15-20% of the overall two wheeler sales in India.

The growth was led by increase in global demand and entry into new markets by players such as Bajaj and TVS. Also, joint ventures with global brands — such as KTM, Husqvarna and BMW — and catering to the global demand of these brands from India has given an additional thrust to two-wheeler exports.

However, the tightening global monetary condition after the inflation spiral and forex unavailability limited the exports. Geopolitical conflicts have also been impacting the overseas demand.

During the six-year period, export volume remained almost steady at around 3.5 million with fiscal 2022 being an exception, when the shipments rose a healthy 24% as OEMs focused on exports amid a slowdown in the domestic market. The exports normalised in fiscal 2023, with increased demand from domestic markets. Its share in overall industry sales also regularised to normal 15-20% range.

In fiscal 2024, two-wheeler exports dropped a further 5% amid continued focus on rising domestic demand and slowdown in demand in major overseas markets of Africa and Asia.



Two-wheeler exports trend

Source: SIAM, CRISIL MI&A

Two-wheelers are primarily exported to developing countries from India with Africa accounting for a major share. However, exports to Africa have been under pressure amid the slowdown in the economy, a sharp rise in inflation and unavailability of forex in Nigeria, the leading two-wheeler importer from India. In fiscal 2024 (until February), the region's share in India's two-wheeler exports fell to 41% from 44% in fiscal 2023.

The higher exports to North American countries (share expanded 6% y-o-y), primarily Mexico, lent some support to exports in fiscal 2024. The increase in exports to Turkey aided the share of Middle East during the fiscal. Given the FTAs with countries such as Saudi Arabia and the UAE, the exports to the Middle East have been on the rise.

India also exports significantly Southeast Asian countries such as the Philippines, Indonesia and Taiwan as well as the neighbouring countries of Nepal and Bangladesh. Share of exports to the neighbouring countries also contracted in fiscal 2024 owing to the economic weakness in these countries. Continued exports to Indonesia have restricted the loss of share.

The popularity of scooters has increased in South Asian markets such as Thailand, Malaysia, Vietnam and Indonesia because of the vehicles' affordability, fuel efficiency and agility in navigating congested roads. These developing nations have limited per capita incomes making passenger vehicles unaffordable for a significant customer base. Moreover, scooters are favoured as a family vehicle which can be used in urban and rural areas for the daily commute as well as to haul small luggage to and from the market.

Additionally, the governments in these countries are also incentivising purchase of low emission and technologically advanced vehicles which align with environmental and safety goals set by the government.



Geographical split for Indian two-wheeler exports (fiscal 2024 YTD)

Note: YTD: Until February

Source: Ministry of Commerce and Industry, CRISIL MI&A, SIAM

Segment-wise exports

Motorcycles dominate the exports segment as well with more than 85% share in two-wheeler exports. However, they lost some ground to scooters, especially in the last 3 years.

Motorcycle exports registered a modest 1% CAGR during fiscals 2019-2024 while scooters clocked a faster 5% CAGR, albeit from a smaller base. Increased push from HMSI as well as TVS with further geographical expansion in Latin American and South East Asian countries aided the faster growth of scooter exports.

Even in fiscal 2024, while the exports of motorcycles contracted 9%, those of scooters rose nearly 23% on-year, restricting the overall contraction of exports.

Mopeds form an insignificant part of the two-wheeler exports. Their share contracted further during fiscals 2019-2024 with a 30% CAGR decline in exports .



Segmental split within exports

Source: SIAM, CRISIL MI&A

CAGR for segmental split within exports - fiscals 2019 to 2024

Motorcycle	Scooter	Moped
0.5%	5.1%	-30.4%

Source: SIAM, CRISIL MI&A

Demand drivers and trends in the domestic two-wheeler market

The performance of the Indian two-wheeler industry is dependent on numerous social and economic factors, including demographic trends and preferences, income levels, affordability of two-wheelers for customers, changes in government policies, overall economic conditions and the availability of finance and interest rates. Certain factors, such as general macroeconomic and consumer trends, have direct impact on the demand of two-wheelers.

According to the International Road Federation - World Road Statistics 2023 report, India had around 243 million two-wheelers in use in CY 2020 i.e. India had 175 two-wheelers for every 1,000 people. The two-wheeler penetration of India is much lower than that of many Southeast Asian countries such as Taiwan (592 two-wheelers per 1,000 people), Indonesia (423), Malaysia (406 – as of 2018) and Vietnam (613 – as of 2018).

Country	Two-wheeler penetration (per thousand people)	
India	175	
Brazil	136	
Mexico	42	
Indonesia	423	
Malaysia	406*	
Taiwan	592	
Vietnam	613*	
Korea	44	
USA	25	
China	51	
Japan	82	

Note: Data for 2020; *: Data for 2018

Source: International Road Federation- World Road Statistics 2023

This provides a sizeable headroom for the two-wheeler industry to grow going forward. Some of the key drivers aiding India's domestic two-wheeler industry demand are:

Macroeconomic support

The primary demand drivers for the two-wheeler industry are improving affordability and lower cost of acquisition and ownership. Macroeconomic factors primarily determine the disposable income and affordability for customers.

During the fiscal 2009 -2019 decade, India's GDP grew at a healthy pace of 7% CAGR, aiding the affordability of the customer base. The private final consumption expenditure also expanded in tandem with the GDP growth over the same period.



This improvement in income levels translated into a healthy growth for the domestic two-wheeler industry at a CAGR of 11%. The industry achieved this growth despite a few hurdles, including the demonetisation, the implementation of the Goods and Services Tax, as well as the implementation of BSIV norms, which pushed up the vehicle prices in fiscal 2018.



GDP vs two-wheeler industry growth trend

After this healthy growth, the slowdown in the GDP growth in fiscal 2020 and the pandemic-induced economic contraction in fiscal 2021 impacted the healthy run of the domestic two-wheeler industry further. The improvement in the macroeconomic scenario post the pandemic, with the reopening of the economy, has aided the two-wheeler sales growth in the past two years.

Going ahead, CRISIL expects India's GDP to clock a healthy 6.5-7.5% CAGR (till fiscal 2031), aiding the growth of domestic two-wheeler industry sales in the long-term.

Private consumption

Private final consumption expenditure (PFCE) reflects the overall consumption patterns and spending capacity of households in an economy. An increase in the measure often translates into higher demand for various goods and services.

PFCE marginally rose to 3.5% year-on-year in the third quarter of fiscal 2024 compared with 2.4% in the previous quarter but remained sluggish. Rural demand indicators were a mixed bag, with demand for work under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) slowing this quarter, and growth in two-wheeler sales surging. However, growth in consumer non-durables production slowed considerably. Urban demand seemed to have sustained some momentum, with a pick-up in the growth of passenger vehicle sales, consumer durables production and continued double-digit growth in retail credit (18.1% versus 18.3% in the previous quarter). The latter indicates the impact of past rate hikes and regulations on unsecured lending are still pending.

PFCE quarterly trend

Source: MoSPI, SIAM, VAHAN, CRISIL MI&A



Source: Industry, SIAM, VAHAN, CRISIL MI&A

Rising rural incomes

Rural income growth is an important determinant of two-wheeler demand in India. Rural sales account for 55-60% of the overall domestic sales of two-wheelers.

Improvement in rural infrastructure and road connectivity have helped the scooters segment to make inroads into the rural areas despite rural customers' preference for motorcycles. With rising electrification, a significant portion of EV demand is also coming from tier 3 and rural areas. So, the rural incomes have a direct bearing on the two-wheeler industry sales.

The rural areas are still primarily agrarian. With 86% of land holdings, small and marginal farmers dominate the country's agricultural sector. They rely on monsoon for water. Hence, its timely arrival and adequacy are crucial for a good crop. Any negative impact on crop supply owing to low rainfall has a cascading effect on the economy, as it leads to higher food prices and subsequently lower discretionary spending. As per the India Meteorological Department (IMD), monsoon deviation was 6% in fiscal 2023.

Monsoon has been favourable over the past few years with deviation staying in the acceptable range. Fiscal 2024 witnessed an uneven spread of rainfall during the initial months. Rabi output was favourable in fiscal 2023, supporting farmer income during the early months of fiscal 2024. In fiscal 2024, kharif sowing was initially delayed owing to delay in monsoon. However, sowing picked up in later. Moreover, higher minimum support price (MSP) this fiscal and good price in the mandis have maintained on-ground positivity.

In fiscal 2025, the IMD expects the monsoon to be normal, which is expected to boost the farm incomes in the short term.

Rainfall deviation trend



Note: If the rainfall average is within ±10% from its long period average (LPA) or 90% to 110% of LPA, the rainfall is said to be "normal". The LPA for the June to September period is 868.6mm.

Source: IMD, CRISIL MI&A

Rural infrastructure

Rural infrastructure also has a pronounced impact on rural incomes and, in turn, two-wheeler sales. Under the Pradhan Mantri Gram Sadak Yojana (PMGSY), launched in 2000, the government aims to build all-weather roads in the rural regions to improve connectivity and support the rural economy.

Over the years, the government has successfully executed a major portion of the PMGSY annual target set for the year. Even during fiscal 2024, it achieved 89% of the target constructing 26,000 km of 38,000 km target.

Expansion of the rural road network not only improves connectivity but also aids the rural economy. Improvement of rural infrastructure impacts two-wheeler demand in two ways: directly by generating employment in the rural economy during the construction of roads, thereby increasing wages and overall income, and indirectly by enabling accessibility, which, in turn, increases mobility.

Thus, the continued expansion in rural infrastructure is expected to back two-wheeler demand growth over the long term.



Source: NHAI, MoRTH, CRISIL MI&A

Financing support

Finance support plays an important role in the overall demand growth of the two-wheeler industry given the relatively lower income profile of customers as well as the smaller ticket size of the industry.

Over the years, as competition intensified, financial institutions have expanded their reach to gain further market share within the auto finance industry. Moreover, the entry of NBFCs that focus primarily on non-metros, expanded the reach of the financing system further as banks primarily catered to the urban and salaried customers.

The expansion aided the growth of overall finance penetration in the industry and, in turn, supported the growth of the domestic two-wheeler industry. Additionally, financiers have been offering a wide range of schemes and promotions (such as low-down payment, attractive EMI options and waiver of processing fees) to attract more customers for small ticket-sized purchases aiding the finance penetration within the two-wheeler industry.

Going forward, CRISIL MI&A Consulting expects finance penetration to improve further and support the growth of two-wheelers.

Two-wheeler finance penetration trend



Source: CRISIL MI&A

Growing gig economy

The gig economy is a significant contributor to the two-wheeler industry demand as delivery boys use these vehicles for last-mile delivery.

According to NITI Aayog, there were nearly 6.8 million gig workers engaged in the gig economy which includes food, grocery, electronics, and e commerce in fiscal 2020. The gig workforce is expected to expand to 23.5 million by fiscal 2030 backed by the expected rise in underlying industries of e commerce and food delivery services.

The Indian e-commerce industry, estimated at ~Rs 3,000 billion in fiscal 2023, has had a phenomenal run over the past few years. It has managed to attract not only consumers but also investors across the world and has grown more than three-fold between fiscals 2018 and 2023 on the back of increasing internet penetration, rising popularity of online shopping and lucrative deals and discounts offered by well-established players and start-ups. However, in fiscal 2023, the growth moderated a bit but remained healthy.

CRISIL MI&A projects the e-commerce industry to cross Rs 5.3 thousand billion by fiscal 2026, logging a CAGR of 20-25% between fiscal 2024 and fiscal 2026. Healthy growth is expected to support the demand for two-wheelers in the long run.



E-commerce industry outlook

Source: CRISIL MI&A

Premiumisation in the industry

A clear shift towards premium vehicles is visible in the two-wheeler industry. Customers are looking to upgrade to the next premium vehicle segment in both motorcycle and scooter segments. The premiumisation trend is supported by various factors such as younger profile of buyers, attractive feature-rich new vehicle launches at competitive rates, vehicles being seen as an extension of a customer's personality, easier access to finance and more launches in the premium segment.

Over fiscals 2019-2024, the share of premium vehicles (=>125cc) in motorcycle sales increased significantly from 41% to 52% and in scooter sales from 21% to 47%. Despite the commuter motorcycles and basic 110 cc scooters segments witnessing a sharp contraction, traction in premium motorcycles and scooters restricted the fall in overall sales. In the last five years, the premium segments have primarily provided the thrust to the industry.



In the long term, CRISIL MI&A expects the premiumisation trend to support the overall industry growth and support the sales.



Share of premium two-wheelers

Note: Premium motorcycles/ scooters: => 125 cc vehicles Source: SIAM, CRISIL MI&A

Electrification in the two-wheeler segment

Usage of EVs has increased globally because of the need to curb pollution. In India, too, EVs are gaining popularity, as the government is extending support via Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME II)), a policy that encourages the use of electric vehicles and reduce the use of fossil fuel-powered vehicles and tax rate cuts to encourage EV adoption. Further, growing awareness and concerns about environmental issues are likely to drive electrification in India.

EV sales have skyrocketed, especially post the pandemic, aided by the rising awareness, government support and expanding EV portfolio of the industry. The entry of the new age non-traditional OEMs such as Ola, Ather and Okinawa provided an additional boost to the EV segment in India.

While the ICE two-wheeler sales contracted at 3.7% CAGR between fiscals 2019 and 2024, EV sales logged 101% CAGR, thus restricting the drop in overall industry sales.

Even going ahead, the furthering electrification is estimated to provide the much-needed thrust to the industry growth over the long-term horizon. EVs have been covered in detail in the next chapter.



Electric two-wheelers sales trend over fiscals 2019-2024

Note: VAHAN data does not include Telangana & Lakshadweep retails Source: VAHAN, CRISIL MI&A

Electric two-wheeler retails were growing only at a moderate pace until fiscal 2022 owing to limited vehicle portfolio, lower awareness, customer concerns regarding the range and inadequate charging infrastructure, despite the Rs 10,000 per kWh government incentive under the FAME scheme. In June 2021, demand incentive for two-wheelers was increased to Rs 15,000/ kWh. Further, expansion in vehicle portfolio and entry of Ola provided an additional thrust to the electric two-wheeler sales in fiscal 2022.

Additionally, ICE vehicles witnessed a steep rise in prices in fiscal 2021 owing to the BS-VI implementation and a further price hike in fiscal 2022 because of the increase in raw material prices. The price hike was much higher than the typical 3-4% annual raise. Over and above the increase in vehicle acquisition costs, the sharp rise in petrol prices (petrol prices crossed Rs 100 mark) during the year provided an additional incentive to customers to shift from ICE vehicles to electric two-wheelers. During fiscal 2022, amid the severe Covid-19 second wave, pressure on incomes and increased medical expenses, limiting other expenses was a priority for most of the customer base.

Thus, the increased subsidy on electric two-wheelers, vehicle portfolio expansion and increased acquisition and operating costs of ICE two-wheelers led to the sharp growth in electric two-wheeler retails during fiscal 2022 to \sim 253,000, up 5.6x from 45,000 in fiscal 2021.

Growth momentum continued for the segment in fiscal 2023, when a sharp push from new age players such as Ola and Ather supported the growth. Legacy OEMs, especially TVS, scaled up their EV production, providing an impetus to the EV sales during the year.

Fiscal 2024 began on a very strong note. However, on June 1, the government reduced the FAME subsidy incentive cap from 40% of a vehicle's value to 15% and capped the subsidy at Rs 10,000 per kWh of battery from Rs 15,000. Owing to this, manufacturers have had to increase the prices of electric scooters, which led to a 57% sequential slowdown in sales in June. This sharp sequential contraction was on an elevated base of May 2023, where customers had pre-bought significantly owing to the price rise from June.

Shrinking replacement cycles

The replacement cycles in the passenger vehicle sector has shortened from an average of 10-12 years a decade ago to 7-8 years because of various factors.



For one, the vehicle portfolio has been expanding with entry of newer players — global and non-traditional — and launch of attractive, feature-rich and competitively priced vehicles. Also, frequency of new vehicle launches by OEMs have increased. The new launches are technologically advanced, state-of-the-art vehicles catering to younger buyer demographic. Moreover, the financing coverage has been expanding and awareness level increasing. The rising share of scooters with a relatively lower ownership holding period is another factor contributing to the shortening of the replacement cycle. Rising premiumisation and electrification is also supporting the trend.

The shortened replacement cycle for the average customer is an added boost for the two-wheeler sales.

R&D support

The customer base of the two-wheeler industry has shifted towards the young, tech savvy gen Z customers, who prefer the latest state-of-the-art features, attractive designs and colours, connected technology and hi-tech accessories for their new vehicles. This customer base sees vehicles as an extension of their personality.

Moreover, as the replacement cycles have shortened, the intermittent new vehicle launches are a must to ensure continued demand.

Thus, all the OEMs spend a notable amount on research and development (R&D) to integrate the latest tech, design and features for the upcoming models. R&D has also become a necessity to analyse the safety of the two-wheeler riders.

In the last six years, the two-wheeler OEMs have spent ~2% of their annual operating incomes on R&D.

Advancement in vehicle technology

Over the years, there has been a significant advancement in vehicle technology. Various new features have been added in ICE and EVs, making them more appealing to the customers, especially the younger buyers. The EV segment has revolutionised the industry in terms of latest technological designs and offerings and ICE vehicles are following with notable advancements. The new-age vehicles offer a wide range of features and innovations to ensure safer, more efficient and environmentally friendly transportation and that cater to varied consumer needs.

Over the years, two-wheelers have seen addition of features such as digital instrument cluster (around 2010), navigation (around 2017), USB charging port (2017), Bluetooth connectivity (2018) and cruise control. Over and above these basic features, premium vehicles, including EVs, offer much advanced features such as full-colour thin film transistor (TFT) displays, gear shift indicators, real-time mileage, fuel efficiency metrics, music, calls on vehicle display, riding modes, traction control, keyless ignition, smart helmets with built-in communication, heads up display etc.

As technology continues to advance, the two-wheeler industry will witness more innovations in the coming years, making ride safer and more enjoyable for the customer, in turn, supporting the growth of the industry over the long-term.

Accessories supporting OEM margins

Over the years, companies have expanded the offerings introducing company-branded accessories and merchandise such as scooter covers, handlebar pads, engine guard, backrest, helmets, apparels, gloves etc. Such branded accessories form an integral part of the two-wheeler industry. The merchandise is more common for the premium models and form a sizeable portion of the revenue for the OEMs.



Today EV manufacturers also offer accessories and merchandise for their customers, including smart helmets, portable chargers, fast chargers, pressure monitors etc. EV manufacturers also offer merchandise for their customer base (T-shirts, jackets etc).

These are high-margin (25-30%) products. They not only promote the OEM's brand but also provide an added support to the company's top line and bottom line.

Outlook for the Indian domestic two-wheeler industry (fiscals 2025-2029)

The industry is expected to continue its growth momentum over the long-term horizon led by the positive microeconomic and macroeconomic environment, favourable rural demand, premiumization, intermittent launches, shrinking replacement cycle and continued support from financers. Moreover, continued R&D investments by the OEMs and the technological advancements in the industry to provide an added support to the growth of the industry over the long-term horizon.

Additionally, the fast-rising EV segment, with EV portfolio expansion by legacy players, capacity expansion by new age players will accelerate the industry growth.

Introduction of CNG powertrain, which will offer lower operating costs compared to petrol variants, will push the two-wheeler industry growth further.

Led by these positive industry drivers, two-wheeler industry sales are projected to log 6-8% CAGR and reach volume of 25-27 million by fiscal 2029.



Domestic two-wheeler industry outlook until fiscal 2029

Source: SIAM, CRISIL MI&A

Going ahead, over the long term horizon, CRISIL MI&A expects the scooter segment to grow at a much faster pace off the relatively lower base, backed by expected sharp rise in E scooter demand, ubiquitous usage of scooters, rising share of women in workforce, projected growth of e commerce segment coupled with continued focus of OEMs on the scooters segment. The strong launch pipeline, especially for e scooters and faster replacement

cycles of the scooters segment will also back the faster growth of the scooters segment. Further, the improvement in supporting charging infrastructure is expected to provide added impetus to the segment's growth.

CRISIL MI&A projects the scooters segment to grow at a faster pace of 8-10% CAGR over the long-term horizon. However, the ICE scooters segment is expected to contract amidst the shift towards the EV segment. Sizeable portion of the ICE scooter replacement demand will shift towards the electric variants.



Segmental Split Outlook

Source: SIAM, CRISIL MI&A

Motorcycles, on the other hand, are projected to clock a slower 5-7% CAGR during the period. The premium motorcycles sub-segment is expected to continue to provide the thrust to the motorcycles segment while the commuter segment is projected to grow only moderately.

Premiumisation and upgradation will limit the growth of commuter motorcycles sub-segment. Shifting customer preference towards premium segments supplemented by OEM focus and more launches in the premium segment will provide the thrust to the premium segment going ahead.

The moped segment is expected to grow almost in line with the overall industry growth led by the electrification in the price sensitive segment. Electrification within the mopeds segment will lead the growth of this segment. CRISIL MI&A expects the relatively financially weak, bottom-of-the-pyramid customer base of mopeds to opt for EV mopeds which have relatively lower acquisition costs.

At present, there is only one model, the recently launched E luna, in the mopeds segment. However, more models are expected to be launched in the short term, which will revive the growth of this contracting segment.

Exports outlook

CRISIL MI&A expects two-wheeler exports to clock a faster 3-5% CAGR (vs 1% CAGR between fiscals 2019-2024) to reach 4.0-4.5 million by fiscal 2029.

The growth will be propelled by macro-economic improvement in exports markets, expansion in geographical coverage by the OEMs and more vehicle models getting shipped. Moreover, the fast-growing EV segment is



expected to contribute meaningfully to exports amid the capacity expansion by players, sharpening focus on exports and sharp rise in the number of EV models.

Being one of the largest two-wheeler markets, India has a unique opportunity to leverage its scale and manufacturing competitiveness to produce electric two-wheelers not just for the domestic market but also for the exports markets. Further, policies, including the PLI scheme, are offering a momentum to domestic OEMs to manufacture and export EVs. The government offers incentives through PLI for the entire EV ecosystem, including automobiles, auto components and ACC batteries.

Additionally, the growing demand for eco-friendly and sustainable transportation options globally is expected to provide a fillip to the demand for electric two-wheelers going forward. Countries such as Nepal, which have a strong dependence on two-wheeler imports from India, have tall electrification targets (90% EV sales by 2030). These will also aid the electric two-wheeler exports demand going ahead. Thus, the rise in EV exports will support the overall two-wheeler industry exports during fiscals 2025-2029.

India's trade agreements with major global economies would help the domestic OEMs enhance the exports of automobiles and related components. India has signed FTAs with several nations, including the UAE and Australia. The country is also negotiating with the UK and EU to sign FTAs. Such agreements offer immense opportunities for Indian OEMs, helping them tap into a broader customer base and establish the country as a key player in the global automotive industry.

Nonetheless, geopolitical flare-ups can have a negative impact on the oil prices, thereby increasing the inflationary pressure in major importing countries. This can, in turn, impact demand for vehicles in the near term.



Exports outlook

Source: SIAM, CRISIL MI&A

FTA boost two automobile exports

In order to expand the exports markets while ensuring access to raw materials and capital goods necessary to accelerate domestic manufacturing, India is engaged in regional and bilateral trade negotiations. Currently, the country has favourable market access and economic cooperation with more than 50 countries through multiple trade agreements. FTAs are aimed at eliminating or lowering the trade barriers for Indian exporters, so that they can gain a competitive advantage in the foreign markets, paving the way for increased sales and market share.


FTAs give exporters access to overseas markets at low customs duties or any applicable other taxes. Further, such agreements offer a conducive environment for automakers and suppliers to technically collaborate, potentially gaining investments and knowledge that could augment the industry's overall performance and growth.

The following table lists a few trade agreements that India has signed.

Agreement	Enforced date	Member country	Agreement type	Benefit for automotive industry	Description
Comprehensive Economic Partnership Agreement	1 May 2022	UAE	FTA	Zero-duty market access	Passenger vehicles, including two-wheelers, three-wheelers, personal vehicles and a few automotive components, get duty-free market access in the UAE.
Economic Cooperation and Trade Agreement	29 December 2022	Australia	FTA	Zero customs duty	Passenger vehicles and associated components get preferential market access. They shall be exempt from customs duty.
Trade and Economic Partnership Agreement	10 March 2024	Iceland, Liechtenstein, Norway, and Switzerland	FTA	Zero customs duty	Vehicles other than railway or tramway rollingstock, and parts and accessories are exempt from customs duty
Comprehensive Economic Partnership Agreement	1 January 2010	South Korea	FTA	NA	Motor cars and automotive components are exempt from the obligation of tariff reduction or elimination
Malaysia-India Comprehensive Economic Cooperation Agreement	1 July 2011	Malaysia	FTA	Tariff reduction	Motorcycles get market access; tariffs reduced to a pre-determined level
ASEAN-India Free Trade Agreement	1 January 2010	Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam	FTA	Reduction in tariff	 Indonesia, Cambodia plan to reduce import duty on passenger vehicles. Brunei reduced custom duty and passenger vehicles are going to get duty- free market access Malaysia, Vietnam, Myanmar, Laos, the Philippines and Thailand have passenger vehicles in the exclusion list (EL), under which no concession is granted. However, the EL is subject to annual tariff review with a view to improving market access.

These FTAs can drastically reshape the duty scenario while also offering exporters improved access in the overseas markets through various mechanisms, including duty elimination/ concession. Apart from that most favoured nation (MFN) status of India with developed/ developing nations could bring trade advantages to India in the form of low tariffs or high import quotas.

Cost of Ownership Comparison - EV vs ICE

For the Total cost of ownership (TCO) calculation, an annual running of 8000 km is considered, i.e., 25 km per day for 325 days of operation per year. A 7-year holding period is considered, assuming no battery replacement happens during the ownership period.



As of fiscal 2024, the total cost of ownership (TCO) of an e2W, even without a subsidy, was 37% lower than that of an ICE 2W for an annual running of 8,000 km. With subsidy this difference increased to 55% for fiscal 2024.

Going ahead, by fiscal 2031, e2W ownership is expected to become financially more lucrative. For an annual running of 8,000 km, the e2W TCO is projected to be 52% lower than its petrol counterpart even without the subsidy. Total cost of ownership for an e2W is decreasing over the years amidst the lowering global battery prices, economies of scale and improving technology resulting in higher manufacturing efficiency of the electric vehicles.

Despite the favorable TCO, the acquisition cost for an e2W was more than 40% higher than its ICE counterpart during fiscal 2024. However, the price gap between the two is expected to narrow going ahead, with expected decline in battery prices. Considering the GST and road tax benefits to continue, the price gap between the acquisition costs of EV and ICE are projected to shrink to 5-10% by fiscal 2031.

TCO for seven-year ownership without subsidy

Year/Annual Running	3,000 km	6,000 km	8,000 km	10,000 km	12,000 km
Fiscal 2024	5% lower cost than petrol	28% lower cost than petrol	37% lower cost than petrol	44% lower cost than petrol	49% lower cost than petrol
Fiscal 2031	32% lower cost than petrol	46% lower cost than petrol	52% lower cost than petrol	56% lower cost than petrol	60% lower cost than petrol

TCO for seven-year ownership with subsidy

Year/Annual Running	3,000 km	6,000 km	8,000 km	10,000 km	12,000 km
Fiscal 2024	34% lower cost	49% lower cost	55% lower cost	59% lower cost	62% lower cost
	than petrol				
Fiscal 2031	32% lower cost	46% lower cost	52% lower cost	56% lower cost	60% lower cost
	than petrol				

Note:

- Convenience ICE scooter and Convenience E scooter have been considered for the comparison
- Subsidy Scenario includes both Central & State subsidy and have been considered till fiscal 2026, no subsidy is considered between fiscal 2026 and fiscal 2036
- Above analysis is done without considering battery replacement
- In case of battery replacement, TCO for an EV was 41% lower than ICE vehicle TCO in fiscal 2024 and it will be 55% lower than ICE vehicle TCO by fiscal 2031 considering 8000 km annual running, 7 year holding period and no subsidy.
- According to Ather Energy, battery packs can last for 7 years without a battery replacement, however, the battery can degrade in case of extreme use cases such as excessive use of fast charging, accidental damages, lack of periodic maintenance, use of unauthorized chargers, extended exposure to temperatures higher than 50 degrees Celsius and prologued idle periods.

Source: CRISIL MI&A

EVs currently offer much better technological features compared to an ICE vehicle. For example, premium variants of the EVs are equipped with touch screen HMI, Bluetooth and LTE connectivity. However, premium ICE counterparts offer only Bluetooth connectivity and basic smart connected features.

The acquisition cost of a comparable ICE 2W with Bluetooth connected features is currently 80%+ lower than the EV variant with a Touchscreen display and the software pack.

By fiscal 2031, the acquisition price gap between the ICE vehicle (with a touchscreen, connected features) and a comparable EV will narrow down to 8-12%.



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Despite the favorable TCO, the acquisition cost for an e2W was more than 40% higher than its ICE counterpart during fiscal 2024. However, the price gap between the two is expected to narrow going ahead, with expected decline in battery prices. Considering the GST and road tax benefits to continue, the price gap between the acquisition costs of EV and ICE are projected to shrink to 5-10% by fiscal 2031.

Electrification outlook for domestic two-wheeler market (fiscals 2025-2029)

The electric two-wheeler retails rose at a sharp growth pace of 101% CAGR in the last 6 years, albeit off the small base of fiscal 2019. Going ahead the growth momentum in the industry is expected to continue over the long-term horizon led by rising awareness, improving TCO for electric vehicles, bridging acquisition cost gap between EV and ICE counterparts, larger vehicle portfolio, expanding charging infrastructure, furthering financing support, increasing EV manufacturing capacity, and continued government support.

If the government continues with the demand incentive (FAME, EMPS or an equivalent alternate form) at least for the next 1 year (till fiscal 2026), CRISIL MI&A expects the EV retails to rise at a healthy pace of 45-48% CAGR and reach 6.0-6.5 million levels in fiscal 2029. And the EV penetration levels to reach 23-25% by fiscal 2029.



Electric two-wheelers and penetration outlook

Note: Only high-speed electric two-wheelers are considered for the analysis Source: SIAM, SMEV, VAHAN, CRISIL MI&A





Segment-wise EV outlook

Note: Only high-speed electric two-wheelers are considered for the analysis *Source: SIAM, SMEV, VAHAN, CRISIL MI&A*

Scooters are expected to lead the charge going ahead as well. EV penetration within scooters is currently the highest at 14.7% as of fiscal 2024. Amidst the fast-expanding e scooter portfolio, shifting of customer preference from ICE scooters to e scooters, OEM focus, state of the art advanced offerings, improvement in TCO as well as acquisition cost difference, a sharp rise in e scooter penetration is expected going forward. CRISIL MI&A expects the EV penetration to reach ~55% for scooters by fiscal 2029.

Electrification within motorcycles segment has remained limited amidst limited offerings as well as typical longer distance usage of motorcycles compared to scooters. However, amidst the projected launch of e bikes/ motorcycles from OEMs including Revolt, OLA, Tork will back electrification within motorcycles as well. Over the longer horizon, EV penetration is expected to reach ~3% within motorcycles by fiscal 2029.

In the above projections, CRISIL MI&A has considered the government demand incentive to continue till fiscal 2026 which will provide an additional support to the EV adoption going forward.

Indian passenger vehicle industry

Review of domestic passenger vehicles industry (fiscals 2019-2024)

Until liberalisation in 1991, there were only three major car manufacturers in India – Hindustan Motors, Premier and Maruti Suzuki (formerly Maruti Udyog). The partnership between Maruti and Suzuki Motor Corporation of Japan was the country's first joint venture with a foreign country. Post liberalisation, Tata Motors entered the passenger vehicle (PV) segment with a series of launches throughout 1990s. Another home-grown brand Mahindra & Mahindra, which traditionally manufactured off-roading utility vehicles, also entered the PV space in the late 2000s. Also, major international corporations such as Hyundai and Honda entered the country in late 1990s following gradual implementation of economic reforms. Hyundai quickly gained prominent market share. From 2000 to 2010, almost every major car company in the world had established manufacturing facilities in the country.

Owing to improvement in macro-economic scenario, rising disposable incomes and expanding vehicle portfolios, the Indian PV industry witnessed stellar growth and PV sales reached a high of 3.4 million vehicle in fiscal 2019.



The high growth until fiscal 2019 was led by steady GDP growth, increase in disposable incomes, new model launches, stable cost of vehicle ownership and increasing traction for sports utility vehicles (SUVs).

Between fiscals 2019 and 2024, India's domestic PV sales clocked 5% CAGR despite a sales contraction (10% CAGR) during fiscals 2019-2021. From the low base of fiscal 2021, PV sales bounced back and grew healthily to reach a historic high of 4.2 million vehicles in fiscal 2024, registering a CAGR growth of 16%.

In fiscal 2020, the economic contraction owing to the pandemic put pressure on vehicle sales. Other factors that heightened the pressure are the non-banking financial company (NBFC) liquidity crisis and halting of BS-IV vehicle production amid mandatory implementation of BS-VI norms from fiscal 2021. The industry also lost nearly half a month's sales during the end of the fiscal owing to the outbreak of Covid-19 and subsequent nationwide lockdown.

In fiscal 2021, domestic sales continued to be impacted by the first wave of the pandemic. A nation-wide lockdown, restrictions on mobility and supply-chain constraints majorly of semiconductors led to production cuts, which weighed on annual sales. Despite some improvement in sales with the reopening of the economy and increased demand for personal mobility during the second half of the year, sales contracted ~2.2% year-on-year owing to the price hikes after the implementation of the BS-VI norms.

Fiscal 2022 began with a much severe second wave of Covid-19. State-imposed lockdowns, economic uncertainty, and a global shortage of semiconductor supply extended waiting periods, impacting the sales, especially in the fiscal first half. There was some improvement in the economic scenario with the reopening of markets in the second half. Pent-up vehicle demand, increased use of personal mobility options owing to fears of infection and improved supply scenario boosted PV sales during the period, pushing up the full-year PV sales 13% on a low base.

In fiscal 2023, the PV industry grew 27% y-o-y, more than double the rate 13% y-o-y witnessed in fiscal 2022. The orderbooks of auto OEMs were further supported by several new launches in the growing SUV category, which saw higher traction. Facelifts of existing models and easing supply of semiconductors also helped. In fact, overall wholesale volume reached a historic high of 3.9 million units in the fiscal.

Fiscal 2024 marked the third year of consecutive growth in PV industry by recording 8% growth. This comes over a high base of fiscal 2023 which grew by 27% (almost double the growth of 13% in fiscal 2022) due to healthy pent-up demand created by two years of slump in sales volumes owing to a pandemic induced disrupted supply chain. The orderbooks of auto OEMs were further supported by plethora of launches in the growing UV (Utility vehicles) category, which had witnessed high traction, along with multiple facelifts of existing models and easing semiconductor supplies drove record sales in each quarter in fiscal 2024. The overall wholesale volumes settled at ~3.9 million units in fiscal 2023.



Historic production development (fiscals 2019-2024)

Review of domestic PV sales volume

Note: Figures in bracket are negative (Eg. (10) denotes negative 10) Source: SIAM, CRISIL MI&A

During fiscal 2024, growth momentum of the industry continued, albeit at a slower pace, backed by the continued traction for the SUV segment, intermittent launches and improvement in disposable income. On the high base of fiscal 2023, the industry grew 8% in fiscal 2024 to hit a record 4.2 million units.

Segmental shifts amidst premiumisation

Based on body types, PVs in India are broadly classified into hatchbacks, sedans, SUVs, multipurpose vehicles (MPVs) and vans. Traditionally, domestic vehicle buyers have been cost conscious, with mileage and initial vehicle buying cost being the two key factors influencing the decision-making. Hence, the hatchback segment had been leading PV sales over the years primarily because of the lower ticket size and lower running costs, making them affordable to the average Indian customer.

However, with a growing share of younger buyers with global exposure, there is an increasing awareness and preference towards other parameters such as driving experience, safety, advanced features aesthetics and a comfortable ride due to poor road conditions, which are impacting the decision-making process. To address this change, OEMs such as Tata Motors and Hyundai have started incorporating enhanced vehicle safety in their recent launches. Several carmakers have introduced advanced features in top variants and gradually incorporated them in even the mid variants. Furthermore, rising disposable income has also given an impetus to growth in the SUV segment.

There has been a perceptible shift in the customer buying behaviour, with customers prioritising vehicle experience over costs and willing to pay a premium. They are also ready to accept longer waiting time for the desired vehicle. More and more customers are now opting to buy mid to top level variants that fall within their budgets. The shift towards premium vehicles is resulting in inter-segmental and intra-segmental shifts.



Segment-wise trends in the overall PV sales volume in India

Note: Figures above bars are the sales volume.

Source: SIAM, CRISIL MI&A

CAGR for segment-wise trends in the overall PV sales volume in India - fiscals 2019 to 2024

	Hatchbacks	Sedans	SUVs	MPVs	Vans
FY19-24 CAGR	-7.7%	-11.2%	19.5%	11.7%	-6.9%

Note: Figures above bars are the sales volume. Source: SIAM. CRISIL MI&A

Split of industry by domestic sales and exports

The Indian PV makers are largely domestic-focused, with domestic sales accounting for 85.4% of the total sales in fiscal 2023. Share of exports in total sales contracted from 16.8% in fiscal 2019 to 14.6% in 2023 because of moderate growth in the global automobile industry and major OEMs focusing on catering to the fast-growing domestic market. Following a ~38.6% on-year decline in fiscal 2021, exports rose a sharp 42.9% in fiscal 2022 and 14.7% in fiscal 2023 owing to demand from emerging countries further supported by push from the major OEMs.

In fiscal 2020, though, the share of exports in total sales had risen to 19% as the OEMs refocused on export markets. Stagnating domestic sales over the past three years resulted in foreign automobile manufacturers, such as Ford, General Motors and Volkswagen, increasing their focus on exports. This improved their capacity utilisation and boosted their revenue. These players were utilising India as an export hub, which was reflected in the consistent increase in the share of exports in their total production. However, with the exit of GM and Ford, onset of Covid-19 and major OEMs prioritising the fast-growing domestic market over foreign markets, the export volume declined in fiscal 2021. However, the government, through various schemes including PLI, is boosting domestic manufacturing capacity and is offering free access for Indian OEMs to various markets through FTAs. These factors and development of products in line with global trends by players are expected to boost the exports going forward.



Domestic sales and exports of domestic PVs (fiscals 2019-2024)

Source: SIAM, CRISIL MI&A

CAGR for domestic sales and exports of domestic PVs - fiscals 2019 to 2024

	Domestic Sales	Exports
FY19-24 CAGR	4.5%	8.3%

Source: SIAM, CRISIL MI&A

Manufacturers from India has grown a stable base in African and Latin American countries over the years. Good brand recognition of Indian brands for entry level cars. Share of exports to South Africa increased to 27% in fiscal 2023 from ~22% in fiscal 2022. South Africa has become the major export market surpassing Mexico (whose share declined from ~29% in fiscal 2018 to 13% in fiscal 2023), due to higher demand for UV (Utility vehicles) segment. Newer markets such as Saudi Arabia and USA have also seen increase in exports.

Anticipated improvement in economic growth, push from OEM's with India as the base for exports of certain models is projected to boost exports resulting in 6-8% growth in fiscal 2025. Indian OEM continued to exports higher number of small cars with 5 out 10 top exported models being small cars. Affordable prices along with higher fuel efficiency has led to increased in demand for small cars especially from emerging markets in Latin America and Africa.

Review of key export destinations

PV manufacturers from India have grown a stable base in African and Latin American countries over the years owing to good recognition of Indian brands for entry level cars. The share of exports to Africa increased to 64% in fiscal 2023 from ~36% in fiscal 2019. South Africa, Tunisia and Angola are the key export destinations within Africa. The share of exports to Latin America also increased in the same period from 17% to 20% due to the increased focus on economies such as Mexico, Chile and Peru. Other top export destinations include Saudi Arabia in the Middle East and the Philippines and Indonesia in Asia. Exports to North America have decreased gradually in the past five years primarily due to American automakers such as GM and Ford exiting India.

Trade tensions between China and other developed economies including the US and Europe, coupled with initiatives taken by these countries to diversify their supply chain, could enable domestic car makers to increase their exports by leveraging various government initiatives such as FTAs, PLI and PMP.



Key export destinations by region (fiscals 2019-2024 YTD)

Note: YTD refers to April-December 2023 sales volume Source: DGFT, CRISIL MI&A Consulting

Key export destinations by country (fiscal 2024 YTD)



Note: YTD refers to April-December 2023 Source: DGFT, CRISIL MI&A Consulting

The share of exports to South Africa increased to 43.4% in fiscal 2023 from 20.1% in fiscal 2019. South Africa has become the major export market, followed by Mexico, whose share increased from 2.1% in fiscal 2022 to ~11% in fiscal 2024 YTD. New markets such as Saudi Arabia and Indonesia have also seen an increase in exports from India.

The economic slowdown in major PV export destinations is playing a crucial role in hindering India's export potential. High interest rates, coupled with monetary and energy crises in certain regions, are dampening consumer spending and leading to a decrease in goods imports, including vehicles made in India. Consequently, growth potential of India's passenger vehicle exports to these markets is likely to be limited. However, developing



economies are increasingly becoming high focus destinations for PV exports due to rising income, infrastructure availability and changing consumer preferences.

Resilient small car segment and strong UV (Utility vehicles) traction canabilised large cars exports from India

The increasing demand for UVs globally coupled with OEM's moving away from small car manufacturing in India has led to the share of UV's rising from 22% to 33% between FY18 and FY24 with small cars declining from 60% to 41%. Share of UVs in exports market further expanded by 200 bps canabilising large car share due to shift in demand for UVs which has experienced a shift in consumer preferences. Export of less chip-intensive small car models has continued to emerging markets. The demand for fuel-efficient small cars, along with a supply push of lesser chip-intensive hatchbacks to export markets by OEMs, has led to a sustained market share in small car. Reduced exports of foreign OEMs such as Volkswagen, Hyundai, and Nissan in large car segment models, such as *Virtus, Verna,* and *Sunny*, which has led to a decline in share of large cars by 200 basis points.



PV segment wise exports share (fiscals 2019-2024)

Source: SIAM, CRISIL MI&A Consulting

PV production by transmission type

Transmission components, which transfer power from engine to the wheels, are key components of vehicles. There are various types of transmissions available depending on the level of automation in the transmitting power from engine to the wheels.

In manual transmission (MT) vehicles, there is a clutch and gear shifter which are used to manually change gears. In such vehicles, fuel efficiency is dependent on the skill of the driver to shift gears at appropriate engine revolutions per minute. Driving vehicles with manual transmissions is tiresome in heavy traffic conditions. To reduce strain on drivers, transmission system technologies such as semi- automatic and fully automatic transmission have come up over the years.



These technologies differ in terms of their level of automation and reduction in driving strain. In semi-automatic transmission, transmission technologies such as automated manual transmission (AMT) and intelligent manual transmission (iMT) are available. In AMT, in place of the manually operated gear lever and clutch pedal, a hydraulic actuator system mounted inside the engine operates both. The actuators of the AMT system are linked to the ECU of the car. iMT is a clutch-less transmission system, here the driver must manually shift the gears, while the clutch is operated automatically by sensors and software.

Fully automatic transmission doesn't require a manual shifting by the driver. Examples of fully automatic transmission includes automatic transmission (AT), dual clutch transmission (DCT) and continuously variable transmission (CVT). DCT uses two clutches — one operates the even gears (2, 4 and 6) and the other the odd gears (1, 3, 5 and reverse). A DCT uses clutch packs rather than the torque converter used by traditional (hydraulic) automatic transmissions. CVT is an automatic transmission that can change seamlessly through a continuous range of gear ratios. It is a single speed with infinite gear ratios. Unlike conventional transmission system, it uses pulley and a drive train. Transmission technologies such as AMT, iMT, CVT, DCT and AT differ in their fuel efficiency, response time for gear shift which influences driving experience, cost of acquisition, maintenance cost etc.





Source: Industry, CRISIL MI&A

PV production is completely dominated by relatively cheaper manual transmission vehicles. However, over the years, automatic transmission has been gaining popularity.

Share of automatic transmission vehicles in domestic PV sales has increased from 8-10% in fiscal 2018 to approximately 30-32% in fiscal 2024. However, domestic PV sector is still dominated by manual transmission system, which accounted for more than 65% of sales in fiscal 2024. Penetration of manual transmission vehicles is still higher owing to dominance of high price consciousness over the need for comfort. However, with worsening traffic conditions, rising affordability, need for comfort and availability of semi-automatic transmission at affordable price points, AMT and iMT started gaining share over the last five years. AMT and iMT together accounted for 14-16% share in sales in fiscal 2024.

Transmission mix



Note: MT – Manual Transmission, AMT – Automatic Manual Transmission, iMT – Intelligent Manual Transmission, AT – Automatic Transmission, DCT – Dual Clutch Transmission, E – Estimated

Source: Industry, CRISIL MI&A

AMT and iMT technologies dominate the affordable vehicles segment (less than Rs 8 lakh). In premium cars, technologies such as AT, CVT and DCT are preferred as they offer smoother driving experience. CRISIL's market checks indicate that AT offers best driving experience but is the costliest among competing technologies. Its penetration is prevalent primarily in premium and luxury passenger vehicles. AT, CVT and DCT approximately accounted for 5-7%, 3-5% and 1-2% of domestic vehicle production in fiscal 2024.

Changing powertrain mix in the Indian PV industry

Conventional fuel powertrains (petrol and diesel) have dominated the Indian PV industry for decades. Petrol vehicles were the preferred choice despite diesel being cheaper than petrol primarily because of their low acquisition cost compared with diesel vehicles. However, the preference for diesel vehicles surged over fiscals 2012 to 2014 due to rising petrol prices and an increase in the price gap with diesel. Further, diesel vehicles offered better mileage and the difference between the acquisition cost of diesel and petrol vehicles was only marginal.

However, the Supreme Court ordered a ban on diesel vehicles in the national capital region (NCR) region to reduce air pollution and improve air quality. Moreover, a higher price rise in diesel vehicles following the implementation of emission norms (BSIV & BSVI) shifted the consumer preference towards petrol vehicles after fiscal 2015. Subsequently, the share of diesel PV retails in the industry dropped from 48% in fiscal 2015 to 37% in fiscal 2019.

Moreover, a shift in OEM focus from diesel to petrol vehicles including discontinuation of diesel models by a few OEMs such as Maruti with the onset of stricter BSVI norms, exacerbated the situation for diesel vehicles. In fiscal 2024, the share of diesel powertrain in the industry retail slid to only 18%. On the other hand, the share of petrol variants expanded from 56% in fiscal 2019 to 65% by fiscal 2024.



Powetrain mix trend of PV industry retails

Note: Strong hybrid: Vehicles having a combustion engine as well as an electric motor. The vehicle can be powered by the engine or the battery, or by both simultaneously. The battery of the vehicle is charged by the combustion engine and not by an external power source. Telangana & Lakshadweep retail data is not available on VAHAN.

Source: VAHAN, CRISIL MI&A Consulting

Maruti Suzuki, which accounted for ~35% of retail sales in fiscal 2019, discontinued its diesel portfolio entirely. Thus, players such as Mahindra and Tata Motors expanded their presence in diesel retails in the next five years. Additionally, recent entrant Kia pushed diesel retails further with its SUV models and accounted for 11% of overall diesel retails in fiscal 2024. Hyundai, with its SUV offerings in diesel powertrains, maintained its 14% share in diesel retails.

A shift in preference towards petrol variants as well as an increased portfolio aided the expansion of petrol vehicle sales in industry retails. Amid the increased shift towards petrol variants, traditional diesel vehicle players such as Mahindra, Tata Motors gained some ground in petrol vehicle retails in the past five years. Mahindra increased its share from 1% in fiscal 2019 to 3% by fiscal 2024, while Tata Motors grabbed a 12% share of petrol vehicle retails by fiscal 2024. Kia accounted for ~6% of petrol vehicle retails in fiscal 2024. Traditional petrol vehicle manufacturers Maruti and Hyundai lost some ground to the above mentioned non-traditional players off their high base of fiscal 2019.





Conventional fuel vehicle retails by OEM





Petrol vehicle retails by OEM



CNG vehicle retails by OEM



EV retails by OEM



13.4%

10.7%

51.2%

14.2%

FY24

Tata Motors

Others

Diesel vehicle retails by OEM



Source: VAHAN, CRISIL MI&A Consulting

The share of CNG vehicles more than doubled in the past five years to 15% of overall industry retails in fiscal 2024. CNG vehicles were primarily preferred in the commercial (taxi) segment, limiting their contribution to 6-8%. Further, the share of CNG powertrains rose from 8.5% in fiscal 2022 to 15% in fiscal 2024 owing to introduction of CNG powertrain options in premium hatchbacks and SUVs (Exter, Punch, Brezza, Fronx, Altroz, Baleno, etc.) due to rising acceptance of CNG among personal vehicle buyers. Additionally, the fall in CNG fuel prices post the Kirit Parikh panel recommendation boosted CNG sales in fiscal 2024.

The emerging EV segment also expanded its presence, especially in the past three years backed by the launch of several EV models, expanding charging infrastructure as well as rising climate consciousness. The share of electric vehicles in the overall retails increased from 0.1% in fiscal 2019 to 2.3% in fiscal 2024 (the EV segment is covered in detail below).

The recent launch of strong hybrid variants for a few models such as Maruti Suzuki Grand Vitara, Toyota Innova Hycross and Honda City introduced an additional powertrain option for Indian consumers. Hybrid powertrains witnessed healthy traction as consumers sought increased mileage at relatively low acquisition costs. Lower operating costs, environmental benefits and relief from uncertainties faced by EV customers such as range anxiety or charging station accessibility have boosted hybrid vehicle retails in the past two years.

Cost of Ownership Comparison - EV vs ICE

As of fiscal 2024, the total cost of ownership (TCO) of an EV for a personal vehicle was 11% higher than that of a petrol vehicle and 6% higher than that of a diesel vehicle for 10,000 km. This is expected to be 3% lower versus petrol and 8% lower versus diesel in fiscal 2029 for the same distance, highlighting the financial viability of electric PVs for personal use application. Additionally, the TCO per km of an e-PV become even more economical without the subsidies by fiscal 2029 owing the lowering battery cost and improving technology.

Annual running	6,000 km	10,000 km	15,000 km	18,000 km	20,000 km
EV vs petrol	19% higher cost than petrol	11% higher cost than petrol	4% higher cost than petrol	0.3% higher cost than petrol	2% lower cost than petrol
EV vs diesel	10% higher cost than diesel	6% higher cost than diesel	2% higher cost than diesel	0.2% higher cost than diesel	1% lower cost than diesel

TCO for	private	vehicles	in fiscal	2024 fo	r four-yea	r ownership	o and ar	nnual runni	ng of	12,000	km

Annual running	6,000 km	10,000 km	15,000 km	18,000 km	20,000 km
EV vs petrol	4% higher cost than petrol	3% lower cost than petrol	10% lower cost than petrol	13% lower cost than petrol	15% lower cost than petrol
EV vs diesel	4% lower cost than diesel	8% lower cost than diesel	12% lower cost than diesel	14% lower cost than diesel	15% lower cost than diesel

TCO for private vehicles in fiscal 2029 for four-year ownership and annual running of 12,000 km

Note: Nexon EV and Nexon Petrol/Diesel variants have been considered for comparison Source: CRISIL MI&A

The FAME-2 subsidy is only offered for commercial use and no benefits are provided for personal-car owners. The decreasing battery cost due to the localisation under PMP and PLI is expected to lower the cost of an EV and will help maintain the competitiveness of EVs against diesel and petrol variants in the long run.

Competitive OEM landscape

The domestic PV market is oligopolistic with a few players dominating the entire industry. Maruti Suzuki leads the PV industry in terms of domestic sales volumes. Hyundai is the second-largest contributor to domestic sales, closely followed by Tata Motors and Mahindra. These four players together account for ~80% of the market.

However, competition has intensified in the past five years with all players launching competitively priced featurerich vehicles and recent entrants such as Kia and MG grabbing a sizeable share.

The share of Maruti Suzuki contracted from a high base of 52% in fiscal 2019 to 43% in fiscal 2024 due to a shift in customer preference from hatchbacks towards SUVs and Maruti Suzuki's focus on the cars segment. However, success of recent launches such as Grand Vitara, Fronx, Invicto and continued traction for Ertiga and Brezza helped Maruti Suzuki regain some lost ground in fiscal 2024.

Hyundai is the second-largest contributor to Indian domestic PV sales and has maintained its position in the market due to continued traction of popular SUV models such as Creta and Venue, coupled with intermittent new vehicle launches and upgrades of its popular models. Introduction of Venue, Aura and Kona helped the company expand its market presence in fiscal 2020. In the next four years, Hyundai maintained a 15-18% share within the domestic market amid continued demand aided by intermittent upgrades to its popular models such as i10, i20, Creta, Verna and Venue.



Domestic market share of PVs by OEM

Note: Others include MG, Renault/Nissan, Skoda, PCA. etc, figures above the bars are sales volumes. Source: Society of Indian Automobile Manufacturers (SIAM), CRISIL MI&A Consulting

Tata Motors gained ground in the past five years riding on the success of SUV models Nexon and Punch. The increased traction for EVs (where the company dominates) has also boosted Tata Motors sales. In turn, Tata Motors' share of total market expanded from 6% to 11% during the fiscal 2019-2024 period.

Portfolio expansion in the form of XUV3OO, XUV7OO, Scorpio N has enabled Mahindra to expand its share from 7% in fiscal 2019 to 11% by 2024.

Recent entrant Kia tasted early success in the Indian market in the form of Seltos and Sonet, which helped it grab a sizeable 6% share of the market by fiscal 2024.

Toyota has maintained a 4-6% market share with continued demand for its flagship Innova, while Glanza, Urban Cruiser and Hyryder provided additional support to its sales.

Honda has been facing intense competition in the domestic market and its share contracted from 6% in fiscal 2019 to 2% in fiscal 2024 (April-February period).

Key regulatory/macroeconomic trends and domestic sales growth drivers

GDP per capita

GDP per capita is calculated by dividing total GDP by the country's population. Per capita income shows the increase in income, thereby indicating economic well-being and average living standards of a country's population.

India's GDP per capita rose to \$2,612.5 in 2023 from \$1,438.1 in 2013, at a CAGR of 6.2%. It fell 6.7% in 2020 owing to the pandemic and nationwide lockdown which impacted manufacturing and service sectors. However, these sectors rebounded and GDP per capita increased 17% to \$2,238.1 in 2021 supported by the global dependence on India for production of goods and service sector growth. The increase in population, along with demand for employment, has significantly increased the country's GDP per capita.



GDP per capita over 2013-2023



Source: IMF, CRISIL MI&A Consulting

Vehicle penetration in India

The Indian PV market is one of the fastest growing in the world and ranked second in terms of annual sales (after China) in 2023. However, the market is highly underpenetrated. According to CRISIL MI&A Consulting, car penetration of 26 per 1,000 people in India as of fiscal 2024 was significantly lower than that of developed countries and even emerging economies such as Brazil, Russia, and Mexico, providing significant headroom for growth, especially given the expected increase in disposable income, faster economic growth, younger population, and increased focus of international OEMs. With penetration below the global average, India offers tremendous growth potential for automobile manufacturers.



Car penetration by country in 2021

Source: International Road Federation- World Road Statistics 2023, CRISIL MI&A

Note: Data for CY 2021, India Data for FY24;



Regulations/safety norms

Based on European emission standards, the Indian government has introduced and implemented Bharat Stage (BS) norms in a phased manner. These mandatory norms increase the capital expenditure of auto OEMs and in turn significantly impact the industry's profitability. Currently, India has adopted BS-VI norms.

Adherence to safety regulations (such as mandatory installation of anti-lock braking system (ABS)/combined braking system (CBS), airbags, manual lock in anti-locking systems, seat belt warning system, speed warning system, etc) in new models has increased the manufacturing cost per vehicle in the PV industry. However, most car models, other than low-end ones, were already equipped with these safety systems and the impact will be subdued for them.

Companies have invested in the relevant technology, research, and development, and signed joint ventures (JVs) with global players to adhere to BS-VI stage 2 norms applicable from fiscal 2024, leading to price hikes across vehicle segments owing to the addition of new technologies to meet new emission regulations.

Safety norms

The Ministry of Road Transport and Highways (MoRTH) launched the Bharat New Car Assessment Programme (BNCAP) on August 22nd, 2023 to enhance the road safety standards of passenger cars. BNCAP would promote healthy competition between home grown OEMs and international OEMs to manufacture safer cars, along with boosting the safety and quality of vehicles in India. The BNCAP rating system is a voluntary assessment programme that came into effect on October 1, 2023.

The BNCAP crash testing methodology is in line with the Global New Car Assessment Programme (GNCAP). The testing method offers star ratings to cars based on their crash testing performance. The BNCAP regime has formulated a new standard, AIS 197, and will offer star ratings on a scale of five for both adult occupant protection (AOP) and child occupant protection (COP) based on crash test assessment of a car. Moreover, metrics and technologies such as Electronic Stability Control (ESC), seat belt reminder, pedestrian protection and pole side impact are assessed for each rating.

The crash testing protocols are:

- Frontal impact test
- Side impact test
- Pole side impact test

Other safety systems include mandatory inclusion of ABS from April 2019, air bags for the driver from April 2020, dual front airbags from January 2022, ESC from June 2022 ABS and seat belt reminders for both driver and front passenger from June 2023. Further, the government proposed six mandatory airbags for all cars from October 2023; however, the plan was dropped as the new BNCAP regime will ensure OEMs equip their cars with safety features to obtain a high star rating.

Some other safety measures are:

- Seat-belt reminders
- Alert systems for speeds beyond 80 kmph
- Reverse parking alerts
- Manual override over the central locking system in case of emergencies



GST tax structure

The government has been levying a high tax on diesel vehicles to discourage their use. Consumers have a preference for diesel vehicles due to their better mileage than petrol variants. The government has significantly reduced taxes from 12% to 5% for EVs compared with 28% for ICE vehicles. Also, the excise duty on petrol is a variable as the government adjusts it to control fuel prices, which again have a high correlation with PV industry sales. Further, the government may lower GST for hybrids to further minimise the usage of traditional ICE vehicles.

Government measures to boost CNG vehicles

The government increased the price of domestic natural gas to \$6.1 per metric million British thermal unit (mmBtu) in the first half of fiscal 2023 and further raised it by 40% to \$8.57 per mmBtu in second half of fiscal 2023 following elevated gas prices globally on account of geopolitical uncertainty.

On April 6, 2023, the Cabinet Committee on Economic Affairs chaired by Prime Minister Narendra Modi approved a revised pricing mechanism for natural gas produced in India based on the recommendations made by the Kirit Parikh Committee in December 2022. The committee evaluated ways to boost natural gas production and ensure availability and affordability of gas for end-users. The recommendations by the committee focused on price capping, deregulating the gas market, and bringing natural gas under the GST umbrella.

With the new pricing mechanism, the domestic gas price was capped at \$6.5 per mmBtu for fiscal 2024. Thus, CNG prices declined 4% to Rs 74/kg in fiscal 2024. This decline in prices affected the difference in the total cost of ownership of diesel and CNG vehicles, favouring CNG transition and hence the long-term prospects for CNG adoption remain promising.

Fluctuating fuel prices and potential government incentives for eco-friendly alternatives could potentially ignite demand for CNG-powered vehicles. Moreover, advancements in CNG technology and the expansion of refuelling infrastructure may enhance the appeal of CNG models, offering a greener and more sustainable solution for the transportation sector.

As of fiscal 2023, gas pipelines of 21.9 thousand km were operational under multiple city gas distribution (CGD) projects commissioned, and a total of 33.1 thousand km was under construction.

After completion of the 11A CGD bidding round in 2022, 295 geographical areas (GAs) covering about 98% of the population and 88% of the country's total geographical area spread over ~630 districts in 28 states/UTs were authorised to be covered under the CGD network. Uttar Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Karnataka and Haryana have been the largest beneficiaries in the allocation of GAs. In the 11th round, the government focused on uncovered regions/districts in Tamil Nadu, Maharashtra, Madhya Pradesh, West Bengal, and Chhattisgarh for setting up the CGD network. It targets to set up 17,700 CNG stations in urban and rural areas by 2030.

In fiscal 2023, an additional 1,232 new stations were added, taking the total number of CNG stations to 5,665. Between fiscals 2019 and 2023, the number of CNG stations grew at a CAGR of 34.5%.



Number of CNG stations over fiscals 2019 to 2024 YTD

Note: YTD refers to the April 2023 to February 2024 period

Source: Petroleum Planning & Analysis Cell (PPAC), CRISIL MI&A Consulting

According to PPAC, the number of retail fuel outlets in India increased from ~86,855 as of fiscal 2023 to 89,396 as of fiscal 2024 YTD. The availability of refuelling infrastructure for traditional fuels has also increased, but at a lower rate compared with that for CNG and EVs.

Premiumisation trend

The average selling price (ASP) increased at a CAGR of 7-8% between fiscals 2019 and 2023 due to the premiumisation trend as well as a sharp rise in vehicle prices. Consumers in India are opting for mid-end or top-end versions of vehicles and moving away from traditional fuel-efficient budget-friendly small cars to higher priced feature-loaded large cars, which offer more space, better ride height, seamless connectivity, and an improved performance. Further, there has been a major shift in customer preference with the launch of compact and mid-size SUVs. The share of small cars (hatchbacks) reduced from 46.9% in fiscal 2019 to 34.4% in fiscal 2023 majorly driven by a shift in consumer sentiment towards newly launched feature-rich vehicles in the SUV segment. Meanwhile, the share of SUVs increased from 23.1% in fiscal 2019 to over 50% in fiscal 2023. Increased spending of the upper middle class after the pandemic, a higher number of model launches in the category (which has higher profit margins), and an increase in affordability with launch of compact SUVs led to cannibalisation of the share of hatchbacks.

Increased penetration of digital technologies and safety features in vehicles also support ASP growth, with growing adoption of sunroof, digital infotainment systems and smart phone connectivity solutions. Buyers also prefer cars equipped with necessary safety features such as airbags and disc brakes. These systems, coupled with inclusion of modern LED lights, camera, and radar systems, are increasing the overall cost of vehicles. For example, Hyundai introduced sunroofs in i10 and i20 hatchbacks in 2008-09 and most of its models have a sunroof option. The company has played a crucial role in popularising many modern features in India.

ASP trend of vehicles



Source: CRISIL MI&A Consulting

New model launches

Apart from increasing sales of existing models, sales of new models have supported the overall industry's growth over the past decade. Industry growth is driven by recent launches in the SUV segment. As many as 10 new models launched in various segments accounted for 3.1% of overall PV sales in fiscal 2023. A few notable launches include Maruti Suzuki Grand Vitara, Toyota Urban Cruiser Hyryder, Volkswagen Virtus, Innova Hycross and Hyundai Ioniq 5. In fiscal 2024, nine models were launched, accounting for over 6.6% of PV sales. Key model launches include Maruti Suzuki Fronx, Hyundai Exter, Honda Elevate and MG Comet EV. The new vehicle pipeline is expected to provide additional thrust to domestic sales.

EV penetration in PVs

Amid rising environmental concerns, EVs are gaining traction globally, including in India. The country is one of the signatories to the Paris Agreement under the United Nations Framework Convention on Climate Change. It is also part of the EV30@30 campaign, targeting a 30% sales share for EVs by 2030.

To accelerate EV adoption, the government has been incentivising consumers by extending support via Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME) subsidy as well as tax cuts. The government announced Rs 100 billion for Phase II of FAME, which commenced on April 1, 2019. The policy aims to provide a subsidy of Rs 10,000 per kWh to four-wheelers (battery EVs, plug-in hybrid EVs, strong hybrids) for commercial purposes and public transport. It also envisions creation of charging infrastructure for EVs.

These schemes, alongside the PLI scheme, scrappage policy as well as the Make in India initiative, are setting up the roadmap for widespread EV manufacturing and adoption (these policies have been covered in detail in earlier sections).

Furthermore, the government is taking measures to address one of the major concerns regarding EVs: range anxiety (fear of running out of charge in the middle of the journey) due to low availability of public charging infrastructure, with the Ministry of Road Transport and Highways setting up new EV charging stations as well as supporting the expansion of charging stations in homes and commercial centres.



Government support, coupled with rising awareness about EVs and environmental concerns and expansion of EV infrastructure as well as an increasing EV model portfolio, is driving electrification in India. The EV segment received a real thrust over the past two years backed by model launches at competitive rates, price hikes in ICE vehicles and elevated petrol and diesel costs. While EVs bring several cost benefits and have evolved into a desirable powertrain choice today, the public perception towards them and rising awareness about pollution from ICE vehicles also played a major role in increased EV adoption across the country.

EV adoption in India is led by two wheelers and three wheelers; however, PVs are catching up fast. EV penetration in the PV segment was insignificant till fiscal 2021 amid a limited vehicle portfolio, coupled with lower customer awareness. Fast expansion of the portfolio (from three models in fiscal 2019 to ~14 models in fiscal 2024), rising environmental awareness, government support and expanding EV infrastructure have led to a sharp rise in EV adoption. EV retails increased from ~2,000 vehicles in fiscal 2019 to 89,000 vehicles in fiscal 2024: a 45x increase in five years. In turn, the penetration of EVs within the industry retails rose from 0.1% in fiscal 2019 to 2.3% by fiscal 2024.



Domestic EV retail and penetration trend in PVs

Note: VAHAN figures exclude Telangana, Lakshadweep retails Source: VAHAN, CRISIL MI&A Consulting

With only a handful of vehicle options such as Reva, E Verito, and Bolt, EV adoption in PVs was inconsequential in fiscal 2019. Nexon, one of the most popular EVs in India was launched in the second half of fiscal 2020, providing a thrust to EV adoption in PVs. The launch of Kona Electric in the first half and ZS EV in the second half further boosted EV adoption in fiscal 2020. Continued traction for these models helped EV retails clock sizeable growth in fiscal 2021. However, the pandemic hurt the growth pace of EVs, given their higher acquisition costs, production constraints as well as financial pressure on consumers.

EV adoption got a real impetus in fiscal 2022 led by gradual normalisation of the economy, an improvement in the macroeconomic scenario, an increase in mobility, expansion of the EV portfolio and continued government support. Moreover, an increase in ICE vehicle prices, a sharp hike in petrol and diesel prices, increasing customer awareness and younger buyers also fuelled EV adoption.

The entry of new players such as BYD as well as introduction of EV models such as Tiago, Tigor, Punch, XUV4OO, Comet, eC3, Ioniq, Atto 3 in a short span provided a thrust to EV adoption. In fact, the introduction of Tiago and



Comet in the hatchback segment and Tigor in the sub four-metre sedan segment expanded the customer reach of EVs. Traction of Tigor for commercial fleet usage further aided EV growth.

Over fiscals 2021 to 2024, EV retails increased at ~160% CAGR (17x), translating into 2.3% EV penetration in fiscal 2024.

However, electrification in the PV segment is still at a nascent stage and there is significant scope for expansion.

Battery Pack price glide path and drivers

The prices of lithium-ion batteries have been declining steadily in recent years. This is due to several factors, including increased demand, technological advancements, and economies of scale. Compared to 2022, The US National Renewable Energy Laboratory ("NREL") expects the costs of the batteries to fall by 47%, 32% and 16% by 2030 in its low, mid, and high-cost projections, respectively. By 2050, the costs could fall by 67%, 51% and 21% in the three projections, respectively.



Price of selected battery raw materials and lithium-ion batteries, 2015-2023

Notes: Data until March 2023. Lithium-ion battery prices (including the pack and cell) represent the global volume-weighted average across all sectors. Nickel prices are based on the London Metal Exchange, used here as a proxy for global pricing, although most nickel trade takes place through direct contracts between producers and consumers. The 2023 battery price value is based on cost estimates for NMC 622. Source: IEA analysis based on material price data by S&P, 2022 Lithium-Ion Battery Price Survey by BNEF and Battery Costs Drop as Lithium Prices in China Fall by BNEF. IEA. CC BY 4.0

According to BNEF, the price of lithium-ion battery packs has dropped 14% to a record low of USD139/kWh in 2023 after an unprecedented price increase in 2022. This was due to the fall in prices of raw material and components as production capacity improved across the battery value chain. Battery prices vary across different regions, with China having the lowest prices on average, and the rest of the Asia Pacific region having the highest. This price difference is because more than 60% of battery cells and almost 80% of cathodes are manufactured in China. Battery packs in the US and Europe were 11% and 20% higher, respectively. Higher prices are due to the higher production cost, undeveloped market, lower volumes, and the diverse range of applications. Over the last few years, the cell-to-pack cost ratio has risen from the traditional 70:30 split, and the cell cost now contributes to more than 75% of the pack cost. This is due to improved changes in pack design, along with introduction of cell-to-pack approaches, which have helped reduce costs.





Volume weighted average lithium-ion battery pack and cell price (2013-2023)

Notes: Historical prices have been updated to reflect real 2023 dollars. Weighted average value includes 303 data points from passenger cars, buses, commercial vehicles, and stationary storage.

Source: Bloomberg NEF

BNEF expects average battery pack prices to drop again in 2024, reaching USD133/kWh due to decreasing raw material costs for metals like lithium, nickel, and cobalt. In the medium to long term, advancing technological innovations along with manufacturing improvement should further drive decline in battery pack prices, to USD113/kWh in 2025 and USD80/kWh in 2030. Manufacturing process improvements, continued R&D investment, and capacity expansion across the battery value chain would help improve battery technology and reduce costs over the next decade. With lowering cost of battery, vehicle prices are expected to decrease thereby reducing the acquisition cost and operational costs of an EV. This would create a positive sentiment among EV buyers and drive the EV adoption further.

Outlook of the domestic PV industry (fiscals 2024 to 2029)

The domestic PV industry grew at a 5% CAGR over fiscals 2019 to 2024 on a record high base of fiscal 2019 despite the pandemic hiatus led by significant traction for the SUV segment, increased vehicle launches, coupled with the entry of new players. A relatively lower impact on disposable income of the upper middle class led to healthy growth in the SUV segment, driving overall PV sales. In turn, the industry reached historic high sales of \sim 4.2 million vehicles in fiscal 2024.

Despite healthy growth, car penetration, at 26 per 1,000 people in fiscal 2024, in India was still much lower than that of global peers such as China (183), Mexico (280), Brazil (276) as well as developed countries such as the United States (594), the UK (489), Japan (495) and Korea (389). Thus, there is a lot of headroom for growth in the domestic market.

CRISIL MI&A Consulting expects the macroeconomic scenario to support to industry growth with GDP projected to grow at a healthy pace between fiscals 2024 and 2029. India's GDP growth is expected to outperform other major geographies over the next five years at 6-8%. Inflation levels are also expected to remain subdued in the 3-5% range, which is within the RBI's target band. CRISIL MI&A Consulting has assumed three years of normal monsoons within the five-year outlook period and has considered positive momentum in rural demand. Fuel prices



are also expected to remain almost steady in the next five years. These favourable macroeconomic factors are expected to support consumer disposable income.

Besides macroeconomic factors, continued government support in terms of policies as well as continued expenditure and investments are expected to boost the industry. The favourable demographics are an added advantage for India and expected to help propel the PV industry.

Additionally, OEMs are expected to continue to launch feature-rich competitively priced vehicles, aiding overall demand growth.

The financing scenario is projected to remain favourable for the industry and lend further support amid expanding financing reach and high loan to value (LTV) levels. Moreover, after multiple rate hikes in the past two years, a rate cut of 25-50 bps is expected to keep interest rates competitive in the near term. Given projections of subdued inflation levels in the long term, any further rate hike seems unlikely.

Changing market dynamics, including a younger consumer base, premiumisation, electrification, shorter replacement cycles (four to five years currently vis-a-vis seven to eight years a decade ago) will provide further impetus to demand. Additionally, the government's push for scrapping old vehicles (as per the government regulation vehicles above the age of 15 years will be compulsorily scrapped) is expected to shorten replacement cycles and support demand.

Further, capacity expansion by players such as Maruti Suzuki, Hyundai, Tata Motors is expected to support growing vehicle demand. Moreover, expansion of supporting infrastructure such as EV charging stations and CNG pumps will also enhance the choice of customers in terms of powertrains.

CRISIL MI&A Consulting expects domestic sales to grow at a 4.5-6.5% CAGR between fiscals 2024 and 2029 to 5.2-5.7 million vehicles.



Domestic PV industry outlook (volumes)

Source: SIAM, CRISIL MI&A Consulting



Segmental outlook

Domestic industry growth is expected to be led by SUV and MPV segments, while hatchback, sedan and van segments are expected to clock muted growth.

Rise of SUVs

The SUV segment, which traditionally appealed to customers valuing larger seating capacity and its ability to drive on rough terrain, has increasingly gained customer preference over the years. The compact SUV segment, especially, provided the much-desired SUV body styling at competitive rates bringing SUV segment within the reach of the common consumers.

Recognising the changing consumer preferences, OEMs also launched higher number of vehicles in the SUV segment compared to other segments providing a further fillip to the SUV share expansion.

Thus, the changing customer preference coupled with new vehicle launches provided the real thrust to the growth of the SUV segment. Moreover, entry of global players like Kia and MG, with their SUV portfolios lent further support to the segment's growth.

All of this has led to the share of SUVs in overall domestic PV sales to more than double from 23% in fiscal 2019 to 50% in fiscal 2024 from. During the last 5 years, while industry witnessed a growth at 5% CAGR, the SUV segment grew at more than 4x the growth rate of 23% CAGR.



Sub segmental shift within SUV segment

Note: YTD: Apr 2023 – Feb 2024 period, Figures above bars are the sales volumes. Source: SIAM, CRISIL MI&A

Within the SUV segment, compact SUVs (length <4m) grew in line (at 23% CAGR) with the overall SUV segment keeping its share steady within the SUV segment.

Launch of Ford EcoSport provided a real thrust to the compact SUV subsegment in India around fiscal 2014. Over the years, introduction of vehicles like Maruti Suzuki Brezza (fiscal 2016) and Tata Nexon (fiscal 2018) aided the growth of entire SUV segment as well as helped compact SUVs gain sizeable share within the SUV segment, reaching 58% by fiscal 2019 from 48% in fiscal 2014. Moreover, launch of Hyundai Venue (fiscal 2020), Kia Sonet



(fiscal 2021), Tata Punch (fiscal 2022), Maruti Suzuki Fronx (fiscal 2024) over and above the launch of facelifts of other popular models backed the healthy growth of the compact SUV subsegment.

Mid-size SUVs (length 4 - 4.4 m) outpaced (24% CAGR) the entire SUV segment expanding its share within the SUV segment in the last 5 years. Continued traction for the high selling models like Hyundai Creta & Kia Seltos as well as successful recent additions including Maruti Suzuki Grand Vitara, Toyota Urban cruiser Hyryder and Honda Elevate provided the thrust to the growth of mid-size SUVs. The intermittent upgrades of the vehicles provided an added fillip to the sub segment's growth.

Demand for entire large SUVs (length > 4.4 m) subsegment got impacted during the pandemic amidst the financial pressures and reduced production levels due to semiconductor unavailability. The segment rebounded during the next 2 years with normalised production, improvement in customers' disposable incomes coupled with introduction of new vehicles like Mahindra Scorpio N, Mahindra XUV7OO & Hyundai Alcazar. The subsegment witnessed healthy (21% CAGR) growth during fiscal 2019-fiscal 2024 period, albeit at a relatively slower rate than the other SUV subsegments impacting its share within the SUV segment.

Full size SUVs (length > 4.7m), form a smaller 12-15% share of the entire large SUV subsegment. These full-size SUVs grew at a much slower pace of 6% CAGR restricting the growth of entire large SUV subsegment.

Sales of MPVs consisting of vehicles like Toyota Innova, Maruti Suzuki Ertiga, primarily catering to the tourist and office transport segment, got impacted during the pandemic with reduced mobility. Amidst the gradual reopening of the offices as well as rise in tourism, segment sales rebounded in the next 3 years. During the entire five-year period, the sales of MPVs increased at a healthy pace of 14% CAGR. Addition of new vehicles like Toyota Innova Hycross, Maruti Suzuki Invicto as well as intermittent upgrades of popular models provided additional fillip to the segment's growth.

Vans typically contributed 3-5% to the overall PV sales. The discontinuation of Maruti Suzuki Omni from fiscal 2020 for the implementation of BS-VI impacted the share of the segment. Van volumes witnessed contraction at 5% CAGR during the last 5 years. However, the sole model within the vans segment, Maruti Suzuki Eeco, after the discontinuation of Omni, continues to garner traction for its commercial purposes.

Segmental growth outlook

Segment	FY19-FY24 CAGR	FY24-FY29P CAGR	
Hatchbacks	(6) %	0 - 2.0%	
Compact hatchbacks	(8) %	(1) -0.5%	
Premium hatchbacks	0%	1.5 - 4.0%	
Sedans	(9) %	0.5 - 2.0%	
SUVs	23%	7.0 - 9.0%	
Compact SUVs	23%	6.8 - 8.8%	
Mid-size SUVs	24%	7.8 – 10.0%	
Large SUVs	21%	7.2 – 9.2%	
MPVs	14%	6.4 - 9.4%	
Vans	(5) %	1.1- 2.0%	
Total	5%	4.5 - 6.5%	

Source: SIAM, CRISIL MI&A Consulting

Outlook by industry segment



Source: SIAM, CRISIL MI&A Consulting

PV export outlook for India

India's PV exports are expected grow 3.1% in fiscal 2024 and at a CAGR of 7-9% between fiscals 2024 and 2029. Potential economic growth in key export regions, along with the push from OEMs will make India the hub for certain models, should boost exports. While the outlook for the Middle East and Asia remains positive, ongoing geopolitical tensions would remain a key monitorable. Any escalation of the conflict could lead to elevated oil and gas prices, alongside affecting shipping through the Strait of Hormuz. Volatile crude oil prices could affect fuel prices in export destinations and increase inflationary pressures and impact the demand for Indian exports.

A few years ago, India was a major export hub for cars such as hatchbacks and compact sedans. However, the country has successfully transformed into a large car (Premium sedans and SUVs) exporter over the past five to six years. OEMs are actively broadening their portfolios to cater to changing consumer preferences in both domestic as well as global markets. Models such as Hyundai Creta, Maruti Suzuki Grand Vitara, Hyundai Venue, Toyota Urban Cruiser HyRyder, Maruti Suzuki Jimny, Maruti Suzuki Fronx, and Volkswagen Taigun have gained strong traction in export markets. Further, premium sedans such as Hyundai Verna and Volkswagen Virtus are key models driving the large car market.

Major OEMs are expanding their production capacity to make India an export hub for Africa, the Middle East, and Asia led favourable policies including PLI to boost domestic manufacturing and export of EVs. PLI covers the entire EV ecosystem including automobiles, auto components and ACC batteries and major OEMs have already announced plans to export EVs from India starting 2025-2026.





Outlook for exports (fiscals 2023-2028P)



India's trade agreements globally would enable domestic auto companies to enhance the export of automobiles and related components. Recently, India established FTAs with several countries including the UAE and Australia. India is also negotiating with the UK and the EU to establish FTAs. These agreements will enable Indian OEMs to tap into a broader customer base and establish them as key players in the global automotive industry. SUVs are gaining strong traction in the global markets and remain the fastest growing segment with the trend expected to continue this decade and their share of exports crossing 40%. Rising disposable income led by falling inflation in key export destinations such as South Africa, Mexico are expected to further aid growth of SUV and overall exports.

Overall PV industry growth: Outlook of domestic sales and exports

Domestic sales, which accounted for 85.4% of overall industry sales in fiscal 2023, is expected to grow at a 4.5-6.5% CAGR between fiscals 2024 and 2029P. Over the period, exports are forecast to grow at a 7-9% CAGR to 15.6% by fiscal 2029.



Overall PV industry outlook by domestic sales and exports (fiscals 2023-2029E)

Source: CRISIL MI&A Consulting

Key drivers and policies to boost domestic and export sales growth

Favourable policies support EV adoption and supply chain

The government has introduced a set of fiscal and non-fiscal incentives to support the adoption of electric mobility. In 2012, the National Electric Mobility Mission 2020 (NEMMP 2020) was launched with a target of having 6-7 million EVs on the road by 2020. This was further supported with the announcement of the FAME scheme in 2015. The scheme provides subsidies for the purchase of EVs and installation of charging infrastructure. FAME II was introduced in 2019 to further support the EV ecosystem which provides Rs 10000 per kWh of battery capacity subject to a maximum of 40% of the vehicle cost. Also, the government introduced PLI and PMP schemes to boost the EV supply chain by providing incentives to OEMs, battery manufacturers and tier suppliers. The PLI scheme for ACC (Rs 181 billion), along with the scheme for the automotive sector (Rs 260 billion) and FAME II (Rs 100 billion), will enable India to transition to an environmentally cleaner and sustainable EV-based system from the traditional fossil fuel-based automobile transportation system.

FAME policy (I & II)

As part of the National Electric Mobility Mission Plan (NEMMP) 2020, the Department of Heavy Industry (DHI) formulated the FAME I policy in 2015 with a budget outlay of Rs 8.95 billion. The FAME I policy was aimed at promoting the EV ecosystem through technology development, demand creation, pilot projects, and charging infrastructure, thereby ensuring sustainable growth. Under FAME 1, ~2.78 lakh EVs were supported via demand incentives. In addition, 465 buses were sanctioned to various cities/states under this scheme. Phase-II of the FAME policy was implemented with an outlay of Rs 100 billion in 2019 for a period of five years to enhance the demand for EVs by supporting 7,000 e-buses, 5 lakh e-three-wheelers, 55,000 e-four-wheelers (commercial purposes) and 10 lakh e-two-wheelers (including commercial and private vehicles). The Ministry of Heavy Industries (MHI) sanctioned 520 charging stations/infrastructure under the FAME I policy. Further, the ministry also sanctioned 2,877 EV charging stations in 68 cities across 25 states/UTs and 1,576 charging stations across nine expressways and 16 highways under FAME II.

Segment	Maximum vehicles supported	Approx size of battery (kWh)	Incentive offered (Rs/kWh)	Maximum ex-factory price to avail incentive (Rs)
Two-wheelers	1,000,000	2	10,000	1.5 lakhs
Three-wheelers	500,000	5	10,000	5.0 lakhs
Four-wheelers	35,000	15	10,000	15.0 lakhs
Bus	7,090	250	20,000	20 million

In June 2021, demand incentive for two-wheelers was increased to Rs 15,000 per kWh capped at 40% of the vehicle cost. In June 2023, this was again revised and reduced to Rs 10,000 per kWh of battery from Rs 15,000 per kWh earlier and the maximum subsidy cap was reduced from 40% to 15%.

PLI policy

PLI for automobiles and auto components

The government approved the PLI auto policy in 2021 with a budget outlay of Rs 259.38 billion for a period of five years from fiscals 2023 to 2027. The total incentive per entire group company is capped at Rs 64.85 billion. The policy offers incentives for manufacturing of advanced automotive technology (AAT) products. This policy would further promote localisation of AAT products and enable creation of an indigenous value chain. The policy consists



of two components, incentivising incremental sales of automobiles and auto components named Champion OEM Incentive Scheme and Component Champion Incentive Scheme, respectively.

- Champion OEM Incentive Scheme: The scheme is a sales value linked scheme, applicable to battery electric vehicles (BEVs) and hydrogen fuel cell vehicles (FCEV) of all segments two-wheelers, three-wheelers, PVs, CVs, tractors, automobiles meant for military use, and any other AAT vehicle as prescribed by MHI. It targets to address cost disabilities related to AAT vehicles faced by OEMs. depending on technical developments
- Component Champion Incentive Scheme: The scheme is also a sales value linked scheme, applicable on preapproved AAT components of all vehicles, CKD/SKD kits, vehicle aggregates of two-wheelers, three-wheelers, PVs, CVs, tractors and any other AAT components prescribed by MHI

A total of 115 companies filed applications under the PLI scheme for the automobile and auto component industry. As of September 2023, 18 applicants had been approved under the Champion OEM Incentive scheme. The approved list of applicants includes Tata Motors, Hyundai Motor India Ltd, Ashok Leyland, Eicher Motors Ltd, Kia India Pvt Ltd, Suzuki Motor Gujarat Pvt Ltd and Mahindra & Mahindra Ltd to name a few. Further, 67 companies have secured PLI approval under the Component Champion Incentive scheme. A few beneficiaries include Sona BLW Precision Forgings Ltd, Hero MotoCorp, Tata Autocomp, Toyota Kirloskar, Motherson Sumi, Lucas-TVS and Bosch.

The PLI scheme for automobiles and auto components was able to attract proposed investments of Rs 748.50 billion against a target of Rs 425 billion over a period of five years. Revised in December 2023, the scheme is now applicable for a continuous period of five financial years commencing from fiscal 2023-24. The disbursement of the incentive is scheduled for the subsequent financial year, April 1, 2024, to March 31, 2025.

PLI for automotive and ACC

In May 2021, the government approved a budget outlay of Rs 181 billion for setting up battery manufacturing facilities with a total capacity of 50 giga watt hour (GWh) as part of its PLI policy to strengthen the EV and battery storage ecosystem in the country. The policy aims to enhance ACC battery manufacturing capabilities with emphasis on maximum domestic value addition. Under the scheme, the beneficiary OEM must achieve a domestic value addition of at least 25% and raise it to 60% within five years while also making a mandatory investment of Rs 2.25 billion per GWh for a committed capacity within two years. The incentives under the PLI scheme will be disbursed over a fixed period of five years from the time of commissioning of the manufacturing facility.

In the first round of PLI awards (March 2022), three companies secured incentives: Ola Electric for 20 GWh lithiumion cell manufacturing, Reliance New Energy for 5 GWh sodium-ion cell manufacturing, and Rajesh Exports for 5 GWh lithium-ion cells. These companies committed a combined investment of Rs 270 billion for the scheme. In the next round of bidding, the government is unlikely to relax the criteria for localisation of cell manufacturing and the minimum bidding capacity is expected to remain at 5 GWh.

PMP

Under the FAME II policy, PMP has been introduced to boost domestic manufacturing of EVs, their assemblies/subassemblies and parts/sub-parts, thereby increasing domestic value addition. It is a government initiative to promote the local manufacturing of EVs in India. PMP offers a scaled duty structure for imported EV parts. To provide further impetus to electric mobility and promote indigenous development of EVs, the central government has reduced and rationalised the basic custom duty on these vehicles.

Under PMP, the following initiatives have been notified:



C No	lo Itom		Current	РМР		
5 NO	nem		BCD	Proposed BCD	Proposed date	
1	CBU	Bus (HS 8702) and Trucks (HS 8704)	25%	50%		
		PV (HS 8703) and three-wheeler (HS 8703/8704)		30%		
2	SKD	Two-wheeler (HS 8711)	15%	25%		
2	SKD	Bus (HS 8702)	1570	25%	April 2020	
		Truck (HS 8702)		25%	onwards	
		Bus (HS 8704)				
3	CKD	PV (HS 8703), two-wheeler (HS 8711), three-wheeler (HS 8703/8704) and Truck (HS 8704)	10%	15%		
4	Lithium-ion cells (HS 85076000) used for the manufacture of lithium- ion accumulator for EVs		5%	15%		
5	Battery pac	ks (HS 8507) used for the manufacture of EVs	5%	15%		
	Parts used	for the manufacture of EVs such as				
	AC or [DC charger				
	AC or [DC motor			April 2021	
	AC or [DC motor controller			onwards	
6	• Power	control unit (inverter, AC/DC converter, condenser)	0%	15%		
	 Energy 	monitor				
	Contac	tor				
	Brake s	system for recovering				
	Electric	compressor				

Note: BCD: Basic customs duty, CBU: Completely built up, SKD: Semi knocked down, CKD: Completely knocked down Source: MHI, CRISIL MI&A Consulting

EV charging and infrastructure policy

The government is actively promoting charging infrastructure and battery swapping to support the EV ecosystem in India. The plan is to establish 500,000 public charging stations (PCS) by 2025 by offering financial assistance to states and private companies. This initiative addresses the lack of charging infrastructure, a key barrier to EV adoption. Further, based on the revised guidelines and standards for charging infrastructure issued by the Ministry of Power, the government aims to augment the station density/reduce the distance between two charging stations as given below:

- At least one charging station to be made available in a grid of three-by-three km. Further, a charging station to be set up every 25 km on both sides of highways/roads
- For long range and heavy duty EVs, there should be a fast charging station at every 100 km, one on each side of the road/highway

Further, the policy was amended to cap the maximum tariff applicable to public charging of EVs. In addition to battery charging stations (BCS), the government is also promoting battery swapping and released its draft battery swapping policy in 2022. The policy aims to standardise battery specifications and create a battery swapping network by rollout of BSS in phased manner. This policy targets to support the adoption of battery swapping for light electric powertrain vehicles (LEV) of category L, and e-rickshaws/e-carts. Also, the policy highlights the importance of reuse of end-of-first-life swappable batteries and recycling of end-of-life batteries.



Scheme to promote manufacturing of electric passenger cars in India

In March 2024, MHI introduced a scheme to promote India as a manufacturing hub for EVs and attract investments from global EV manufacturers. Through the scheme, automakers can import 8,000 EVs per year with a provision for maximum 40,000 for a period of five years provided that the company commits to invest in local manufacturing. The scheme would also enable automakers to carryover unused annual imports during the same five-year period. EVs of minimum cost, insurance and freight (CIF) value of \$35,000 or above are eligible for reduced custom duty of 15% during the period. Also, the total number of EVs allowed for import would be determined by the total duty foregone or investment made, whichever is lower, subject to a maximum of Rs 64.84 billion.

The scheme mandates a minimum investment of Rs 41.50 billion (\$500 million) in India with a timeline of three years for setting up EV manufacturing facilities and commencement of EV production. Further, automakers are expected to achieve a certain level of domestic value addition (DVA) in the next five years. DVA should gradually increase to 25% by the third year and 50% by the fifth year. For availing benefits under this scheme, certain eligibility conditions in terms of global turnover and global investment have to be met. Global group revenue from automotive manufacturing should be minimum Rs 100 billion based on the latest audited annual financial statements at the time of application. Also, global investments of the company or group companies in fixed assets (gross block) should be Rs 30 billion at the time of application. Thus, the scheme would further augment the domestic EV ecosystem, thereby strengthening manufacturing and the domestic value chain, along with attracting investments from leading EV players around the world.

Policies on battery recycling

The government implemented Battery Waste Management Rules 2022 to promote the reuse and recycling of ACC batteries. The policy deals with the provision of financial incentives, the development of standards, and raising awareness about the importance of battery recycling. The traditional EV battery value chain includes raw material extraction, battery manufacturing followed by first life application and finally disposal. However, battery reuse and recycle will introduce an alternate value chain where batteries are repurposed for a second life application in the energy-storage segment. Finally, in the end-of-life stage where the battery no longer meets its performance requirements, it is recycled for extraction of metals such as cobalt, nickel, aluminium and copper. The introduction of reuse and recycle policy of ACC batteries would help to reduce battery prices further and improve availability of raw materials in the future.

An extended producer responsibility (EPR) concept has been introduced, where the producers (including importers) of batteries are responsible for collection and recycling/refurbishment of end-of-life batteries and use of recovered materials into new batteries. EPR mandates that all end-of-life batteries must be collected and sent for recycling/refurbishment and prohibits their disposal in landfills. To meet EPR obligations, battery producers may engage themselves or authorise any other entity for collection, recycling, or refurbishment of batteries. Further, there are targets for recovery of the battery materials - 70% by fiscal 2025, 80% by fiscal 2026, and 90% from fiscal 2027 onwards. Producers will also have to include 5% of recycled material in the total dry weight of a cell by fiscal 2028, 10% by fiscal 2029, 15% by fiscal 2030, and 20% by fiscal 2031.

The battery swapping policy also emphasises the reuse and recycling of swappable batteries. To promote the reuse of swapped batteries after their end-of-life in automotive applications, energy operators or battery swapping operators will be encouraged to develop a power bank using these batteries to store and use energy for EV charging or other stationary applications.



Scrappage policy

The scrappage policy envisages phasing out of old passenger and commercial vehicles. The policy aims to curb air pollution, improve road, passenger and vehicle safety, enhance fuel efficiency, improve auto sector sales and boost availability of low cost materials for automotive, steel and electronics industries.

The process kicked off in May 2016, with the Ministry of Road Transport and Highways (MoRTH) issuing a concept paper outlining the Voluntary Vehicle Fleet Modernisation Programme to encourage scrapping of vehicles manufactured before March 31, 2005. The policy was announced in the 2021-22 Union Budget.

The policy mandates that PVs older than 20 years and CVs older than 15 years should pass a fitness test to continue to ply on the road. End-of-life vehicles, which do not pass the fitness test, will lose vehicle registration and be scrapped. As per the policy, automated testing stations (ATS) and vehicle scrappage centres will be established to support the initiative.

The policy further introduces incentives to scrap vehicles and offers discounts against the certificate issued by scrappage centres. The incentives proposed include a scrap value to be given by the scrappage centre (4-6% of ex showroom price of the new vehicle), road tax rebate by state governments, rebate in registration fees and discounts from OEMs while purchasing a new vehicle with the scrappage certificate.

The policy has also introduced a few penalties for using old vehicles, including increased fees for fitness test and issuance of fitness certificate for CVs as well as increased re-registration fees for private vehicles above 15 years. After 20 years, private vehicles will be de-registered.

As per the policy proposal, mandatory fitness testing for private vehicles would commence from June 2024 in a phased manner.

Incentives offered at the state level

Many state governments are providing incentives for purchasing EVs, wherein the benefit provided is in addition to FAME-2 policy benefits.

- Maharashtra is providing an incentive of Rs 5,000 per kWh, subject to a maximum of Rs 1.5 lakh per vehicle for the first 10,000 electric cars. The policy also provides 100% exemption on road tax until 2025. It offered an additional early bird discount of Rs 5,000 per kWh (maximum of Rs 1 lakh, if the vehicle was purchased before the end of fiscal 2022)
- Gujarat announced an EV policy that would provide purchase incentives of Rs 10,000 per kWh for vehicles with minimum 15 kWh battery and a maximum ex-factory cost of Rs 15 lakh. The policy is valid until 2025
- Bihar is providing an incentive of Rs 10,000 per kWh subject to a maximum of Rs 1.5 lakh. The policy also provides 100% exemption on road tax until 2024
- Odisha has announced a subsidy of Rs 10,000 per kWh for four-wheelers with the subsidy capped at Rs 1.5 lakh per vehicle. The policy, launched in 2021, was revised in April 2023
- Meghalaya is providing an incentive of Rs 4,000 per kWh for the first 2,500 electric cars. The policy also provides 100% exemption on road tax until 2026
- The Telangana government is also providing 100% exemption on road tax and registration fee on purchase of first 5,000 electric cars until 2025
- The Tamil Nadu government is providing an incentive of Rs 10,000 per kWh for commercial electric cars with incentives capped at Rs 1.5 lakh per vehicle and maximum 3,000 vehicles are incentivised per year


 Haryana government is providing a direct purchase incentive of 15% of the ex-showroom price of vehicles and a maximum of up to Rs 6 lakh on purchase of EVs in the state for the first 1,000 units. The incentives are applicable to vehicles in the price range of Rs 15 lakh to Rs 40 lakh

Potential drivers of export market growth

While predominantly a small-car exporter, India has strongly emerged as an exporter of midsize sedans and UVs with a growing acceptance of vehicles manufactured in the country. The car segment's share reduced to 62% in fiscal 2023 from 76% in fiscal 2019 in terms of overall PV exports. Consequently, the share of UVs increased to 37% from 23%.

Africa accounts for the highest proportion in PV exports from India, followed by Latin America. Indian OEMs have diversified their exports by exploring newer geographies. New markets such as Saudi Arabia, the United Arab Emirates and South Africa have shown significant demand growth.

The following factors are likely to support India's PV export growth:

- Capacity expansion by top players
- Stable crude oil prices to aid demand from African and Latin American geographies
- Continued expansion into new markets
- PLI scheme

Estimated penetration of electric PVs by segment by fiscal 2029

The FAME-II subsidy is skewed towards vehicles for commercial use. No benefits are provided to personal car owners.

In case of commercial applications such as cab aggregators, as of fiscal 2023, the total cost of acquisition (TOA) of an EV is 10% higher compared with diesel vehicles, 19% higher compared with petrol vehicles and 12% higher compared with CNG vehicles. However, due to high annual running, the TCO for EVs is 14% lower compared with diesel taxies, 18% lower compared with petrol taxies and almost at par with CNG cabs. However, due to heavy running of the vehicles, the TCO of EVs for cab aggregators was lower compared with that of diesel alternatives but higher than that of CNG alternatives even in fiscal 2023. By fiscal 2026, CRISIL MI&A Consulting expects the TCO for EVs to be lower than diesel alternatives and marginally lower than CNG. The lower battery cost is expected to offset the lack of FAME subsidy and will help maintain competitiveness of BEVs against diesel and CNG variants for cab aggregators.

CRISIL MI&A Consulting believes that lack of charging infrastructure, range anxiety and lack of large OEM presence is hindering EV adoption in India. The taxi segment accounts for 10-15% of sales within passenger cars, Within the taxi segment, cab aggregators are expected to lead EV adoption, resulting in an estimated adoption of 25-31% within this segment by fiscal 2027 (considering that adequate infrastructure is available by then).

The TOA and TCO of electric personal cars are still higher compared with the petrol alternative due to their lower running costs. Therefore, EVs are currently not a viable use-case. However, the gap is expected to shrink in fiscal 2029, driving EV adoption in the personal usage segment. In addition, availability of charging infrastructure and range, especially for intercity travel, are likely to be key deciding factors for EV adoption in the personal car segment.



Hence, CRISIL MI&A Consulting expects the share of EVs in total passenger car sales to grow to 12-14% in fiscal 2029 from 1.2% in fiscal 2023.

EV penetration could be higher if the government adopts stricter policies on OEMs for not meeting CAFÉ norms. The exact quantum of EV penetration in an aggressive case depends on incentives given for adoption and setting up of charging infrastructure.

EV penetration outlook for PVs



Source: CRISIL MI&A Consulting

Indian electric three-wheeler industry

Review of Indian electric three-wheeler industry in India (fiscals 2018-2024)

With the emphasis on reducing carbon footprint, EVs are gaining importance globally. India is a signatory to the Paris Agreement under the United Nations Framework Convention on Climate Change. The country is also part of the EV30@30 campaign, targeting a 30% sales share for EVs by 2030.

The government is extending its support via FAME and tax-rate cuts to boost EV adoption. Furthermore, growing awareness, concern for environmental issues and keener focus from automotive companies are driving electrification in India. The EV segment has received a real thrust over the past two years with model launches, increasing awareness, elevated fuel prices and improvement in infrastructure support.

The government announced Rs 100 billion for Phase II of FAME, which commenced on April 1, 2019. This phase mainly focuses on supporting electrification of public and shared transportation through demand incentives of 0.5 million for electric 3Ws. The policy aims to provide a subsidy of Rs 10,000 per kWh to 3Ws. It envisions the creation of infrastructure for EV charging. The subsidy for 2Ws is Rs 15,000 per kWh, although it was cut from June 2023, by lowering the cap on maximum subsidy from 40% of a vehicle's ex-showroom cost to 15%. EV adoption has been relatively fast in the 2W and 3W segments. A sharp rise in fuel costs over the past two years has provided an added incentive to the price-sensitive customers of 2Ws and 3Ws. Moreover, a bevy of vehicle launches from the industry backed the growth in adoption, especially in fiscal 2023.



Sales of e-3Ws in India

In the e-3W segment, mobility, especially in the case of e-rickshaws, is widely used for last-mile connectivity. Eautos and e-rikshaws differ primarily in the design specification of electric powertrain, performance (in terms of torque and maximum speed) and passenger capacity. E-rikshaws are a low-cost variant of e-3Ws, without an exact ICE counterpart.

The overall e-3W market logged a healthy CAGR of 33% between fiscals 2018 and 2023. e-3Ws with high assured utilisation rates are more profitable for businesses, as they become economical to operate at higher utilisation. E-commerce giants are preferring e-rikshaws for clean and economical last-mile connectivity.

Figure: Electric 3W sales



Note: Electric 3Ws include e-autos and does not include e-rickshaws Source: VAHAN, CRISIL MI&A

Figure: EV penetration in 3Ws



Note: Electric 3Ws include e-autos and does not include e-rickshaws Source: VAHAN, CRISIL MI&A



E-auto (i.e., the L5 category) rickshaws use lithium-ion batteries and have an average speed of more than 25 kmph. They are used for moving cargo as well as passengers. The leading players in this segment are Mahindra Electric and Piaggio. Under FAME-I, e-3Ws driven by lead-acid batteries were also eligible for subsidy. However, under FAME-II, only advanced batteries and registered vehicles are eligible. Higher initial cost of e-autos, lack of availability of a wide range of products in the market, and insufficient charging infrastructure have hindered their penetration (~5% in fiscal 2022). Despite these challenges, the shift towards e-autos has occurred due to their low operating costs, economic benefits and environmental friendliness.

Drivers of electrification

Total cost of ownership (TCO)

TCO for 3Ws in fiscal 2024 for a four-year ownership

Annual running	30,000 km	35,000 km	40,000 km
Petrol-equivalent 3W EV	37% lower cost than petrol	42% lower cost than petrol	45% lower cost than petrol
CNG-equivalent 3W EV	33% lower cost than CNG	37% lower cost than CNG	41% lower cost than CNG



TCO for 3Ws in fiscal 2029 for a four-year ownership

Annual running	30,000 km	35,000 km	40,000 km
Petrol-equivalent 3W EV	43% lower cost than petrol	48% lower cost than petrol	50% lower cost than petrol
CNG-equivalent 3W EV	40% lower cost than CNG	44% lower cost than CNG	47% lower cost than CNG

Note: Total cost of ownership analysis framework takes into consideration down payment/initial payment, incentives/subsidies, EMI, fuel cost, maintenance cost and battery replacement cost, if any, over the ownership period adjusted for the resale value *Source: Industry, CRISIL MI&A*

TCO for an electric 3W was 37% lower than that for a petrol 3W and 33% lower than that for a CNG 3W for 30,000 km in fiscal 2024. This is expected to be 43% lower versus petrol and 40% lower versus CNG in fiscal 2029 for the same distance, highlighting the viability of electric 3Ws for a typical commercial application. Additionally, the TCO per km of an e-auto becomes even more economical, because of the subsidies for e-autos.

Unlike ICE vehicles, e-3W passenger vehicles do not fall under the ambit of the permit system, leading to a shift in customer preference towards e-3Ws. We expect the launch of new products by players in this category to drive 3W sales. Incentives declared under FAME-II and state EV policies are also anticipated to be the key drivers.

FAME to promote EVs

To promote the adoption of EVs in the country, **the** Government of India launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013. In April 2015, the FAME India scheme was launched as part of the mission. The first phase of the FAME scheme continued until March 31, 2019, and the second phase, termed as FAME-II, was launched on April 1, 2019. FAME-II aims to strengthen the EV manufacturing ecosystem in the country through demand incentives and the establishment of a network of charging stations.

Incentive structure under FAME II

Maximum no. of vehicles to be supported	Approx. size of battery in KwH	Incentive (Rs/ KwH)	Maximu m incentive (Rs)	Max ex factory price to avail incentive (Rs.)	Total fund supported (Rs Cr)
500,000	5	10,000	20% of cost of vehicle	500,000	2500

Source: Department of Heavy Industries (DHI), CRISIL MI&A

FAME II versus FAME I

	FAMEII		FAMEI	
	Approx. Incentive	Max ex-factory price(Rs lakh)	Incentive L1 (Rs)	Incentive L2 (Rs)
Registered 3W	40,000-62,000	5	45,000	54,000

Source: DHI, CRISIL MI&A

Replacement opportunity in 3Ws

Following the pandemic, demand for 3Ws has improved as customers are upgrading and replacing their old fleets for higher uptime and cleaner vehicles. The replacement market for 3Ws has expanded. Pent-up demand from fiscal 2021 (when vehicular moment was restricted) had helped the segment last fiscal. It is expected to continue this fiscal, too. Further, demand in the replacement market is expected to grow owing to deeper penetration of electric 3Ws. Additionally, central and state subsidies have lowered the capital cost. Some of the states have either



reduced or waived registration fees, road tax and permit requirement for electric 3Ws. Moreover, these vehicles have lower running costs. Overall, their cost of ownership is now much lower than conventional diesel or CNG 3Ws, rendering the shift to electric 3Ws attractive.

Piaggio, Mahindra top players in electric 3W segment



Figure: Share of key players in electric 3W market (e-autos, FY24)

Note: Electric 3Ws do not include e-rickshaws Source: VAHAN, CRISIL MI&A

Mahindra Last Mile Mobility and Piaggio were the top two players in fiscal 2024, together accounting for over 45% of the electric 3W market. They saw strong growth in sales in the fiscal as 3W operators looking to lower their operating costs amid high fuel prices switched to electric variants.

Unlike ICE vehicles, electric 3W passenger vehicles do not come under the ambit of the permit system, because of which customers prefer them. As more players launch products in this category, we expect it to drive 3W sales in general. Incentives under FAME-II and state EV policies are also expected to support.





Figure: Share of key players in e-rikshaw market (FY24)

Source: VAHAN, CRISIL MI&A Consulting

E-rikshaws used for passenger transport and those used for goods have witnessed strong growth on the back of continued demand. The goods carriers are used for last-mile transport of e-commerce deliveries, food deliveries and others. These electric vehicles play a vital role in promoting sustainable and zero-emission transportation.

YC Electric Vehicle is the leader in the e-rikshaw market, enjoying a 25% share in fiscal 2024, followed by Saera (18%) and Dilli Electric (15%). The total number of e-rikshaws (both passenger and goods carrying) sold during the fiscal stood at 0.53 million units. The top 10 manufacturers of e-rikshaws accounted for 40% of the overall organised market in fiscal 2024. The e-rikshaw market is primarily unorganised, with more than 10 players dominating the overall market.

Outlook on Indian electric three-wheeler industry in India (fiscals 2024-2029)

CRISIL MI&A Consulting expects EV penetration in the 3W segment to reach 30-34% by fiscal 2029. 3Ws will spearhead EV penetration in India because they are mostly used for short-distance trips and carry more load than e-rikshaws and e-bikes.

Moreover, all the conventional large OEMs, including Bajaj, Piaggio, Mahindra and TVS, have launched e-autos in the Indian market, which has improved their supply. This is expected to boost EV adoption in the long term.



Share of electric 3Ws to increase

Figure: Electric 3W sales outlook



Note: Electric 3Ws include e-autos and does not include e-rickshaws Source: VAHAN, CRISIL MI&A

Figure: EV penetration outlook



Note: Electric 3Ws include e-autos and does not include e-rickshaws Source: CRISIL MI&A

The penetration of EVs in 3Ws was ~13% in fiscal 2024. However, the shift to electric 3Ws is gaining momentum owing to the high prices of diesel, petrol and CNG.

The electric 3W segment will continue to innovate and lead the industry as fixed and swappable battery solutions have revolutionised the sector. Also, leading OEMs are focused on electric 3Ws. Bajaj currently dominates the petrol segment, and its market share is expected to expand with aggressive initiatives in the EV space.

A favourable regulatory environment, along with central and state government subsidies, is lowering the capital cost of purchasing electric 3Ws. Also, reduction or waiver of registration fees, road taxes and permit requirement by some of the states continue to support EV adoption. Moreover, their TCO is 30-40% lower than conventional diesel or CNG 3Ws, making the conversion to electric autos an attractive proposition.



4 Review of global bicycle industry

Global bicycle industry (calendar years 2019-2023)

The bicycle, a seemingly simple invention with a rich history, is experiencing a remarkable comeback on a global scale. From its humble origins as a wooden contraption in the early-19th century, the bicycle has undergone a remarkable evolution, driven by innovation, and adapting to the ever-changing needs of society. Today, it stands as a symbol of sustainability, health and a potential solution to urban mobility challenges.

The 21st century has witnessed a surge in demand for bicycles, fuelled by several key factors:

- Environmental consciousness: As the world grapples with climate change, the bicycle's zero-emission nature resonates with environmentally conscious consumers seeking sustainable transportation alternatives
- Urbanisation and congestion: Growing cities face increasing traffic congestion, making bicycles a convenient and efficient way to navigate crowded streets, especially for short-distance trips
- Health and wellness: The well-documented health benefits of cycling, from improved cardiovascular health to stress reduction, are attracting people of all ages to embrace cycling for recreation and fitness

The global bicycle industry is a complex ecosystem with various players, such as:

- Manufacturers: These companies design and produce bicycles for diverse purposes, from highperformance racing bikes to comfortable cruisers and utilitarian cargo bikes
- Component suppliers: A vast network of companies provide the essential building blocks frames, wheels, drivetrains, brakes and accessories that make up a bicycle
- Retailers: Bicycle shops, sporting goods stores and online retailers play a crucial role in distributing bicycles and accessories directly to consumers

The bicycle industry is getting a powerful boost from electric bikes. E-bikes, with their humble beginnings in the late-19th century, have evolved from clunky prototypes to modern marvels. Early pedelecs with pedal-activated motors kickstarted wider appeal, and 21st-century advancements in battery technology and design have made e-bikes a serious contender for commuting, recreation and utility cycling. This e-bike surge is a boon for the industry. It expands the customer base by attracting new riders and fuels innovation in areas such as battery tech, motor design and connected features, all while promoting sustainable transportation. Challenges such as regulations, cost and safety concerns remain, but the future looks promising. Lighter batteries, smarter features and diverse e-bike options are on the horizon. Collaboration between e-bike makers, policymakers and urban planners will be key to creating an e-bike-friendly world, propelling the bicycle industry towards a sustainable and accessible future.



Historical production development (calendar years 2019-2023)

Overall bicycle market volumes



Note: Above figures include bicycle market volumes for conventional and electric combined for the US, Europe, Japan and ASEAN ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*



Overall bicycle market value

Note: Above figures include bicycle market value for conventional and electric combined for the US, Europe, Japan and ASEAN ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

There has been an increase in demand for electric bicycles in many countries over the past several years. Increased gasoline costs, traffic congestion during rush hours and the health advantages of exercise are driving the adoption of e-bikes in several countries, including the UK and the US. With a greater adoption rate in 2019 compared with other regions, Europe is the primary market for the sale of electric bikes.



The bicycle industry was favourably impacted by the rapid global expansion of Covid-19 cases. Both conventional and electric bicycles experienced significant growth in this period. While e-bikes garnered much attention, conventional bicycles remained the dominant force in terms of sales volume. Fuelled by a global focus on health and fitness, coupled with expanding cycling infrastructure in cities, conventional bicycles of all types saw a surge in popularity. Their affordability and accessibility compared with e-bikes further solidified their position. However, e-bikes emerged as a game-changer during the pandemic, offering assisted pedalling and attracting a broader demographic seeking less strenuous riding options.

Two years of continuous proliferation in the industry led to a decline in 2023. There was high consumer demand during the pandemic, compounded by global crises such as the Covid-19 aftermath and the Ukraine conflict. The rising costs of essential materials such as aluminium, steel and carbon fibre led to a significant increase in production costs and, consequently, retail prices. The industry, at the time, was grappling with the 'bullwhip effect', where small fluctuations in demand lead to significant supply-chain disruptions and inventory accumulation. Retailers, who anticipated continued high demand, ordered excessive stock. However, an unforeseen slowdown in consumer demand resulted in bloated inventories, exacerbating the overstock problem. The situation was further complicated by the seasonal nature of the bicycle industry. Historically, the industry has seen fluctuations in demand based on seasons, with higher sales in warmer months. This seasonality has traditionally required careful inventory management to avoid overstock during off-peak periods. However, the pandemic-induced surge in demand led many in the industry to miscalculate future demand, resulting in the overstock situation.

The challenges of overstock and supply-chain disruptions necessitated a re-evaluation of business strategies, emphasising the need for adaptability, technological innovation and alignment with changing consumer preferences.

Bicycle industry trends by product type

Segmentation by product type in volumes (calendar years 2019 to 2023)



Note: Above figures include bicycle market volumes for the US, Europe, Japan and ASEAN *Source: Mordor Intelligence, CRISIL MI&A*



Segmentation by product type in value (calendar years 2019 to 2023)

Note: Above figures include bicycle market value for the US, Europe, Japan and ASEAN Source: Mordor Intelligence, CRISIL MI&A

The global bicycle industry witnessed a fascinating power shift from 2019 to 2023, with a clear demarcation emerging between conventional and e-bikes. While conventional bicycles continue to hold their own, e-bikes have become the undisputed growth champion, transforming the bicycle landscape. Following are some of the trends that shaped this divergence.

During 2019-2021, the conventional bicycle market witnessed a CAGR of 5.6%, backed by demand during Covid-19. However, during 2021-2023, the market logged a negative CAGR of 9.8% as the trend for e-bikes had already picked up pace with geographies such as Europe and the US experiencing strong demand for e-bikes, which partially hit the share for conventional ones. For the overall period (2019-2023), the conventional bicycle market clocked a negative CAGR of 2.4%.

E-bikes, though lower in volumes than conventional bicycles, have already been experiencing a rising trend in demand as more people have started to opt for e-bikes over conventional ones. Also, governments in many countries have been constantly encouraging cycling with the announcement of policies/campaigns, driving more people towards cycling over other available transport options. E-bikes witnessed a CAGR of 20.8% during 2019-2021 and 11.6% during 2021-2023, with e-bikes almost accounting for ~22% of the entire global bicycle market by the end of 2023.

Conventional bicycles

The market for conventional bicycles exhibited steady, albeit measured, growth throughout this period between 2019 and 2022. This resilience can be attributed to several factors:

• Established market base: Conventional bicycles have a well-established customer base that appreciates their simplicity, affordability and pure cycling experience



- Fitness focus: For riders seeking a more physically demanding workout and a deeper connection to cycling, conventional bicycles remain the preferred choice, particularly for segments such as road cycling and mountain biking
- Price point advantage: In a cost-conscious market, conventional bicycles continue to offer a significant price advantage compared with e-bikes, making them an attractive option for budget-conscious consumers

However, in 2023, conventional bicycles experienced a downturn in volumes due to emerging electric bicycles slowly capturing their market share and the high inventory levels for conventional bicycles eventually hampering their overall sales.

Nuances within the segment:

It is important to note that the conventional bicycle market is not monolithic. Sub-segments such as road bikes and mountain bikes may have experienced fluctuations based on their own specific trends and technological advancements. For example, the introduction of lighter materials or innovative gear-shifting mechanisms could drive growth within a specific segment of conventional bicycles.

E-bikes:

Electric bikes are appreciated for their efficiency, accessibility and minimal environmental impact. With advancements in battery technology, they offer extended ranges and excellent performance, making them the preferred choice for urban commuting. Governments globally, along with environmentally conscious consumers, are accelerating the shift to electric mobility, solidifying the dominance of e-bikes in the industry.

The e-bike market, in stark contrast, has witnessed a meteoric rise in recent years, fundamentally altering the bicycle industry. Following are some of the reasons for the same:

Broadened appeal: E-bikes have expanded the cycling demographic significantly. They cater to individuals who may find traditional bikes physically demanding, those seeking a more convenient way to navigate cities with hilly terrain, or even older adults who want to enjoy cycling without the exertion. This inclusivity has fuelled the e-bike revolution.

Technological advancements: Improvements in battery technology, motor efficiency and overall design have played a critical role. E-bikes are becoming lighter, offering longer ranges and boasting a more sleek aesthetic, making them more attractive to a wider range of riders.

Environmental alignment: The growing public focus on sustainability has positioned e-bikes as a compelling alternative to polluting vehicles. They offer a practical and eco-friendly mode of transportation, further propelling their popularity.



Trend in market share by bicycle type (in volume terms)

Note: Above figures are inclusive of geographies such as the US, Europe, Japan and ASEAN *Source: Mordor Intelligence, CRISIL MI&A*

Trend in market share by bicycle type (in value terms)



Note: Above figures are inclusive of geographies such as the US, Europe, Japan and ASEAN *Source: Mordor Intelligence, CRISIL MI&A*

As the global markets evolve and more people increasingly start to prefer electric bikes, the share of e-bikes is set to continue the increasing trend. In 2023, e-bikes recorded a market share of 22% — highest in the last five years. However, the e-bike boom has not been uniform across the globe. Following are some of the glimpses into the regional variations:

Europe: A leader in e-bike adoption, Europe boasts a well-developed market with high penetration rates and continued strong growth. Supportive government policies and existing cycling infrastructure have fuelled this trend.

China: A manufacturing powerhouse, China is a major player in both e-bike production and sales. The focus here is on affordability and practicality, with utility-focused e-bikes dominating the market.

North America: The North American market is experiencing rapid e-bike growth, with a focus on higher-end models and recreational use. Consumers here are increasingly drawn to the performance and technological advancements offered by premium e-bikes.



Japan: Japan's e-bike market is experiencing moderate growth, but with a unique twist. Innovation is a key focus, with manufacturers developing e-bikes tailored to an ageing population, such as compact models or those with features that enhance stability and comfort.

ASEAN: This emerging market presents a promising future for e-bikes. Rapid urbanisation, coupled with government initiatives promoting cycling, is creating fertile ground for e-bike adoption in Southeast Asia.

Going forward, the bicycle industry is likely to see a continuation of the e-bike surge. However, conventional bicycles are not expected to become obsolete. Instead, the market is poised for a future where both product types co-exist, catering to different needs and preferences. Factors such as affordability, technological advancements in both e-bikes and conventional bicycles, and continued infrastructure development for cyclists will play a crucial role in shaping the industry's trajectory. One thing is certain: The two-wheeled revolution is here to stay, with both conventional and e-bikes offering exciting possibilities for a more sustainable and healthy future.

Bicycle industry trends by motor type

The e-bike revolution has already gained significant momentum, with two distinct motor types vying for dominance: hub motors and mid-drive motors. Each offers a unique riding experience, catering to different rider profiles.



Overall share of e-bike market by motor type (in volume terms) (calendar years 2019 to 2023)

Note: The above figures are in million units and include e-bike market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

Hub motors, the silent workhorses of the e-bike world, are renowned for their affordability and user-friendly nature. Nestled discreetly within the front or rear wheel, they provide a comfortable and reliable boost of electric power, perfect for casual riders who enjoy leisurely cruises on flat terrain or budget-conscious commuters seeking a convenient way to navigate city streets. On the other hand, mid-drive motors occupy the heart of the e-bike, seamlessly integrating with the drivetrain to create a powerful and natural riding experience. They reign supreme in the realm of performance, offering superior torque that conquers hills with ease and mimics the familiar feel of traditional cycling.





Overall e-bike market value by motor type (calendar years 2019 to 2023)

Note: The above figures include bicycle market value for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

Despite hub motors holding the crown for sales volume due to their affordability and ease of use, the e-bike market awards a higher value to mid-drive motors. This seemingly counterintuitive trend boils down to the inherent advantages mid-drive motor possess. Their more complex design, integrating seamlessly with the drivetrain, translates to higher production costs. However, these costs are eclipsed by the superior performance benefits they offer.

While hub motors remain a popular choice for casual riders on a budget, the premium features and targeted marketing of mid-drive motors elevate their market value, solidifying their position as the technology of choice for the discerning e-cyclist.

On an overall level, combining the market for both the motors, the bicycle industry clocked a CAGR of 5.1% between 2019 and 2021, 1.9% between 2021 and 2023, and 3.5% between 2019 and 2023.

Some of the key drivers for the industry with respect to motor types are as follows:

Hub motor

Hub motors, electric motors embedded directly within the wheel hub, have become a pivotal technology driving the growth of the e-bike industry. Their inherent advantages, including ease of use, reduced maintenance requirements and attractive price points, have fostered widespread adoption among a significant segment of the e-bike user base. However, inherent limitations necessitate ongoing innovation to ensure continued dominance in this burgeoning market.

Design

Wheel-centric powerhouse: Unlike its mid-drive counterpart, the hub motor becomes an integral part of the wheel itself. The motor housing replaces the standard hub, seamlessly integrating the electric motor with the wheel's rotation. Hub motors come in two main configurations: front-mounted and rear-mounted. Each offers distinct advantages:



- Front-mounted hub motor: This option generally offers a lighter overall weight distribution for the e-bike and can be slightly more affordable. However, it might provide a less natural riding experience due to the altered weight distribution and the potential for a slight dragging sensation when not using the motor assist.
- Rear-mounted hub motor: This configuration offers a more intuitive riding experience as the power delivery closely mimics that of traditional pedalling. Additionally, rear-mounted hub motors can benefit from the existing drivetrain components, potentially offering greater efficiency and torque.

One of the most significant advantages of hub motors is their affordability. The simpler design and fewer moving parts translate to lower production costs compared to mid-drive motors. Hub motors are renowned for their user-friendly nature. The simpler design typically requires less maintenance compared to mid-drive motors.

There are other key advantages that position hub motors strongly in the market:

- **Pursuit of enhanced power and efficiency**: Manufacturers are relentlessly developing novel technologies to bridge the performance gap with mid-drive motors in terms of power output and efficiency. This will create a more diversified product portfolio catering to the varied needs of a wider range of riders.
- Advanced thermal management systems: Innovative cooling systems and refined motor designs are under exploration to optimise heat dissipation and guarantee optimal performance under diverse riding conditions. This not only extends the lifespan of the motor but also unlocks its full potential.
- **Seamless integration for an enhanced experience**: The seamless integration of hub motors with other e-bike components, such as braking systems and controllers, is a growing area of focus. This fosters a more streamlined, user-friendly, and ultimately safer riding experience.
- **Increased range and efficiency**: Modern hub motors boast impressive efficiency, allowing riders to travel farther on a single battery charge. This extended range makes e-bikes a more viable alternative to traditional bicycles for commuting and leisure rides, encouraging a shift towards a more sustainable mode of transportation.
- **Standardisation**: Standardisation of hub motor components and communication protocols is another area of ongoing exploration. This will streamline manufacturing processes, improve compatibility with diverse e-bike frames and components, and ultimately benefit both manufacturers and consumers.

Along with their many advantages, bicycles fitted with hub motors face some challenges with respect to cycling experience:

- **Power output limitations**: Hub motors generally exhibit a lower power ceiling compared to their mid-drive counterparts. While this might be inconsequential for casual riders, it presents a significant limitation for those seeking high speeds, traversing challenging terrains or transporting heavy cargo.
- **Heat dissipation considerations**: The enclosed nature of the wheel hub necessitates careful consideration of heat management. Prolonged use or high speeds can lead to heat buildup, potentially impacting performance and even causing motor damage. Manufacturers are actively seeking solutions to achieve an optimal balance between power output and thermal efficiency.
- Weight distribution and handling: The placement of hub motors, particularly in the rear wheel, can alter the weight distribution of the e-bike. This necessitates potential adjustments to riding styles for optimal control. While some riders might adapt quickly, others might require a period of acclimation.
- **Spoke compatibility concerns**: Certain hub motor designs exhibit limited compatibility with specific spoke types traditionally employed in bicycle wheels. This can restrict customisation options and necessitate specialised wheel builds, potentially increasing overall costs for consumers.



The hub motor remains a cornerstone of the e-bike revolution. Its affordability, simplicity and reliable power assistance make it a compelling choice for a vast segment of riders. Whether it is for a casual rider seeking a comfortable and convenient way to get around, or a budget-conscious commuter looking for a reliable e-bike solution, the hub motor is a powerful option to consider on the journey into the world of e-cycling. And as technology advances, continued improvements in hub motors can be expected. Battery integration within the hub itself is a possibility, further streamlining the design. Additionally, advancements in motor efficiency and torque output could narrow the gap between hub motors and mid-drive motors in terms of power delivery.

Major players in the hub motor space

The burgeoning e-bike market is fuelled in part by the innovation and competition within the hub motor space. Among the numerous players, two prominent manufacturers have established themselves as one of the leaders: Bafang (China) and Hyena (China). Each caters to specific segments of the e-bike market through distinct value propositions.

Bafang's dominance lies in affordability and power options. Its extensive range of hub motors caters to a diverse clientele. Budget-conscious consumers and casual riders benefit from its cost-effective options, while those seeking more power for hills or cargo hauling have a wider selection. Bafang's established brand reputation assures manufacturers and consumers of consistent quality and performance.

Hyena, on the other hand, focuses on the everyday rider. Its mid-range motors strike a balance between affordability and features. While power options might be more limited compared to Bafang, Hyena prioritises reliable power delivery and impressive efficiency. This translates to maximising battery range, a crucial factor for commuters, errand runners and leisure riders.

Mahle GMBH is another player in this industry who has launched a motor for e-bikes and has been allocating a substantial investment toward research and development initiatives.

Mid-drive motor

The mid-drive motor sits at the centre of an e-bike's performance, seamlessly integrated with the drivetrain and offering a riding experience that closely mimics traditional cycling. Unlike the hub motor that resides within the wheel, the mid-drive motor becomes the heart of the e-bike's power delivery system. Unlike hub motors, mid-drive motors are positioned near the pedals, typically mounted directly on the frame of the e-bike. They connect with the bicycle's crank set and cassette, essentially working in conjunction with the existing gears. This creates a more natural riding experience as the motor's power augments rider's pedalling effort.

Some of the key advantages of bicycles fitted with mid-drive motors are as follows:

Enhanced hill-climbing capability: Perhaps the most compelling advantage of mid-drive e-bikes lies in their demonstrably superior hill-climbing prowess compared to their hub motor counterparts. The strategic placement of the motor allows for direct interaction with the drivetrain, resulting in a seamless and potent surge of power that effortlessly propels the rider up inclines. This newfound ability unlocks previously inaccessible terrains, transforming challenging mountain biking routes, off-road expeditions, and hilly commutes into effortless endeavours.

A natural and familiar ride experience: Unlike hub motors, which tend to deliver a more detached and abrupt power application, mid-drives excel at replicating the natural sensations associated with traditional cycling. The motor's assistance meticulously adjusts in direct proportion to the rider's pedalling effort, fostering a familiar and



connected riding experience. This characteristic is particularly attractive to seasoned cyclists who value the core aspects of cycling but appreciate the supplementary power for conquering more strenuous challenges.

Superior handling and stability attributes: A significant contributor to the exceptional handling and stability exhibited by mid-drive e-bikes is the strategic positioning of the motor near the bike's centre of gravity. This advantageous placement results in a more balanced weight distribution when compared to rear hub motors. This translates into demonstrably superior handling characteristics, especially on technically demanding trails where precise control is paramount. Riders can navigate narrow switchbacks, descend steep slopes and conquer rough terrain with unwavering confidence.

Gearing versatility for diverse terrains: Mid-drive systems frequently boast seamless integration capabilities with existing drivetrains. This compatibility empowers riders to leverage a significantly broader range of gears. Such versatility equips cyclists to tackle flat commutes with efficient pedalling and conquer challenging climbs with the optimal gear ratio, essentially providing them with a bicycle specifically tailored to dominate any path they choose.

While mid-drive motors are gaining wider acceptance in the industry across different geographies, there are some challenges to be considered:

- Cost: The more complex design and integration with the drivetrain typically make mid-drive motors more expensive than hub motors.
- Maintenance: While generally reliable, mid-drive motors might require slightly more maintenance than hub motors due to the additional moving parts.
- Weight: In some cases, mid-drive motors can add a bit more weight to the e-bike compared to hub motors. However, the weight distribution is often more centralised, potentially improving handling characteristics.

The mid-drive motor has become synonymous with performance in the e-bike world. Its ability to deliver superior torque, offer a natural ride feel and work seamlessly with the existing drivetrain makes it the preferred choice for serious riders and those who value a more traditional cycling experience. While considerations such as cost and maintenance exist, the advantages offered by mid-drive motors are undeniable, making them the ideal choice for those seeking to elevate their e-bike experience to new heights.

Major players in the mid-drive motor space

The mid-drive motor market is dominated by a few key players: Bosch, Shimano and Yamaha. Each offers unique strengths — Bosch prioritises power and user experience, Shimano focuses on performance and efficiency with smooth integration into its drivetrains, and Yamaha emphasises user-friendliness and quiet operation, and specialised motors for a natural riding feel. These companies develop and manufacture motors that integrate with the e-bike's drivetrain, providing torque for tackling hills and a natural cycling experience, while potentially offering greater efficiency than hub motors.



Bicycle industry trends in different geographies

Bicycle market volume share, by geography (calendar years 2019 to 2023)

Notes:

Above figures include bicycle market volumes for the US, Europe, Japan and ASEAN Source: Mordor Intelligence, CRISIL MI&A

The global bicycle industry has witnessed a remarkable boom in recent years, fuelled by a confluence of factors. A growing focus on health and sustainability has spurred a long-term trend towards cycling, with people increasingly viewing it as a practical and eco-friendly transportation option. In urban areas worldwide, traffic congestion has reached a tipping point, making cycling a more attractive alternative for short-distance commutes. The affordability and popularity of e-bikes have been a game-changer, attracting new demographics to cycling who may have previously found traditional bikes physically demanding.

This surge in cycling enthusiasm is not uniform across the globe, but the underlying drivers share common threads. In China, for example, government initiatives promoting cycling infrastructure and e-bikes have complemented the existing focus on urban mobility due to traffic congestion. The US experienced a temporary boom during the pandemic as concerns about public transportation and a desire for outdoor activities drove bike sales. While sales have not remained at those highs, they are projected to stay elevated compared with pre-pandemic levels, suggesting a potential long-term shift in consumer behaviour. Europe, with its well-developed cycling infrastructure and strong environmental consciousness, has seen steady growth, particularly in the e-bike segment. Japan, with its established cycling culture, is experiencing moderate growth fuelled by innovation and the development of e-bikes tailored to an ageing population. Finally, the ASEAN region presents a promising emerging market with rapid urbanisation, a growing middle class and government support for cycling infrastructure.

The global bicycle industry is thriving, thanks to a perfect storm of health and sustainability concerns, urban challenges, and the rise of e-bikes. While regional nuances exist, the overall trend points towards a future where cycling plays a more prominent role in transportation and recreation.



US





Source: Mordor Intelligence, CRISIL MI&A



US - market volume in million units (calendar years 2019 to 2023)

The US bicycle market has experienced a remarkable surge in recent years, driven by a confluence of factors.

Prior to the Covid-19 pandemic, the US bicycle market exhibited a relatively stable growth pattern. Sales figures hovered around the 15 million unit mark, with a mix of traditional bicycles and a nascent electric bicycle (e-bike) market. The year 2020 marked a turning point. As the pandemic unfolded, concerns about public transportation and a desire for outdoor activities led to a surge in bicycle sales. This resulted in a nearly 18% on-year increase, with sales figures reaching an estimated 17.69 million units in 2021.

In revenue terms, the US bicycle market witnessed a CAGR of 2.1% between 2019 and 2023, whereas in volume terms, it logged a CAGR of 0.1%. 2023 saw some challenges in the industry with respect to high inventory levels as players had maintained excess stock in anticipation of continued trend of increased demand seen during the Covid-

Source: Mordor Intelligence, CRISIL MI&A



19 period (2020-2022). However, the demand could not maintain that trend, eventually leading the industry into a downturn in 2023.

Major reasons for the boom:

Several factors contributed to the US bicycle market growth:

- Covid-19 pandemic: Public health concerns and social distancing measures spurred a rise in cycling for recreation and essential transportation
- Increased focus on health and wellness: The pandemic heightened awareness of personal health, and cycling's well-documented health benefits attracted new riders
- Shifting transportation landscape: Rising fuel costs and growing congestion in urban areas made cycling a more attractive alternative for short-distance trips
- E-bike growth: Increasing trend in the disposable income of people reflected in the increased affordability and popularity of e-bikes to a wider demographic, including those who may have found traditional bikes physically demanding. The share of e-bikes in the US bicycle industry witnessed a significant surge between 2019 and 2023. In 2019, only 3% of the entire bicycle industry consisted of e-bikes, whereas the share reached 8.6% in 2023, as demand for e-bikes took an upward trajectory



E-bike industry volumes in US (calendar years 2019 to 2023)

The e-bike market witnessed a CAGR of 38.6% between 2019 and 2021 and 21.9% between 2021 and 2023. Overall, the CAGR between 2019 and 2023 was 30%, with volumes reaching 1.31 million units in 2023, which clearly indicates significant growth in the e-bike segment in the US.

On the other hand, retailers are also focusing on youth living in big cities, as they prefer to commute by a bicycle instead of a car to avoid the inconveniences and responsibilities that accompany car ownership, such as insurance, parking, gas, licensing, and overall maintenance costs. According to the Sports & Fitness Industry Association (SFIA), in 2023, the share of the population in the US that took part in outdoor sports amounted to 57.3%. This was an increase of 2.3% from the previous year and an increase of almost 7% on the figure from 2018. In 2023, the number of participants in mountain/non-paved surface biking reached over 9.2 million. This represented a 4.1% increase from the previous year.

Source: Mordor Intelligence, CRISIL MI&A



A potential long-term shift in consumer behaviour, with cycling gaining increased traction, US bicycle industry is well poised for a continued growth momentum provided there is increased government support for the bicycle industry.

Europe



Europe – market value (calendar years 2019 to 2023)

Source: Mordor Intelligence, CRISIL MI&A



Europe - market volume in million units (calendar years 2019 to 2023)

The European bicycle market witnessed stagnant growth during 2019-2023. Europe has been experiencing an unprecedented surge in demand for bicycles, causing both manufacturers and retailers to grapple with rapidly diminishing inventory. In response to the increasing cycling traffic, several European countries are introducing bicycle infrastructure and accessibility across the region. In May 2023, the French government allocated EUR 2 billion towards the improvement of cycling infrastructure, with the primary goal of promoting greater bicycle adoption and reducing car usage. Over 2023-2027, it plans to invest EUR 250 million annually to double the existing cycle lane network. The focus of these initiatives will be on smaller cities and rural regions rather than major urban centres. These developments create a significant opportunity for the bicycle market in Europe.

A total of 2.1 million e-bikes were sold in Germany in 2023, accounting for 53% of the market, compared with the 1.9 million regular bikes sold. According to the German Bicycle Industry Association, an average e-bike in Germany

Source: Mordor Intelligence, CRISIL MI&A



was sold for €2,800, or around \$2,900/£2,400, and made up 48% of all bicycle sales in 2022. Subsequently, bicycle sales in Germany hit a record high of €7.36 billion in 2022.

The European market has been on the go for the past five years and has not experienced any major market fluctuations that could have impacted the bicycle industry drastically. In revenue terms, the European bicycle market witnessed a CAGR of 3.5% between 2019 and 2023, whereas in volume terms, it logged a CAGR of 1.2% during the same period.

Key drivers of the European bicycle boom:

- Pre-existing cycling culture: Europe boasts a long-standing tradition of cycling, with well-developed infrastructure in many cities. This existing foundation facilitated further growth
- Environmental concerns: Growing environmental consciousness has positioned cycling as a sustainable transportation choice, aligning perfectly with European values
- Rise of e-bikes: Rising disposable incomes further increased the spending capacities of people, which has helped e-bikes on affordability fronts. They offer an assisted ride, attracting new demographics and making cycling more accessible for various fitness levels
- Focus on urban mobility: Traffic congestion in European cities has reached a critical point, making cycling a viable alternative for short-distance trips
- Road infrastructure: Urban planning in Europe is conducive to bicycle transport, as governments there encourage cycling to a greater extent and therefore plan road infrastructure that is conducive to cycling.

The e-bike revolution and its impact:

The rise of e-bikes has been significant both in volume and value terms. The charts below clearly indicate the rise in preference for e-bikes in European markets, contributing to the rising revenue from e-bikes, which even surpassed the revenue from conventional bikes in 2023.

Europe's e-bike surge stems from environmental concerns, health benefits, and economic factors. E-bikes offer a clean alternative to cars, promote exercise, and boast cost-efficiency with government incentives. This eco-friendly and practical mode of transport is reshaping European mobility.



E-bike industry volumes in Europe (calendar years 2019 to 2023)

Source: Mordor Intelligence, CRISIL MI&A

E-bike share increased from approximately 17% in 2019 to 30% in 2023, indicating an increased trend in usage of e-bikes in Europe. The industry witnessed a CAGR of 21% between 2019 and 2021 and 11.2% between 2021 and 2023. Overall, between 2019 and 2023, the European e-bike industry logged a CAGR of 16%, with volumes reaching up to 6.49 million units in 2023.

E-bikes have been a game-changer for the European market. These bicycles have broadened the appeal of cycling by:

- Catering to diverse needs: E-bikes cater to a wider range of riders, including those who may find traditional bikes physically demanding or those seeking a more convenient way to navigate cities
- Extending range and comfort: E-bikes allow riders to travel longer distances with less effort, making cycling a more practical commuting option
- Boosting recreational cycling: E-bikes have opened the possibility of recreational cycling for a wider audience, contributing to an overall rise in cycling participation

While the entire continent is experiencing a surge in e-bike popularity, the growth rate and market penetration vary significantly by country. Following is the country-wise break-up mentioning key factors contributing to the growth of the e-bike market in Europe:

Germany: The undisputed leader of European e-bikes, Germany boasts the highest sales figures and ownership rates. This can be attributed to a strong cycling culture, government subsidies and a well-developed network of cycling infrastructure.

Netherlands: Another forerunner in cycling infrastructure and e-bike adoption, the Netherlands is known for its cycling-friendly cities and a population that readily embraces e-bikes for commuting and leisure.

France: With a growing focus on sustainability and urban mobility, France is experiencing a rapid rise in e-bike sales. Government incentives and increasing awareness of the environmental benefits of e-bikes are fuelling this trend.

Poland: This region represents a significant growth market for e-bikes. Increasing disposable income and growing awareness of e-bikes are driving sales, with Poland poised to become a major European e-bike player in the coming years.

Czech Republic: Similar to Poland, the Czech Republic is witnessing a surge in e-bike popularity. Affordable e-bike options and a growing network of cycling paths are contributing to this trend.

Hungary: While lagging behind Western Europe, Hungary is experiencing a steady rise in e-bike sales. Government subsidies and increasing urbanisation are expected to accelerate e-bike adoption in the coming years.

Italy: E-bikes are gaining traction in Italy, particularly for leisure cycling and tourism. The country's beautiful landscapes and focus on outdoor activities are creating a strong market for e-bikes.

Spain: Similar to Italy, Spain is seeing a rise in e-bikes for leisure and tourism purposes. The country's warm climate and growing bike-sharing programmes contribute to this trend.

Greece: E-bike adoption in Greece is still in its early stages, but the potential for growth is significant. Government initiatives promoting cycling and the increasing popularity of e-bikes for tourism are promising signs.

The European bicycle market is expected to see further growth in the coming years. However, continued progress hinges on some key factors, such as investment in infrastructure, increased government support, and technological



advancements with respect to batteries and motors, which will help enhance riding experience and attract more riders.

Japan

Japan - market value (calendar years 2019 to 2023)



Source: Mordor Intelligence, CRISIL MI&A

Japan – market volume (calendar years 2019 to 2023)



Source: Mordor Intelligence, CRISIL MI&A

The Japanese bicycle market presents a fascinating case study in balancing tradition with innovation. Unlike the explosive growth witnessed in other regions, Japan's market has exhibited a more measured yet significant rise. This unique trajectory can be attributed to the country's established cycling culture, its unwavering focus on technological advancements, and a strategic response to a changing demographic landscape. During 2019-2023, the Japanese bicycle market witnessed a CAGR of 1.7% in revenue terms, while in volume terms, it logged a CAGR of (5)%. The overall industry had faced challenges in 2022 and subsequently in 2023 as well, bringing down production significantly due to high inventory levels.

Following are some of the key drivers of Japan's bicycle industry:

Pedalling on tradition: In major urban areas, cycling is an ingrained part of daily life. This established cycling culture provides a solid foundation for the market. Existing infrastructure, with its network of dedicated lanes and ingrained cycling etiquette, encourages continued use of bicycles for both transportation and recreation.

Innovation as the gear shift: Japanese bicycle manufacturers have carved a niche for themselves by prioritising cutting-edge technology. Their reputation for producing lightweight and high-performance bicycles attracts a specific consumer segment that values these qualities. This focus on innovation ensures Japanese bikes remain competitive on a global scale, while also catering to a domestic market that appreciates quality and technological prowess.

E-bikes and an ageing population: As Japan's population ages, the market has begun to adapt to meet the evolving needs of its riders. E-bikes have emerged as a compelling option for older adults who may find traditional bicycles physically demanding. While the e-bike revolution has not quite reached the same heights as in Europe, it presents a significant growth opportunity in Japan. The market is strategically shifting to cater to this segment, offering a comfortable and convenient mode of transportation that does not compromise on the established cycling culture. The share of e-bikes in Japan has seen a significant jump from approximately 43% in 2019 to 63% in 2023.



E-bike industry volumes in Japan (calendar years 2019 to 2023)

Japan's e-bike industry witnessed a CAGR of 6.6% between 2019 and 2021 and 3.1% between 2021 and 2023, and an overall CAGR of 4.8% between 2019 and 2023.

Several bicycle and e-bike motor manufacturers across Japan are launching new products to gain a competitive advantage. This is anticipated to boost the target market over the forecast period. For instance, in May 2023, Yamaha launched two new electric Urban Mobility models, BOOSTER Easy eBike and BOOSTER S-pedelec. Both the models are equipped with the latest PWseries S2 motor od 250 W capacities, which is one of the most sophisticated designs in the class, and a 630 Wh 36V Yamaha battery. In June 2023, Yamaha announced the New PW-XM E-Bike Motor, which features a 250 W power output capacity and a torque of 85 Nm. In November 2023, Honda announced the launch of its first electric bike e-MTB. The bike was recently shown at the Japan Mobility

Source: Mordor Intelligence, CRISIL MI&A



Show in Tokyo, where it was displayed among several other cutting-edge and/or brand-expanding debuts from top Japanese automakers and motorcycle companies.

The future of Japan's bicycle market hinges on two key trends:

- E-bike innovation made in Japan: Continued development of e-bikes tailored specifically to the Japanese market is crucial. This could involve compact designs for navigating densely populated urban areas or models with features that cater to the specific needs of older riders. By focusing on such targeted innovation, the market can unlock further growth potential
- Technological leadership: Japanese manufacturers are well-positioned to be at the forefront of e-bike innovation. Their expertise in lightweight materials, coupled with a focus on developing lighter batteries, longer ranges and improved motor efficiency, will make e-bikes even more attractive to Japanese consumers. This technological leadership will not only solidify Japan's position within the global bicycle market but also ensure cycling remains a relevant and appealing transportation option for a wider demographic in the years to come

Japan's bicycle market offers a unique perspective on the global cycling boom. Building upon its established cycling culture and leveraging its technological prowess, Japan has navigated a growth trajectory that is both measured and strategic. With a continued focus on e-bike innovation and technological leadership, Japan's bicycle market appears well-positioned to continue its journey, ensuring cycling remains a prominent fixture on the landscape of Japanese transportation.

ASEAN



ASEAN – market value (calendar years 2019 to 2023)

Note: ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*



ASEAN – market volume (calendar years 2019 to 2023)

Note: ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

The bicycle market in the ASEAN region underwent a fascinating metamorphosis over 2019-2023. While established markets such as Europe and China witnessed a boom, ASEAN presents a unique case of a nascent market experiencing rapid yet measured growth. This surge signifies a captivating shift towards a future where cycling plays a more prominent role in daily life across Southeast Asia. In revenue terms, the ASEAN bicycle market witnessed a CAGR of 8.1% over 2019-2023, whereas in volume terms, it logged a CAGR of 3.8%. Following are some of the key drivers of the ASEAN bicycle industry:

Urban jungle conundrums: Rapid urbanisation across Southeast Asia has led to a surge in traffic congestion. Major cities such as Bangkok and Jakarta are notorious for gridlock. Bicycles offer a convenient and relatively inexpensive solution for short-distance commutes, particularly within densely populated areas. They navigate congested streets with ease, allowing riders to bypass traffic jams and reach their destinations quicker.

Rise of aspiring middle class: A burgeoning middle class with disposable income has emerged in many ASEAN countries. This segment of the population seeks not just basic transportation solutions but also options for leisure and fitness. This newfound affluence has fuelled demand for higher-end bicycles and a growing interest in leisure cycling. Upscale bicycle brands are starting to take notice, with targeted marketing campaigns aimed at this growing demographic.

Government support: Recognising the potential benefits of cycling for health, sustainability and traffic management, some ASEAN governments are actively promoting cycling adoption. This support comes in the form of investments in dedicated cycling infrastructure, including bike lanes and secure parking facilities. These initiatives create a safer and more welcoming environment for cyclists, encouraging more people to embrace cycling as a viable transportation option.

Premiumisation trend: Bicycle industry in ASEAN is experiencing a rising trend in value per vehicle attributing premiumisation within the industry. Owing to improved economic conditions in ASEAN over the years, consumer spending has seen a rising trend and thus manufacturers have started taking that levy to scale their production and increase selling costs.



E-bikes — the catalyst for growth

- The rise of e-bikes has been a game-changer for the ASEAN bicycle market. The geography of Southeast Asia can be challenging, with hilly terrains in some regions and scorching temperatures in others. E-bikes provide the necessary assistance to navigate these terrains and combat the heat, making cycling a more accessible and comfortable option for a wider demographic. This is particularly appealing to individuals and families who may not have the fitness level for traditional bicycles
- Aligning with environmental consciousness: Growing awareness of environmental issues and the need for sustainable transportation options are the major trends across Southeast Asia. E-bikes, with their low carbon footprint, perfectly align with this growing consciousness. Governments and environmental groups are promoting e-bikes as a viable alternative to polluting vehicles, contributing to a cleaner and more sustainable transportation ecosystem
- Promoting inclusive cycling: E-bikes cater to individuals and families with varying fitness levels. This inclusivity makes cycling an activity that everyone can enjoy, fostering a sense of community and encouraging more people to participate in leisure and recreational cycling activities



E-bike industry volumes in ASEAN (calendar years 2019 to 2023)

Note: ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries Source: Mordor Intelligence, CRISIL MI&A

E-bike share in the ASEAN bicycle industry reached 15.6% in 2023 from 12.2% in 2019. Although slow, people in ASEAN countries have started switching to e-bikes. With some of the economies doing well, people are increasingly looking to spend on e-bikes, which are otherwise an expensive alternative to conventional bicycles. The ASEAN bicycle market witnessed a CAGR of 13.8% between 2019 and 2021, 6% between 2021 and 2023, and approximately 10% between 2019 and 2023.

Challenges and opportunities

Despite the promising outlook, the ASEAN bicycle market faces some key challenges that need to be addressed:

Infrastructure development – building a network for riders: While initial investments in cycling infrastructure
are encouraging, further development is crucial. Dedicated bike lanes with proper signage and separation
from motorised traffic are essential to ensure the safety and comfort of cyclists. Additionally, secure parking
facilities are necessary to encourage bicycle ownership and prevent theft



 Affordability and financing options: For some segments of the population, even traditional bicycles can be a significant investment. Government initiatives, such as subsidies or tax breaks, and financing options offered by retailers or banks can make bicycle ownership more accessible. This will broaden the appeal of cycling and encourage participation from a wider range of income groups

The ASEAN bicycle market is poised for continued growth. By addressing infrastructure limitations, affordability concerns and safety issues, the region can unlock the full potential of cycling as a sustainable and healthy mode of transportation and recreation. This 'two-wheeled revolution' has the potential to transform the transportation landscape in Southeast Asia for years to come, creating cleaner cities, healthier communities and a more sustainable future for the region.

Major global bicycle manufacturers

Accell Group

Accell Group, founded in 1998 and headquartered in Heerenveen, the Netherlands, is a manufacturer of bicycles, bicycle parts and accessories. It boasts a diverse portfolio of brands, including Babboe, Batavus, Diamondback, Ghost, Haibike, Koga, Lapierre, Raleigh, Sparta and Winora, with XLC serving as the brand for bicycle parts and accessories.

Operating across 15 countries, the company's products are distributed to dealers and consumers in over 80 countries, with a strong presence in Europe, particularly in the Netherlands, Germany and France, which collectively contribute approximately 80% of sales.

Utilising specialised retail outlets such as bike shops and exercise equipment stores, Accell Group caters to a broad spectrum of consumers seeking high-quality bicycles and related products. With a workforce of roughly 3,700 individuals spanning 15 countries, Accell Group operates on a global scale, distributing bicycles and associated products to dealers and consumers in over 80 countries. In 2022, the company achieved notable sales figures, delivering approximately 845,000 bicycles and generating a turnover of EUR 1.4 billion.

Key focus

Within the bike segment, the company boasts a diverse array of bicycles and operates extensively across Europe under its various brands. The bike lineup encompasses electric bikes, city bikes, children's bikes, racing bikes, folding bikes and speed pedelecs, complemented by a selection of bike accessories available at different price points.

Atala, an Italian brand, offers a comprehensive selection of sports bicycles, children's bikes, and city bikes tailored to a wide customer base. Raleigh, headquartered in Nottingham, England, is a global bicycle manufacturer renowned for its expansive range of electric bikes, mountain bikes and hybrid bikes.

Additionally, XLC caters to customers across Europe and beyond with an extensive lineup of bike parts and accessories.

Trek Bicycle Corporation

Trek Bicycle Corporation, founded in 1975 and headquartered in Wisconsin, the US, is a manufacturer and distributor of bicycles and cycling products, operating under brands such as Trek, Electra Bicycle Company, Bontrager and Diamant Bikes. Previously, the company produced bikes under the Gary Fisher, LeMond Racing Cycles, Klein and Villiger Bikes labels.



Currently, Trek Bicycle Corporation boasts a network of nearly 1,700 dealers throughout North America, with distribution extending across 90 countries globally. The majority of its manufacturing occurs outside the US, with production facilities located in countries such as China, Taiwan, the Netherlands and Germany.

Within the Trek Bicycle Corporation Limited corporate family, there are a total of 66 companies.

Key focus

Trek Bicycle Corporation is a prominent player in the bicycle and cycling product industry, functioning both as a manufacturer and distributor. Under its umbrella, the company offers a diverse range of products sold under various brands, including Trek, Electra Bicycle Company, Bontrager and Diamant Bikes. The company's manufacturing operations are strategically spread across multiple countries, with facilities located in key regions such as China, the Netherlands, Germany and Taiwan.

This global manufacturing footprint allows Trek Bicycle Corporation to efficiently produce bicycles and cycling products to meet the demands of consumers worldwide, while benefiting from logistical advantages and accessing different markets' expertise and resources. It clocked total revenue of \$0.72 billion in 2022 from all the segments it caters to.

Trek Bicycle Corporation's latest product innovation, the CarBack Radar Rear Bike Light, underscores the company's commitment to enhancing cyclists' safety. This new rear light integrates safety technology, including a focused radar system capable of detecting rear-approaching vehicles from a distance of up to 240 metres. Moreover, its daytime-visible light with an interruptive flash pattern extends visibility for drivers up to 2 km away. By introducing CarBack, Trek Bicycle Corporation aims to address the critical need for improved cyclist visibility, thereby fostering greater confidence among riders navigating shared roadways.

PON Holdings BV

Pon Holdings BV, founded in 1980 and headquartered in Almere, the Netherlands, is a prominent family-owned multinational corporation, with 15,700 employees across 34 countries spanning six continents. Pon Holdings operates a diverse portfolio of businesses in four key clusters: automotive, Pon.Bike, equipment and power systems, and agricultural products and services.

Pon Holdings is one of the largest mobility groups in the Netherlands, catering to millions of people with a comprehensive range of bikes, cars and mobility services. Its extensive premium brand portfolio sets it apart, encompassing over 20 bicycle brands distributed across Europe, North America, South America and Asia.

Some of the renowned bicycle brands under Pon Holdings' umbrella include Caloi, Cannondale, Cervélo, FOCUS, Gazelle, GT, Kalkhoff, Mongoose, Santa Cruz, Schwinn, Urban Arrow and Veloretti.

Key focus

Pon.Bike experienced substantial growth in 2022, achieving total revenue of \$10.56 billion driven by several acquisitions, notably Dorel Sports. This strategic move propelled Pon.Bike into a global market leader, boasting a portfolio of renowned brands such as Cannondale, Gazelle, Kalkhoff, Cervélo and Urban Arrow. The company operates in various locations, including the Netherlands, Australia, Germany, Brazil, the US, Canada, China and the UK.

This upward trajectory is anticipated to continue internationally throughout the current year. Pon.Bike embarked on the construction of a bike manufacturing facility in Lithuania, slated to produce approximately 500,000 electric and conventional bikes annually. Beyond bike production and sales, Pon.Bike has diversified into parts, accessories, and innovative services such as leasing and subscriptions.



Pon Holdings has completed 13 acquisitions, spanning sectors such as electric vehicles, green transport, auto retail, aftersales and more, representing a substantial investment of over \$1.7 billion.

Yamaha Motor Co. Ltd

Yamaha Motor Co. Ltd, founded in 1887 and headquartered in Shizuoka, Japan, is a diversified automotive company that manufactures and markets a wide range of products, including motorcycles, e-bikes, marine products, robotics, financial services and various components. Its extensive product portfolio encompasses motorcycles, all-terrain vehicles, snowmobiles, recreational vehicles, outboard engines, personal watercraft, boats, industrial robots, automobile components, and unmanned helicopters for industrial use.

In addition, Yamaha Motor offers financial services and manufactures and sells a diverse array of other products, such as golf cars, automobile engines, generators, electric wheelchairs, parts and accessories. The company caters to a diverse clientele across automobile, water sports, consumer, business and industrial sectors, operating through global development, production and sales networks. In 2023, it clocked total revenue of YEN 2,414,759 million from all the segments in its portfolio.

Yamaha Bicycle, a subsidiary of Yamaha Motor Co. Ltd, has played a pioneering role in the development of electrically powered bicycles, commonly known as "e-bikes." In 1993, Yamaha Motor introduced the world's first e-bike, featuring its innovative Power Assist System (PAS). This system utilises an electric motor to provide assistance to the rider's pedalling efforts in a way that feels natural and harmonious with human movement. Yamaha Motor's product offerings in the bicycle division include select models in city bikes, such as UrbanRush, Civante and Wabash. In mountain bikes, YDX-MORO, YDX-MORO PRO and YDX-TORC are a few models that have gained wider market acceptance.

Yamaha is offering a five-year factory limited warranty on the drive unit, battery, frame and rigid fork for all models that are warranty-registered on or after December 1, 2023. This warranty provides customers with assurance and peace of mind regarding the quality and durability of their purchased Yamaha electric bicycles.

Giant Manufacturing Co. Ltd

Giant Manufacturing Co. Ltd, founded in 1972 and headquartered in Taichung, Taiwan, is recognised as one of the prominent manufacturers and exporters of bicycles worldwide. Originating as an original equipment manufacturer (OEM) for Schwinn in the 1970s, the company launched its brand globally in the 1980s. With a diverse product range and a global presence, Giant has cemented its position as a leader in the bicycle market. It offers a comprehensive range of bicycles catering to various needs and preferences. Its product lineup includes on-road, x-road, off-road, youth and electric models, ensuring there is a suitable option for every type of rider.

In 2022, it recorded total revenue of TWD 92.04 billion from all the segments it caters to.

GIANT, a brand under the Giant Group umbrella, secured the prestigious Most Rated Bicycle Brand Award in Australia. It achieved this accolade in the bicycle brand category amidst stiff competition from nearly 20 other brands, emerging victorious among over 100 retail category projects.

Key focus

Giant operates through three main segments: bicycles, materials and others. While bicycles remain the company's core focus, the materials segment involves producing components and accessories. In contrast, the others segment encompasses related services or ancillary products.



With manufacturing facilities in Taiwan, China and the Netherlands, Giant efficiently produces bicycles to meet global demand. The company markets its products through an extensive network of approximately 12,000 retail stores worldwide, ensuring widespread availability and accessibility for consumers.

Hero Cycles

Hero Cycles Ltd, founded in 1956 by the late Shri Om Prakash Munjal, is India's largest bicycle manufacturer. It is currently headquartered in Punjab, India. As per the Guinness Book of Records 1989, Hero Cycles was the world's largest bicycle manufacturer in 1986, supported by various ancillary units.

Hero Cycles has ventured into global markets by exporting to Europe and other regions. Furthermore, the company has embraced diversification by entering the electric and premium bicycle segments through strategic acquisitions of Avocet Sports, HNF and Firefox Bikes. This strategic move underscores Hero Cycles' adaptability and foresight in catering to evolving consumer preferences and industry trends. In 2022, Hero Cycles clocked total revenue of \$236.77 million from all the segments.

Key focus

Despite its strong foothold in the Indian market, Hero Cycles has extended its reach beyond borders, maintaining a global presence through exports to Europe and other international markets. This global expansion highlights the company's ambition to become a key player in the global bicycle industry.

Hero Cycles has diversified its product portfolio by venturing into the electric and premium bicycle segments. Through strategic acquisitions of Avocet Sports, HNF and Firefox Bikes, the company aims to cater to evolving consumer preferences and capitalise on emerging trends in the cycling market.

Hero Cycles' success extends beyond production prowess. It has meticulously built a comprehensive distribution network throughout India, ensuring its bicycles are readily available in both urban centres and rural areas. This widespread accessibility is paramount to their dominance in the Indian market, where even remote villages can access a Hero bicycle.

Hero Cycles has an annual manufacturing capacity of over 7.5 million bicycles, reflecting its dominant position in the Indian market, holding a commanding market share of over 43% in the country.

Embracing the evolution

The global cycling industry is witnessing a surge in e-bikes, and Hero Cycles is actively embracing this evolution. Recognising the shift in consumer preferences, it has begun venturing into the electric bicycle market. This strategic move aims to maintain its market leadership as e-bikes become increasingly popular not just in developed nations but also in India, where affordability remains a key concern. Some of the popular e-bike models manufactured by Hero Cycles are Hero Lectro C3, Hero Lectro H5, Hero Lectro's range of F3i, F6i, C8i, F1 and F2i models.



Outlook for the global bicycle industry (CY24 to CY29)

Overall bicycle market volume (calendar years 2024 to 2029)



Note: The above figures include bicycle market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

Overall bicycle market value (calendar years 2024 to 2029)



Note: The above figures include bicycle market value for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*





Geography wise share in value terms (\$ billion)

Globally, more and more cyclists are taking to the roads. This market in value terms is poised to grow at a CAGR of 9-11% to \$42-47 billion by 2029, with Europe contributing 60% to the market. Europe's strong cycling culture makes it an attractive premium-priced market, with its e-bike sales expected to grow at a CAGR of 13% between 2024 and 2029 and reach 11-15 million units by 2029.

The global bicycle industry is poised for a period of dynamic expansion, fuelled by a confluence of environmental consciousness, health-driven lifestyles, and technological innovation. Between 2024 and 2029, it is expected to log a CAGR of 5-7% in volume terms and 9-11% in revenue terms, painting a promising picture of a burgeoning market. Some of the key reasons for the growth in the industry in the coming five years are as follows:

Environmental imperative: As environmental concerns take centre stage, bicycles are emerging as a champion of sustainable transportation. Consumers are increasingly opting for eco-friendly cycling over traditional modes of transport such as cars and public transit. This trend is further amplified by government initiatives that promote cycling infrastructure and green commuting policies.

Health and wellness: The growing emphasis on health and wellness is putting bicycles back in the spotlight. The numerous benefits of cycling, from improved cardiovascular health to stress reduction, are being widely recognised. This focus on well-being is making cycling an attractive option for a broader demographic.

Urban mobility solutions: Urbanisation and the ever-present challenge of traffic congestion are creating fertile ground for bicycle adoption. Bicycles offer a faster and more efficient way to navigate crowded city streets, especially when considering rising fuel prices. For many urban dwellers, cycling is becoming not just a leisure activity, but also a practical and cost-effective transportation choice.

Technological revolution: Advancements in e-bike technology, battery life, and affordability are opening the door to a whole new segment of riders. E-bikes are no longer a niche product; they are becoming mainstream, making cycling accessible to those who might have previously found it too strenuous. This technological revolution is significantly expanding the market potential of the bicycle industry.

Source: Mordor Intelligence, CRISIL MI&A


Investment surge: The cycling industry is attracting significant investor interest, leading to a surge in funding for innovative products and the expansion of retail networks. This influx of capital will fuel the development of new technologies, materials and design approaches, pushing the boundaries of the cycling experience.

However, a major reason for the growth is the evolution of e-bikes in many markets globally as consumer acceptance of e-bikes increases, thus supporting the bicycle industry to grow in terms of both volume and value. Following are some of the trends that the industry is experiencing and may continue to do so in the coming years, backed by technological advancements at regular intervals:

E-bike boom: The industry is bracing for an e-bike boom. E-bikes are expected to be the primary driver of growth, with sales projected to surpass traditional bicycles in some regions. The convenience and accessibility of e-bikes are a game changer, attracting riders of all ages and fitness levels.

Premiumisation takes the lead: Consumers are no longer satisfied with basic bicycles. There is a growing demand for high-quality bicycles with advanced features and top-of-the-line components. This trend towards premiumisation indicates a shift in how people perceive cycling, from a utilitarian mode of transport to a valued leisure activity and fitness tool.

Direct-to-consumer (D2C) revolution: The rise of online platforms is disrupting the traditional brick-and-mortar retail model. D2C sales are expected to continue their upward trajectory, offering consumers more choice, competitive pricing, and potentially a more convenient shopping experience.

Data-driven cycling: Cycling is about to get a digital upgrade. The integration of sensors and connected technologies will transform bicycles into data-driven machines. Users can track their performance, navigate unfamiliar routes, and receive real-time maintenance alerts through their connected bike.

Outlook for the global bicycle industry by product type

Conventional bicycles



Conventional bicycle volume forecast (calendar years 2024 to 2029)

Note: The above figures include bicycle market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*



The conventional bicycle segment is anticipated to witness growth between 2024 and 2029. However, it may face competition from e-bikes, which are increasingly gaining market acceptance across different geographies. Conventional bicycles have several advantages such as affordability, health benefits and low maintenance, that help them conquer majority of the bicycle market. Their volume is expected to clock a CAGR of 3-5% between 2024 and 2029, reaching to 34-39 million units.

E-bikes



Electric bicycle volume forecast (calendar years 2024 to 2029)

Note: The above figures include bicycle market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

The future of cycling is electric. E-bikes are poised for good growth in global markets between 2024 and 2029, with market volume projected at 15-20 million units by 2029 (CAGR of 12-14%). Their broader appeal — easier to climb hills and travel longer distances — is attracting new demographics to cycling.

Additionally, e-bikes present an eco-friendly and efficient solution for urban commutes, potentially reducing traffic congestion. Government incentives and advancements in battery range and motor technology are further propelling this e-revolution. While growth rates might vary by region, the outlook for e-bikes is undeniably bright. Challenges such as regulations and battery limitations remain, but continued innovation and a focus on responsible use will solidify e-bikes' dominance in the global bicycle market for years to come.

Outlook for the bicycle industry by geography

US



Overall bicycle market volume forecast for US (calendar years 2024 to 2029)

The US bicycle market volume is expected to reach 14-18 million units in 2024 and further to 17-21 million units (conventional and electric combined) in 2029, registering a CAGR of 3-5% between 2024 and 2029. In revenue terms, the CAGR is expected to be in the range of 7-9%. E-bikes in US may witness a CAGR of 14-16% between 2024 and 2029 as more people may increasingly prefer convenience over manual effort, with an anticipatory strong support from the government in terms of incentives.

The increase in the number of people who use a bicycle as a form of recreation is expected to expand the market during the forecast period. The preference for bicycles as a convenient way of exercising for fitness is expected to drive the market. Trendy mountain bikes and e-bikes are gaining the grip of the millennials in the US.

US retailers are referring to the benefits of bicycles to increase their sales, such as easy to pedal, fitness bound as it helps to manage heart health and stress. Also, as competition increases, manufacturers are forced to invest in R&D to create better bicycles. This could lead to improved battery technology, range and performance, making bicycles more accessible and appealing to a broader range of consumers.

Source: Mordor Intelligence, CRISIL MI&A





Break-up of market share by product type in US (in million units)

Source: Mordor Intelligence, CRISIL MI&A

The market share of conventional bikes in the US is anticipated to decrease 13% between 2019 and 2029, which will be added to the market share of e-bikes.

Europe



Overall bicycle market volume forecast for Europe (calendar years 2024 to 2029)

The European bicycle market is expected to continue its positive trajectory between 2024 and 2029, with market volume projected at 30-34 million units (conventional and electric combined) by 2029. This translates to a CAGR of 7-9%. In revenue terms, CAGR is expected to remain in the range of 10-12%. E-bikes in Europe may witness a CAGR of 12-14% between 2024 and 2029 owing to its wider adoption in the region. Several key drivers are propelling this expansion. Traffic congestion in European cities is a growing concern, prompting a significant shift towards alternative modes of transportation, with bicycles leading the charge. Furthermore, a rising focus on health and fitness, coupled with growing environmental awareness, is fuelling demand for bicycles as a means of exercise, recreation and sustainable commuting.

A key factor propelling this growth even further is the resurgence of e-bikes. These innovative bicycles with electric assist are attracting new demographics to cycling. E-bikes empower riders to conquer hills and longer distances

Source: Mordor Intelligence, CRISIL MI&A



with greater ease, making cycling a more accessible and attractive option for a wider range of people. With advancements in battery technology, e-bikes offer extended ranges and excellent performance, making them the preferred choice for urban commuting. This, combined with Europe's established cycling culture and welldeveloped infrastructure in many countries, creates a strong foundation for continued market expansion in the coming years.



Break-up of market share by product type in Europe (in million units)

The market share of conventional bikes in Europe is anticipated to reduce approximately 23% between 2019 and 2029, which will be added to the market share of e-bikes.

Japan

1-3 CAGR: 3.5-5.5% 0.5-2.5 0.5-2 **Million units** 0.5-1.5 2024 2029 Conventional Electric

Overall bicycle market volume forecast for Japan (calendar years 2024 to 2029)

Japan's bicycle market is poised for a comeback between 2024 and 2029, shaking off recent declines and clocking a CAGR of 3.5-5.5%. By 2029, bicycle volume is expected to reach 1-3 million units (conventional and electric combined). In revenue terms, CAGR is expected to remain in the range of 7-9% between 2019 and 2023. This moderate growth is fuelled by several factors. Urban congestion is prompting a shift towards bicycles for efficient commutes. A rising focus on health and environmental consciousness are making cycling a more attractive option

Source: Mordor Intelligence, CRISIL MI&A

Source: Mordor Intelligence, CRISIL MI&A



for exercise and sustainable transportation. E-bikes in Japan may witness a CAGR of 3-5% between 2024 and 2029 and may remain in between 0.5-2 million units by 2029.

Additionally, e-bikes in Japan, like in other regions, could lure new riders seeking an easier way to navigate Japan's hilly terrain or longer commutes. While growth might be slower than in other markets due to the previous decline, Japan's established cycling culture, growing health and sustainability concerns, and the potential of e-bikes suggest a positive outlook for the coming years.



Break-up of market share by product type in Japan (in million units)



The market share of conventional bikes in Japan is anticipated to reduce approximately 17% between 2019 and 2029, which will be added to the market share of e-bikes.

ASEAN

Overall bicycle market volume forecast for ASEAN (calendar years 2024 to 2029)



Note: ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

The outlook for the ASEAN bicycle market between 2024 and 2029 paints a picture of steady growth, albeit at a more modest pace compared to a few other regions. The ASEAN bicycle market's volume is anticipated to log a CAGR of 2.5-4.5%, reaching 0.5-1.5 million units by 2029. In revenue terms, the market is expected to clock a



CAGR of 5-7%. E-bikes in ASEAN may witness a CAGR of 14.5-16.5%, with volumes remaining between 0-0.5 million units.

As cities in ASEAN continue to expand, traffic congestion is becoming a pressing concern. Bicycles offer a reliable and cost-effective solution for shorter commutes. Also, disposable income is on the rise, and people in ASEAN nations might have more resources to invest in bicycles for recreation and fitness. There is also increased support from governments as they have been promoting cycling through infrastructure development and awareness campaigns, potentially boosting the market.

Unlike in developed markets, the evolution of e-bikes in the ASEAN region has not yet picked up pace. However, they have the potential to gain traction, particularly for riders in hilly areas or those seeking a less strenuous commute.

There are also a few challenges that have kept the bicycle market's volume low in this region. Many ASEAN countries lack dedicated cycling infrastructure, which deters potential riders. Also, bicycles in the region are not perceived as a viable mode of transportation, thus restricting consumers' desire to switch to bicycles/e-bikes. Despite challenges, growing focus on urban mobility solutions, rising disposable income, and the potential of e-bikes suggest a positive, though measured, outlook for the bicycle market in ASEAN between 2024 and 2029.



Break-up of market share by product type in ASEAN (in million units)

Note: ASEAN includes Singapore, Malaysia, Indonesia, Thailand, Vietnam, Philippines and Rest of ASEAN countries *Source: Mordor Intelligence, CRISIL MI&A*

The market share of conventional bikes in ASEAN is anticipated to reduce approximately 15% between 2019 and 2029, which will be added to the market share of e-bikes.



Outlook for the bicycle industry by motor type

Mid-drive motor





Note: The above figures include bicycle market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

Mid-drive motors are poised to dominate the global e-bike market (2024-29) across various terrains. Their natural riding experience, efficiency and performance on diverse landscapes make them a popular choice for riders of all styles. Advancements in motor technology further solidify their dominance. The US market, fuelled by a growing preference for e-mountain biking and recreational cycling, is expected to see a surge in mid-drive motor e-bikes. In Japan's hilly regions, these motors will likely gain traction for their ability to conquer slopes. While cost might initially hinder their widespread adoption in ASEAN, potential exists for increased affordability and recognition of their benefits. Finally, Europe, with its established cycling culture and preference for high-performance e-bikes, will likely continue to favour mid-drive motors due to their superior technology and efficiency. Despite regional variations, mid-drive motors are poised to lead the e-cycling revolution in the coming years.

By 2029, their volume is expected to reach 5-8 million units, at a CAGR of 13-15%. While volume of mid-drive motors remains lower than that of hub motors, mid-drive motors will easily surpass hub motors in value terms owing to their higher cost.



Hub motor



Hub motor volume forecast (calendar years 2024 to 2029)

Note: The above figures include bicycle market volumes for the US, Europe, Japan and ASEAN. *Source: Mordor Intelligence, CRISIL MI&A*

Hub motors are expected to register growth between 2024 and 2029. Their budget-friendly price tag makes them an attractive entry point for cost-conscious riders globally, particularly in regions such as ASEAN with limited disposable income. The simpler design also offers easier maintenance for some riders. While the US and Japan, with their focus on performance cycling, might see slower adoption of hub motors, they could still be a viable option for casual riders or those in flatter areas. Even in Europe, where high-performance e-bikes reign supreme, hub motors might retain some appeal for budget-conscious recreational riders. Overall, affordability and simpler design will ensure hub motors remain a relevant player, especially in budget-conscious markets, despite facing potential challenges from increasingly affordable mid-drive motors in the coming years.

By 2029, their volume is anticipated to reach 11-13 million units, at a CAGR of 11-13%. While hub motors may continue to witness healthy volume compared to mid-drive motors, their price point will keep them below mid-drive motors when looked at from a value perspective.

5 Review of the Indian bicycle industry

Review of the Indian bicycle industry (fiscal 2018 to 2024)

The Indian bicycle industry is a compelling story of tradition embracing innovation, affordability fuelling accessibility, and two wheels driving a nation forward. Its roots trace back to the pre-partition era, with iconic brands such as Hero Cycles and Avon Cycles emerging in the 1940s-1950s. These early pioneers laid the foundation for a thriving industry that today finds its undisputed centre in Ludhiana, Punjab. This city, strategically located with access to raw materials and a skilled workforce, churns out over 80% of India's bicycles. Ludhiana is the hub for bicycle manufacturing in India, with 3,500-4,000 MSMEs producing bicycle components, while the cluster produces almost 40,000-50,000 bicycles daily.

The success of the Indian bicycle industry can be attributed to its core strength: affordability and utility. Bicycles remain the backbone of transportation for millions in rural India, offering a reliable and economical way to commute, run errands and carry goods. This practicality extends to smaller towns and even Tier 2 and Tier 3 cities, where bicycles are seen as a viable alternative to congested public transport or expensive fuel-based vehicles.

However, the Indian bicycle industry is not merely content with serving the needs of the past. It is actively adapting to the changing landscape of the country. With rapid urbanisation leading to traffic gridlock in major cities, bicycles are emerging as a healthy and sustainable solution. Governments are recognising this potential, promoting cycling infrastructure through dedicated lanes and awareness campaigns. Additionally, subsidies on bicycle purchases are making them even more accessible, encouraging a shift towards a more eco-friendly mode of transportation.

Beyond the traditional roadsters dominating rural landscapes, the industry now offers a variety of options. Mountain bikes cater to adventure enthusiasts in India's diverse terrain, from the majestic Himalayas to the rugged Western Ghats. Hybrid bikes offer a comfortable balance between road and off-road capabilities, perfect for navigating the mixed terrain encountered in suburban areas. Folding bikes are gaining popularity in metro cities, providing a practical solution for urban dwellers with limited storage space and a desire to integrate cycling with public transport.

The future of the Indian bicycle industry is brimming with exciting possibilities. The e-bike segment is witnessing significant growth, offering a convenient option for longer commutes or hilly terrains. These pedal-assisted bicycles are poised to revolutionise urban cycling, especially for those seeking a comfortable and eco-friendly mode of transportation. Additionally, technological advancements are shaping the future with lightweight materials, innovative gear systems, and even connected bicycles that enhance user experience and attract new demographics. Manufacturers are also focusing on design and functionality, catering to a style-conscious consumer base with bikes that are not just practical but also aesthetically pleasing.

Classification of bicycles

The Indian bicycle market boasts a diverse range of options, catering to various terrains, riding styles and individual needs. Here is a closer look at some prominent classifications, exploring their unique features and ideal uses:

Roadsters: Roadsters prioritise comfort for everyday use. They feature an upright riding position that reduces strain on the back and neck, making them ideal for navigating city streets or running errands. Roadsters typically have single-speed or limited gear options, making them easy to maintain and perfect for riders who prioritise practicality over complex shifting mechanisms.



Mountain bikes: Mountain bikes boast sturdy frames designed to withstand rough terrain, with front suspension (and sometimes full suspension) to absorb bumps and provide a smooth ride on uneven surfaces. Wider handlebars offer riders better control on descents and technical sections, while knobby tyres with deeper treads provide superior grip on loose gravel, dirt and rocks.

Hybrid bikes: Hybrid bikes typically have a more relaxed riding position than road bikes, but with slightly wider tyres for some off-road capability. Hybrid bikes often have a wider gear range than roadsters, allowing riders to tackle inclines with ease and maintain comfortable pedalling on flat terrain. This versatility makes them ideal for navigating mixed surfaces encountered in suburban areas or for riders who want a single bike for both paved roads and occasional light off-road adventures.

Folding bikes: Folding bikes are a game changer for urban environments with limited storage space. Their ingenious design allows them to fold into a compact size, making them convenient for storing in apartments, offices, or even carrying on public transportation. Folding bikes are a popular choice for urban commuters who combine cycling with other modes of transport.

Electric bikes (e-bikes): E-bikes offer a convenient option for commuting in cities or for riders who want to enjoy the health benefits of cycling without excessive exertion. While still a developing segment in India, e-bikes hold significant promise for the future of cycling. They cater to the growing health-conscious population and offer a practical solution for hilly regions where traditional cycling might be more challenging.

Evolving application dynamics of bicycles

The bicycle in India transcends its role as a mode of transport, weaving itself into the fabric of daily life and economic activity. Here is a deeper exploration of its diverse applications:

Rural lifeline: In the vast tapestry of rural India, the bicycle transcends its role as a mere mode of transportation. It becomes an essential thread woven into the fabric of daily life, empowering communities and driving economic activity. Here is a closer look at how bicycles serve as a rural lifeline:

- In a landscape dotted with villages, bicycles bridge the gap between scattered homes and essential services. Students as well as villagers uses bicycles to navigate to different places that eliminates dependence on unreliable public transport or expensive fuel-based vehicles.
- Bicycles are the backbone of commerce in rural areas. Farmers transport their freshly harvested crops to markets on sturdy bicycle carriers.
- Bicycles play a crucial role in empowering rural women. Increased mobility allows them to access education and healthcare facilities that might otherwise be out of reach.

Fitness on two wheels: The landscape of physical activity in India is undergoing a fascinating transformation. While traditional exercise methods remain prevalent, a surge in cycling for fitness is becoming increasingly evident. This phenomenon can be attributed to a confluence of factors, each contributing to the bicycle's emergence as a prominent tool for promoting a healthier nation. First, cycling offers a highly effective cardiovascular workout. Secondly, the act of cycling strengthens various muscle groups including the quadriceps, hamstrings, calves, glutes and core.

Adventure tourism enabler: India's diverse landscape, from the snow-capped Himalayas to the rugged Western Ghats, presents a unique opportunity for adventure tourism. Nestled within these majestic terrains lie hidden waterfalls, remote villages and breathtaking vistas, all waiting to be explored. However, accessing these off-the-beaten-path locations often requires a mode of transportation that is both adventurous and adaptable.



Economic catalyst: The unassuming bicycle transcends its role as a mode of transport in India, transforming into a powerful economic catalyst that fuels activity across various sectors. The following points cover how bicycles grease the wheels of the Indian economy:

- For countless street vendors and small businesses, bicycles are their mobile shops. Bicycles offer a lowinvestment, efficient way for these entrepreneurs to reach customers, conduct deliveries and expand their market reach.
- Farmers use them to transport their harvested crops to markets, eliminating dependence on expensive fuel or unreliable public transportation.

Historical production development (fiscal 2018 to 2024)



Review of Indian bicycle (conventional) industry's sales volume

Between fiscals 2018 and 2024 the Indian bicycle industry's sales volume logged a negative CAGR of 0.4%. It reached 10.50 million units in fiscal 2024. Covid-19, unlike for other industries, helped the bicycle industry with added demand as many people switched to healthy lifestyle amidst the pandemic fear. Manufacturers, in anticipation of continuity of demand post Covid-19, were prepared as far as production was concerned, but the retail numbers did not meet manufacturers' expectations as the industry started witnessing a downturn in demand. The industry is still on its way to match the highs of fiscals 2020 and 2021.

Source: Mordor Intelligence, CRISIL MI&A



Key regulations/government policies at state and central levels

Dedicated lanes for cycling

Many cities in India have been encouraging cycling at a wider level to enhance health benefits for people and promote cycling as cleaner mode of transport. Following are some of the cities that have laid the foundation for the same and continue to encourage cycling as a safer option.

Pune

- Launched a bicycle-sharing programme alongside dedicated lanes on a specific route
- The initiative aimed to create a convenient and safe cycling experience

Bengaluru

- The Outer Ring Road project boasts dedicated lanes with segregated junctions
- These lanes incorporate improved safety features such as bollards and proper signage

Chennai

- Currently has limited stretches of dedicated lanes, primarily adjoining parks and recreational areas
- While these lanes offer some benefit for leisure cycling, they are not practical for commuting due to their short length. Further development of a more extensive network is needed

Ahmedabad

- The city is exploring the possibility of dedicated lanes in specific areas.
- There is potential to integrate these lanes with their existing cycling-sharing programme, MyByk, creating a seamless cycling experience

Gurugram

- Plans for dedicated lanes are under discussion, with a focus on integration with the Delhi Metro network
- This integration could potentially create a multi-modal transportation system, encouraging cycling for shorter distances and metro usage for longer commutes

Chandigarh

- Chandigarh is known to be a cycle friendly city and their road network planning includes dedicated cycling tracks in parallel with their major roads in order to promote cycling as an eco-friendly transport alternative
- These dedicated lanes are known to be relatively wider than that of other cities for easy and efficient commute

Public bike sharing a rising trend in India

Public bike sharing (PBS) is revolutionising urban mobility in India. As the term suggests, PBS embodies the concept of using bicycles/e-cycles as shared assets of transportation, irrespective of ownership. It is an integral component in ensuring inclusive, safe, resilient, sustainable and futuristic urban development, which aligns with the Sustainable Agenda for Urban Development 2030 and Sustainable Development Goals. In India, players like Yulu and SmartBike already operates in this regard, that facilitates riders to commute for short and medium distances within cities.



At the global level, Copenhagen can be credited with pioneering the adoption of PBS as part of the Traffic and Environment Plan in 1997, wherein the bicycle was the centrepiece of the entire mobility strategy. Similarly, New York introduced PBS as early as 1997.

In India, policies such as National Urban Transport Policy (NUTP), Jawaharlal Nehru National Urban Renewal Mission (JNNURM), and Smart City Mission began PBS by emphasising the implementation of non-motorised transport (NMT) infrastructure. The learnings from the global PBS model, the growing interest of international operators coupled with challenges of congestion, pollution and climate change have kindled interest in adopting PBS in India.

Owing to sustainability, affordability and health benefits, PBS has gradually emerged as a viable and attractive form of mobility in India without the hassle of owning and maintaining a bike. Moreover, it offers the convenience of firstand last-mile connectivity, eliminating the need for users to change transportation at various nodes. According to Census 2011, among 140 million workers in India who commute for work, a quarter travel for less than 1 km to work, and another third transit between 2 km and 5 km. This further strengthens the case for adopting PBS in India. Cities such as Ahmedabad, Indore, Kochi, Mysuru, Bhopal and Chandigarh have taken the lead in adopting PBS.

Rising government support and some recent events promoting cycling

The Indian government, the Cycling Federation of India and other private institutions are launching cycle races and championships to promote the use of bicycles. This, in turn, is expected to bolster demand for bicycles across the country. For instance,

- In February 2024, the Asian Track Cycling Championships 2024 in New Delhi saw the participation of a 22member Indian elite squad, although they failed to secure any medals
- In March 2024, the Asian Institute of Medical Sciences, a premier hospital in the Delhi NCR region and across India, hosted a Cyclothon on March 10. The event aimed to advocate for 'Cycling for Healthy Living' in honour of World Heart Day
- In November 2023, Maharashtra Chief Minister Eknath Shinde inaugurated the registration for the second iteration of the HindAyan Cycle Expedition & Race 2024
- Ahmedabad organises cycling events on a regular basis to promote health, fitness and well-being of people in the Gujarat state

Exports

The Indian bicycle industry has undergone a metamorphosis, transitioning from a dominant domestic market leader to a prominent participant in the international arena. This transformation is evident in the burgeoning export sector, where India has established itself as a formidable force.



Source: Mordor Intelligence, CRISIL MI&A

The Indian conventional bicycle industry boasts a significant presence in the global market, consistently ranking as the world's second-largest bicycle manufacturer over the past decade. This prominent position is largely attributed to a robust export sector, catering to the needs of budget-conscious buyers worldwide. In fiscal 2022, the industry exported 0.97 million units. There was a downturn in fiscal 2023 and fiscal 2024, with volumes declining to 0.55 million and 0.43 million units, respectively. Key reasons for the decline include, high production costs for bicycles catering to international markets like Europe, that restricts the manufacturers to produce premium bicycles specially for these markets; secondly, high freight and import duty from India makes Indian bicycles ~25% expensive than the other Asian countries like Sri Lanka, Bangladesh, Philippines, Cambodia.

Strategic geographic Reach:

While China remains the undisputed leader in global bicycle exports, India has meticulously carved out a niche market for itself. Key export destinations include the African nations (Mozambique, Zambia, Uganda, and Chad) and Nepal, constitute a significant market for Indian bicycles. These nations often seek cost-effective and dependable bicycles, which Indian manufacturers are adept at providing.

Moreover, several European countries, including Germany, the United Kingdom, Poland, and Sweden also import bicycles from India. This showcases the increasing recognition of Indian quality standards and production capabilities, enabling the country's manufacturers to compete effectively in developed markets.

Factors catalysing the growth

- **Cost-effectiveness**: Indian manufacturers possess a distinct advantage in terms of production cost. Lower labour costs compared with some developed nations allow them to offer competitive pricing for bicycles, making them an attractive proposition for import-focused countries.
- **Expansion of production capacity**: The Indian bicycle industry's production capacity has increased substantially in recent years. This augmentation empowers manufacturers to cater to the burgeoning international demand without compromising their ability to meet domestic demand.
- **Government policy Initiatives**: As previously discussed, government policies such as Make in India and the FAME scheme for electric vehicles have played an indirect role in supporting bicycle exports. By establishing a conducive environment for domestic manufacturing and promoting alternative modes of transportation, these initiatives have indirectly contributed to the overall growth of the bicycle industry.



Future considerations:

- E-bike potential: The increasing popularity of electric bicycles (e-bikes) presents a significant opportunity for Indian bicycle exports. By leveraging their existing production expertise and potentially lower production costs for e-bike components, India can capitalise on the global e-bike market boom.
- Sustainability and continued growth: Continued government support in terms of infrastructure development, skill development programmes and fostering innovation can further solidify India's position as a global leader in bicycle exports.

Electrification in bikes

The Indian bicycle industry, traditionally dominated by pedal-powered models, is undergoing a transformation in electrification. Concerns about rising fuel costs, environmental impact and growing urban congestion have sparked a surge in e-bikes. Government initiatives such as the FAME scheme offering subsidies on electric bicycles have further fuelled this trend. Advancements in battery technology with lighter, longer-lasting options have also enhanced the appeal of e-bikes. While still in early stages compared with developed nations, the Indian e-bike market is projected for significant growth, driven by a focus on affordable options, diverse product categories and a rising online sales presence. However, challenges such as limited charging infrastructure and the need for consumer education remain.



Review of electric bicyles in the Indian bicycles industry

Note: The above figures include domestic and export sale volume *Source: Mordor Intelligence, CRISIL MI&A*

Electric bicycles is still a very niche category in the Indian market since consumers are price-sensitive; moreover, the road infrastructure needs further alignment to embed bicycling as a trend. E-penetration has hovered at 0.1-0.8% between fiscals 2018 and 2024.

The evolution of e-bicycles is gradually outpacing the demand for traditional bicycles since it minimizes human effort by 70-80%. As the industry innovates, several other factors can help drive e-bike's growth. These include the following:

Rising trend in fuel costs

The sheer affordability of EV adaption is leading to soaring e-bike sales in India. For decades, a vast majority of the Indian population has relied on two-wheelers or scooters as an affordable option for personal mobility. However, the exponential rise in the cost of petrol has pushed customers to switch to electric two-wheelers. E-bikes offer a compelling alternative – they are significantly cheaper to run compared with fuel-powered vehicles, reducing the financial burden on consumers.

Technology integration for new-age customers

In today's digitally driven world, e-bikes are increasingly being integrated with new-age technologies to supplement evolving customer needs. The modern e-bikes are becoming a game-changer in the advanced and greener world. Apart from boasting a futuristic design, the e-bikes are also backed by a range of data-driven technologies.

Technological integration is critical for the success of electrification in the Indian bicycle industry, particularly for attracting new-age customers, for a few key reasons:

- **Enhanced user experience:** Technology can significantly improve the user experience with e-bikes. E-bikes offer features such as:
- **Connectivity:** Integration with smartphones allows riders to track rides, monitor battery levels, and access navigation assistance
- **Smart features:** E-bikes can be equipped with features like pedal-assist modes, adjustable power levels and built-in lights for increased safety and comfort
- Anti-theft measures: GPS tracking and remote locking systems can enhance security and provide peace of mind for new-age customers who may be hesitant to leave their e-bikes unattended
- Appeal for tech-savvy consumers: New-age customers are often tech-savvy and expect a seamless integration between their devices and the products they use. Advanced features and connectivity cater to this desire for a technologically integrated experience
- **Data-driven innovation:** By collecting data on user behaviour and preferences through e-bikes, manufacturers can gain valuable insights to improve future models and personalise the e-bike experience for new-age customers.

Ease in financing and accessibility

E-bikes, especially e-bicycles, are considered costlier than standard electric two-wheelers due to their futuristic design, engine, high-power battery and tech enablement. To ensure higher cost does not inhibit sales, many industry players have started coming up with easy financing options such as EMIs. This makes the vehicle more affordable and easier to finance.

Government intervention

The Indian government is continuing to support the EV industry by implementing several measures at the state and central levels. India's manufacturing infrastructure has enormous capabilities to develop EVs and e-bikes at a reduced cost. Subsequently, the government is doing its part by offering financial incentives and subsidies for e-bike manufacturing. The government is providing subsidies under the FAME India scheme. It has also announced initiatives such as the PLI scheme, battery switching policy, special electric mobility zones and tax reduction on EVs.

Key players in the Indian bicycle market

Туре	Brands	Description	
Established players	Hero Cycles	Dominating the Indian market, Hero Cycles boasts a diverse product portfolio encompassing an extensive range of bicycles catering to various consumer segments	
	TI Hercules Cycles	TI Hercules Cycles is a heritage brand known for its robust construction and reliability	
	Avon Cycles	Recognised for embracing innovation, Avon Cycles offers a variety of bicycles catering to performance, comfort, freestyle riding, and children	
	Atlas Cycles	Renowned for durability and value proposition, Atlas Cycles offers a wide range of bicycles for various applications	
Emerging players	Ninety One Cycles	Ninety One Cycles positions itself as a modern and innovative brand, appealing to a younger generation of cyclists who value design, performance and a seamless online buying experience	
	Rockstar Cycles	Rockstar Cycles carves a niche for itself by catering to the budget- conscious adventure cyclist	
	Mojospin Cycles	Mojospin Cycles is a relatively new player in the Indian bicycle industry, having emerged in recent years	

Note: Hero Cycles have options both in conventional as well as electric variants. Other mentioned manufacturers majorly caters to conventional buyers in India.

All the above brands have a different set of offerings for specific target customers. Below is the detailed information on the established players in the Indian bicycle industry.

Hero Cycles

Established in 1956 by the Munjal brothers in Ludhiana, Punjab, Hero Cycles has emerged as a prominent player in the Indian bicycle industry. Initially focused on the production of high-quality bicycle components, the company swiftly transitioned to manufacturing complete bicycles. Its unwavering commitment to quality and affordability has been instrumental in its success. By 1975, Hero Cycles had secured a leading position within the Indian bicycle market, becoming synonymous with reliability and value.

Hero Cycles caters to a diverse clientele across various cycling segments. It offers a comprehensive range of fitness and recreational bicycles, including hybrid, road and mountain bikes, catering to both fitness enthusiasts and casual riders. Additionally, it caters to the next generation of cyclists with a vibrant collection of children's bicycles.

In recent years, Hero Cycles has demonstrated a keen awareness of the evolving market landscape. It has strategically entered the electric bicycle (e-cycle) market, acknowledging the increasing demand for sustainable and assisted cycling options. This strategic move positions Hero Cycles to capitalise on the growing popularity of e-cycles. Furthermore, its commitment to innovation extends beyond product development. Through strategic acquisitions such as Firefox and Avocet Sports, it has broadened its product portfolio to encompass premium segments of the market. Additionally, recognising the global potential of cycling, it has made inroads into the



European market. This expansion beyond the Indian market signifies its ambition to establish itself as a global leader in the cycling industry.

TI Hercules Cycles

Established in 1949, the Hercules brand occupies a prominent position in the Indian bicycle industry. Although not a distinct entity, Hercules operates under the umbrella of the leading Indian bicycle manufacturer, Hero Cycles, founded in 1956.

Over the years, the Hercules brand, as part of the broader Hero Cycles portfolio, has catered to a diverse range of cycling needs. It offers a range of sturdy and economical bicycles specifically designed for everyday commuting, ensuring a reliable and cost-effective transportation option for many. Recognising the growing emphasis on health and leisure, the brand also includes a selection of fitness and recreational bicycles. Additionally, it caters to the next generation of cyclists with a vibrant collection of children's bicycles offered under the Hercules name.

Recent developments undertaken by Hero Cycles extend to the Hercules brand as well. Both Hero Cycles and the Hercules brand are actively entering the e-cycle market, acknowledging the increasing demand for sustainable and assisted cycling options.

Avon Cycles

Established in Ludhiana, Punjab, in 1951, Avon Cycles occupies a prominent position in the Indian bicycle industry. Founded by the Pahwa brothers, the company emerged with a distinct vision.

Avon Cycles caters to a diverse range of cycling needs, ensuring it possesses a product portfolio that caters to a variety of riders. A significant portion of its market lies in sturdy and economical bicycles for everyday commuting purposes. These bicycles serve as a reliable and cost-effective mode of transportation for individuals in both urban and rural areas. Recognising the growing popularity of cycling as a form of exercise and leisure, Avon Cycles offers a range of fitness and recreational bicycles. This includes options such as hybrid and mountain bikes, catering to both fitness enthusiasts and casual riders.

Acknowledging the increasing demand for sustainable and assisted cycling options, Avon Cycles has embraced ecycles, ensuring it remains relevant in the face of changing consumer preferences and environmental concerns.

Atlas Cycles

Established in 1951 in Sonipat, Haryana, by the Sohan Lal family, Atlas Cycles once occupied a prominent position in the Indian bicycle industry. Initially, Atlas Cycles rose to prominence by offering high-quality bicycles at prices accessible to most of the Indian population. The early years for Atlas Cycles were marked by a steadfast commitment to quality and consistency.

Atlas Cycles faced increasing challenges in the latter half of its journey. The market for bicycles in India began to evolve, with growing demand for a wider range of products beyond those solely focused on utilitarian commuting. Consumers increasingly desired options for fitness and recreation, a segment that Atlas Cycles was not well-positioned to address. Additionally, the Indian bicycle industry witnessed an influx of competitively priced imports alongside the emergence of new domestic players. These factors put significant pressure on Atlas Cycles' market share, which forced it to cease operations in 2014.



Outlook of the Indian bicycle industry (fiscal 2025 to fiscal 2029)

Sales outlook of the organised market in India

Outlook of domestic Indian bicycle (conventional) industry sales volume



Source: Mordor Intelligence, CRISIL MI&A

The Indian bicycle industry is expected to grow at a decent pace from fiscal 2025 to fiscal 2029. Several factors are projected to contribute to this upward trajectory. One key driver is the growing national emphasis on health and fitness. As the health benefits associated with cycling gain wider recognition, a corresponding rise in demand for bicycles designed for fitness and recreational purposes is expected. Furthermore, urbanisation and the concurrent need for environmentally friendly transportation solutions are poised to play a significant role. As Indian cities continue to expand, the demand for convenient and sustainable alternatives to automobiles and public transportation is expected to surge. Bicycles offer a healthy and eco-friendly mode of transportation, contributing to reduced air pollution and traffic congestion. Government initiatives that promote cycling infrastructure and green transportation initiatives will further fuel this growth.

The burgeoning e-cycle market presents another exciting avenue for expansion. E-cycles provide an assisted cycling experience, making cycling more accessible to a wider demographic, encompassing senior citizens and individuals seeking to undertake longer commutes. Additionally, ever-increasing fuel prices are likely to incentivise the adoption of bicycles as a more economical mode of transportation.

Amid the requirement to improve on the innovation and infrastructure fronts, the Indian bicycle industry is expected to grow at 4-6% CAGR between fiscals 2025 and 2029, with volumes reaching 13.2-13.7 million units.

Impact of regulatory changes on the Indian cycle market

Cycle reflector law

The cycle reflector law mandates bicycles must be equipped with front and rear reflectors. These reflectors should be strategically placed to maximise visibility, ensuring that both oncoming and trailing vehicles can spot cyclists.

The government's decision to make BIS (Bureau of Indian Standards)-certified reflectors mandatory on bicycles from January 1, 2023, was later followed by an extension of 6 months with all guidelines remaining unchanged. Though manufacturers have been mandated to comply with this law, there have been some differences among the



manufacturers and the All India Cycle manufacturers' association because of which the decision has been implemented leniently. However, efforts are being made to penalise manufacturers in case of non-compliance since as the law's objective is to ensure the rider's safety.

Potential upcoming PLI schemes for the bicycle industry

Government is considering a PLI scheme for the cycle sector, especially for e-bikes, to support their manufacturing in India without being reliant on any other country for sourcing of raw materials, auto-components, etc. A PLI scheme will boost the production of e-cycle components, making India a hub for the technology powering these vehicles worldwide.



Estimated sale volume of electric bike in India by fiscal 2029

Note: The above figures include domestic and export sale volume Source: Mordor Intelligence, CRISIL MI&A

The electric bike industry in India is expected to log a CAGR of 18-22%, reaching 0.17-0.19 million units by FY2029. In revenue terms, the market is expected to clock a CAGR of 25-30% between FY2024 and FY2029 and stand at Rs. 6.5-7.5 billion by FY2029. Electric penetration in Indian bicycle industry is expected to be 0.7-0.9% in fiscal 2025; the penetration may be at 1.2-1.5% in fiscal 2029. Going ahead in the next five years, realization per unit may go up as premiumisation in the industry is expected to gain acceptance amongst customers.

6 Review and outlook of the global ATV industry

Review of the global ATV industry (2019 to 2023)

The all-terrain vehicle (ATV), a four-wheeled machine distinguished by its knobby tires and expansive stance, has carved out a unique niche within the transportation landscape, situated between motorcycles and automobiles. Emerging in the 1960s from modified agricultural three-wheeled utility vehicles, ATVs, also known as quad bikes, gained popularity rapidly due to their exceptional ability to traverse challenging terrain. This capability offered a thrilling recreational experience for off-road enthusiasts while simultaneously proving to be a practical tool for farmers and ranchers.

ATVs excel in an array of applications, ranging from recreational pursuits such as hunting, fishing and exploration, to vital roles in search-and-rescue operations. Their manoeuvrability and proficiency in navigating rugged landscapes make them an invaluable asset. The flourishing recreational sector, with its emphasis on adventure sports and off-road activities, has fuelled demand for ATVs, particularly among younger demographics. Within the agricultural sector, ATVs have become a workhorse, effectively replacing manual labour for tasks such as crop spraying, livestock herding and equipment transportation. Even the military has embraced the utility of ATVs, employing them for reconnaissance, patrolling and troop transport in difficult terrain.

The global ATV market is poised for continued expansion driven by several key demand drivers. Rising disposable income, particularly evident in developing economies, empowers consumers to invest in leisure activities such as ATV riding. The burgeoning tourism sector, with its focus on adventure travel, creates a demand for ATV rentals and tours in scenic locations. Additionally, increased military spending in certain regions could translate to a higher demand for ATVs for military applications.

However, the ATV market has not been without its challenges. Safety concerns and environmental impact have been prominent issues. The industry is actively addressing these concerns. Advancements in safety features, such as the implementation of roll cages, and improved rider training programmes are enhancing the safety profile of ATVs. Additionally, manufacturers are actively exploring the development of electric and hybrid models to mitigate the environmental impact and cater to environmentally conscious consumers.

Geographically, North America remains the dominant market for ATVs, driven by a culture of outdoor recreation, hunting and established off-road riding trails. However, significant growth is expected in the Asia Pacific and Latin America due to rising disposable income, increasing interest in adventure sports and the development of dealership networks. Europe holds a steady market share, with a focus on utility applications in agriculture and recreational riding in designated areas.

The ATV market is expected to witness continued technological innovation. The focus will be on the development of electric and hybrid models to address environmental concerns and potentially lower running costs. Safety will remain a paramount consideration, with continued development of features to enhance rider protection.

Historic production development (2019-2023)

Review of global ATV sales volumes



Note: Above figures comprise of sales for United States and Europe Source: Mordor Intelligence, CRISIL MI&A

During the period 2019-21, ATV industry witnessed a CAGR of 3.2%, which further took a hit during the latter half where industry saw a decline of 1.7% between 2021-23. Overall, between 209-23, industry witnessed a CAGR of 0.7%. United States has been the major contributor to the demand of ATV (All-Terrain Vehicles)

Types of ATVs and their applications

Category	Focus	Features	
Utility ATV	Work and Functionality	Large engines, robust racks and towing capacities, driver & passenger seats	
Sport ATV	Performance and Handling	High-performance engines, sport suspensions, aggressive tires (single-rider)	
Recreational ATV Fun and Leisure Riding		Balance between utility & sport, comfortable ride, larger tires (single or two-rider)	
Youth ATV Safe Riding for Young Riders		Smaller, less powerful versions with safety features for young riders	
Side-by-Side (SxS) VehicleOff-road Passenger Transport & Utility		Bench seating (2-4 riders), steering wheel, cargo bed	



Global ATV sales by geography

United States

Review of United States ATV sales volumes



Source: Mordor Intelligence, CRISIL MI&A

During 2019-23, the industry grew at 0.6% CAGR in the US. Key industry drivers included the benefits of using ATVs in agriculture, sports, recreation and military. These serve as the significant determinant for the growth of the ATV market in the country. The total expenditure on recreation in the United States touched \$507.8 billion in 2022 compared with \$ 447.3 billion in 2021, recording 13.3% on-year growth between 2021 and 2022.

There are strict rules and regulations for consumers operating an ATV in the United States. Each state has its own set of regulations. For instance:

- **Ohio's ATV law** states no person younger than 16 years of age may operate an ATV unless accompanied by a licensed adult 18 years of age or older or on private land owned or leased by a parent or guardian
- **Pennsylvania's ATV law** states no one between the ages of 8 and 15 may operate an ATV unless it is on a parent's or guardian's land, or the individual has participated in an ATV safety training course and has a safety certificate, or if they are under the direct supervision of a certified ATV safety instructor during the course.

Following are some of the features driving the ATV industry in the United States:

Demand for ATVs in United States: <u>With the increasing popularity of outdoor sports in the US, demand for ATVs</u> has been gaining traction in the country in recent years owing to their usage in outdoor recreational activity, hunting, snow plowing, killing weeds, camping, winching, field plowing, lawn/field mowing, etc.

According to the Sports and Fitness Industry Association, the share of population who took part in outdoor sports in the US comprised 57.3% in 2023 compared with 55.0% in 2022.

Consumer demographics: Many ATV-owning individuals in the US have an annual household income of \$65,000 or more. Polaris, Yamaha, and Honda are widely popular among consumers. A majority share of Honda and Polaris ATV owners live in rural areas.



Recent developments: In August 2023, Honda announced the launch of three new ATV models in the United States: the FourTrax Recon, the TRX250X, and the TRX90X. The FourTrax Recon, equipped with a 229-cc engine, attracts a starting price of \$4,799.

Europe

Review of Europe ATV sales volumes



Source: Mordor Intelligence, CRISIL MI&A

During 2019-23, the ATV industry in Europe grew at 1.2% CAGR. The use of ATVs in Europe has been significantly boosted by recreational activities and agricultural, and landscaping operations. Numerous nature parks have integrated these vehicles into activities such as horticulture, herding and timber cutting. Since most ATVs are not permitted to be operated on highways and other main roads, government authorities across the region have increased the budgetary allocations to build new off-road trails that may be helpful for recreational enthusiasts and boost adventure sports activities in the region. This is expected to have a positive impact on the market.

Popular players and brands

Country Brands		
	Polaris	
	Can-Am	
US	Honda	
	Yamaha	
	Kawasaki	
	CFMOTO	
Europa	BRP (Can-Am)	
Europe	Yamaha	
	Polaris	

Outlook of the global ATV industry (2024 to 2029)

Outlook of ATV sales volumes (2024-2029)



Note: Above figures comprise of sales for United States and Europe Source: Mordor Intelligence, CRISIL MI&A

Overall, the industry is expected to grow at 3-4% CAGR from 2024 to 2029 period, with volumes reaching up to 500-550 thousand units, for both the US and Europe geographies.

Outlook of global ATV sales by geography

United States

Outlook of US ATV sales volumes (2024-2029)



Source: Mordor Intelligence, CRISIL MI&A

Various companies operating in the ecosystem are actively focusing on ramping up their production capacity to cater to the increasing consumer demand. We expect technological integration during the forecast period in the market, with GPS navigation systems, smartphone integration and touch screen displays.

Thus, the ATV industry is expected to grow at 3-4% CAGR between 2024 and 2029, with volumes reaching up to 380-430 thousand units.



Europe

Outlook of Europe ATV sales volumes (2024-2029)



Source: Mordor Intelligence, CRISIL MI&A

People's growing interest in sports and recreational activities has emerged as a major driving factor for ATVs. Manufacturers are working towards making frequent advancements in developing a eco-friendly versions to address growing carbon emission concerns and further boost the market size of ATVs.

Thus, we expect the ATV industry in Europe to grow at 3.5-4.5% CAGR between 2024 and 2029 with volumes reaching up to 120-140 thousand units.



7 Review and outlook of the Indian auto component industry

Review of the Indian auto component industry (fiscal 2019 to fiscal 2024)

Historic growth and review of current market size (fiscal 2019 to fiscal 2024)

Auto component production (which includes sales to OEMs, exports and the replacement market) has increased at 7.3% CAGR to Rs 5,328 billion in fiscal 2024 from Rs 3,738 billion in fiscal 2019. While domestic sales are more volatile due to various factors such as regulations, fuel prices, economic cycles, etc. that impact short-term demand, exports and the aftermarket help buffer overall growth in auto component production from similar fluctuations.



Figure: Domestic production of auto components (fiscal 2019 to fiscal 2024)

Source: CRISIL MI&A

Auto component production revenue increased at 7.3% CAGR between fiscals 2019 and 2024, helped by the economic recovery, buoyant demand from the OEM and replacement markets as well as increase in exports. CRISIL estimates domestic auto component production revenue to increase 8-10% in fiscal 2025.

Production of automotive components depends on consumption by different end-user segments, such as OEMs, exports and the replacement market. OEM demand can be further segregated based on various vehicle segments. In fiscal 2024, OEMs accounted for almost 63% of auto component production by value. Among OEMs, cars and utility vehicle manufacturers remain the largest consumers.

Automotive component players are prone to risk due to the dependence on a few select clients or vehicle category; they are highly dependent on demand from OEMs.

The domestic auto components industry largely comprises small and medium enterprises. The industry is composed of 780+ organised players and 5,800 unorganised players. In terms of revenue, however, the organised



segment dominates. Auto Component Manufacturers Association (ACMA) members represent 85% of the overall industry turnover. Over the past few years, more auto component companies have been registering as members of the ACMA.



Figure: Review of auto component production segments by vehicle category

Source: SIAM, CRISIL MI&A





Source: CRISIL MI&A

Figure: CAGR trend in domestic production of automotive components (fiscal 2019 to fiscal 2024)

	OEM	Replacement	Exports
FY 2019-24	7.2%	5.0%	10.1%

Source: CRISIL MI&A



In fiscal 2024, the replacement segment is expected to clock 6-8% growth supported by economic expansion. In fiscal 2023, replacement demand growth was on the back of healthy OEM demand witnessed between fiscals 2017 and 2019. Assuming a 2-3 year lifespan of automotive components, pent-up demand from fiscal 2020 and 2021 is likely to have translated into replacement opportunity in fiscals 2022 and 2023. Additionally, demand in the replacement market is expected to grow due to an increase in penetration of cab aggregator services in the overall stock of passenger vehicles in the medium term.

Auto component production revenue has surpassed the fiscal 2019 levels, when the industry reported robust growth across segments. Passenger vehicles, commercial vehicles and tractors are seen surpassing pre-Covid levels of production in fiscal 2023 while 2W, 3W will recover from the slump in fiscals 2021 and 2022, albeit still remaining below pre-Covid levels. Healthy demand from OEMs will drive auto-component demand followed by the replacement and export markets.

The second wave in April 2021 and the resultant lockdown impacted industry revenue in the first quarter of fiscal 2022. Post the reopening, there was some recovery in the industry in the second half. Growth in the fiscal was aided by economic recovery, buoyant demand from key export destinations such as North America and Europe and increased demand from the replacement market led by pent-up demand. CRISIL MI&A estimates production revenue increased 27% in fiscal 2022.

In fiscal 2024, imports increased by ~10% on year growth. Fiscal 2022 saw big spike of 37% in imports on lower base of FY21. In fiscal 2021, imports declined by ~20% owing to subdued demand from OEMs and aftermarket amid the pandemic. Besides, the domestic auto component manufacturers also operated at below-normal utilization levels in the first half owing to subdued demand and nationwide lockdown.

Review of auto component exports (fiscal 2019 to fiscal 2024)

Auto component exports grew at a strong 11% CAGR during fiscals 2019-2024. Even during fiscals 2017-2020, exports increased at a healthy 11% CAGR. There was a contraction in fiscal 2021 amid the pandemic and related restrictions.

Auto component exports accounted for 21% of overall demand in fiscal. They are projected to grow 7-9% on-year this fiscal after an expected increase of 11-13% in fiscal 2024. The growth would be on the back of demand from North America and Europe, which together contributed ~45-50% to export demand in the April to January period in fiscal 2024. We also expect increased global demand and manufacturers looking to derisk their supply chain to support export revenue. However, rising inflation and global economic slowdown remain key monitorables.

Exports grew in fiscal 2024 despite the higher base of fiscal 2022. Demand from North America surged 19% whereas Europe expanded a modest 3% on-year during fiscal 2023 over a high base. From April to May 2024, demand from North America and Europe grew 8% and 21%, respectively.

India's top exports destinations are the US (27.8% of total exports), Germany (6.9%), Turkey (5.4%) and Brazil (3.7%). Export demand recovered strongly post the unlocking. However, demand from Europe has been under pressure due to recessionary fears and the global slowdown.



Figure: Review of auto component exports (fiscal 2019 to fiscal 2024)

Source: CRISIL MI&A

Segment-wise major auto component categories in value terms

Engine components command the major share by revenue, followed by suspension and braking, drive transmission and steering, etc.

Critical components, such as engine parts, drive transmission and steering, and electrical are technologically more complex compared with lower-margin components, which were earlier the preserve of Indian players. They offer higher margins to manufacturers, but require greater investment in research and development, as well as high-precision engineering to adhere to the stringent quality standards of global OEMs.



Figure: Segment-wise production break-up (Fiscal 2024)

Source: Automotive Component Manufacturers Association (ACMA), CRISIL MI&A

Growth drivers for the Indian auto component industry

Demand-side factors

Vehicle production: Passenger vehicles, commercial vehicles and tractors are seen surpassing pre-Covid levels of production in fiscal 2023 while two- and three-wheelers will recover from slump in fiscals 2021 and 2022, but will remain below pre-Covid levels. Healthy demand from OEMs has been driving auto-component demand followed by replacement and export markets.

CRISIL MI&A expects almost all vehicle segments to log robust production growth over fiscals 2024-29. Production of two-wheelers, three-wheelers, passenger vehicles and commercial vehicles is projected to grow at a CAGR of 7-9%, 10-12%%, 5-7% and 3-4%, respectively, over the forecast period.

Key macroeconomic trends are also likely to support demand for two-wheelers, three-wheelers and passenger vehicles over the medium to long term. CRISIL MI&A expects urbanisation to reach 37-38% by fiscal 2027 from ~35% in 2020. India's per capita income is also projected to log 6-7% CAGR over fiscal 2022 to fiscal 2027. These factors are likely to drive premiumisation across vehicle segments.

Rising per capita income: In fiscal 2021, per capita income declined 8.9% owing to GDP contraction amid the pandemic's impact. On the lower base of fiscal 2021, per capita income rose 7.6% in fiscal 2022. However, per capita income is forecast to decline in line with the GDP projection. According to the International Monetary Fund's estimates, India's per capita income (at current prices) is expected to increase at 7.6% CAGR over calendar years 2023 to 2028.

Investment in Infrastructure: Infrastructure improvements are expected to support automobile demand on account of employment generation, and improved accessibility and mobility.

Supply-side factors

- India has a cost advantage in auto component production since it has cheap labour costs, is the world's second-largest producer of steel, and is close to important automotive markets. This makes it an ideal location for businesses to source vehicle components
- India exports a significant amount of car components, which is likely to increase in the future years. India
 excels at manufacturing particular types of vehicle components, such as shafts, bearings and fasteners, giving
 it a competitive advantage over other countries
- The industry has been continuously upping its quality standards and developing new products to compete globally. Trade liberalisation in western markets has led to the emergence of Asia as an export hub for Europe and North and South America over the past decade. With supply-chain realignment, several countries (including India) are likely to emerge as global outsourcing hubs in the coming years
- Many domestic manufacturers have successfully entered strategic alliances/collaborations, while others are
 actively testing the waters. Many of the world's leading Tier 1 suppliers have set up manufacturing facilities in
 India, including Bosch, Delphi, Visteon and Denso. Additionally, some suppliers already meet global technical
 and quality standards at the Tier 1 level. Some of India's leading OEM suppliers include TACO (Tata AutoComp
 Systems Limited), Bharat Forge, Sundaram Clayton and Sundaram Brake Linings
- Two-wheeler automakers are introducing new models more frequently ever than before. This will also drive growth of the auto component industry as changes in the process of manufacturing and designing will support the pricing power of component manufacturers



Policy support

- PLI schemes on automobiles and auto components are estimated to generate a capex of Rs 748.50 billion (\$9.58 billion) over the next five years. Under the automated route, 100% FDI is permitted in the auto components business. The Bharat New Car Assessment Programme (BNCAP) will not only enhance the auto component value chain, but will also push the production of cutting-edge components, inspire innovation and nurture global excellence
- As many as 115 companies applied for the Rs 259.38 billion PLI scheme for the automotive and the auto component sector; 75 have been approved for the Component Champion Incentive scheme. Incentives are applicable for vehicles and auto components manufactured in India from April 1, 2022 onwards for five consecutive years. The proposed incentives for OEMs range from 13% to 18% of determined (incremental) sales value, while those for component manufacturers vary from 8% to 13%
- As the FAME scheme concluded on March 31, 2024, the government Automotive Mission Plan (AMP) 2006-26 has been critical in assuring the sector's growth
- The EMPS 2024 (Electric Mobility Promotion Scheme) was introduced by the Ministry of Heavy Industries with a total outlay of Rs 5 billion for four months, with effect from April 1, 2024 till July 31, 2024. The scheme promotes faster adoption of electric two-wheeler (e-2W) and three-wheeler (e-3W) to provide further impetus to the green mobility and development of electric vehicle (EV) manufacturing ecosystem.

Electrification

The government has reaffirmed its support for EVs and its goal of achieving 30% electric transportation by 2030. Customs duty exemptions on the import of capital goods and machinery essential for the manufacture of lithium-ion batteries, which commonly power EVs, were announced in the budget.

EV adoption in India over the next five years is expected to be largely driven by the two- and three-wheeler segments. Electric two-wheelers are seen to have lower cost of ownership and acquisition compared with ICE scooters, which account for over 30% of the two-wheeler industry. This segment is expected to be the first one to migrate to the electric platform. Electric three-wheelers also have a lower cost of ownership and acquisition compared with their CNG and diesel counterparts.

Growing electronics content per vehicle

The use of semiconductors in automobiles has increased manifold in the past couple of years. Semi-conductors are used in engine control units, power steering, airbags, reverse parking assist, smart keys, telematics, in-car entertainment and other applications inside an automobile. Among vehicle segments, the intensity of use of semiconductors is higher for passenger vehicles (especially high-end models) and moderate for commercial vehicles while lesser for two-wheelers (except premium motorcycles) and tractors since there are fewer electronics used.

Critical component mix is increasing in the auto component exports basket

Critical components, such as engine parts, drive transmission and steering, and electrical, are technologically more complex compared with lower-margin components, which were earlier the preserve of Indian players. They offer higher margins to manufacturers, but require greater investment in research and development, as well as high-precision engineering to adhere to the stringent quality standards of global OEMs. Typically, automotive OEMs are highly selective in qualifying suppliers with respect to critical products given the risks of switching suppliers, especially where product reliability is critical.



Indian manufacturers have been able to gradually increase their proportion of exports of critical components since they faced relatively less competition from other low-cost producing countries in this segment. Many of these countries supplied more basic components, which were not as cost and quality intensive. India stepped up its share of exports of critical components significantly. This was possible since the domestic automotive market is increasingly attaining global technological intensity levels and component manufacturers continue to acquire greater technological prowess. Critical components are mainly exported to the US, Germany, Turkey, Italy and Brazil. Also, of late, Indian safety and emission norms have been nearing global standards, and domestic companies have been gaining technological capabilities through joint ventures. Hence, critical component exports are projected to grow in the medium term.

Outlook of the Indian auto component industry (fiscal 2025 to fiscal 2029)

CRISIL MI&A expects auto component market size to grow at 9-11% CAGR between fiscals 2024 and 2029 to reach Rs 8,500-9,000 billion. This is more than the ~7% CAGR during fiscals 2019 to 2024. Long-term growth will appear higher over a low base wherein the auto component industry witnessed a significant decline in the preceding two fiscals (fiscals 2020 and 2021). Demand from all segments has grown further post fiscal 2023.

CRISIL MI&A projects auto component revenue would increase 8-10% in fiscal 2025. This can be attributed to increase in OEM demand, driven by the recovery in the CV and PV demand. On the export front, auto component exports (accounting for 21% of the overall demand in fiscal 2024) are projected to post higher double-digit growth post fiscal 2024.



Figure: Outlook on domestic production of auto components (fiscal 2024 to fiscal 2029P)

E: Estimated, P: Projected Source: CRISIL MI&A





Figure: Outlook on domestic consumption of auto components (fiscal 2024 to fiscal 2029P)

E: Estimated, P: Projected Source: CRISIL MI&A

Growth this fiscal will be aided by economic recovery (GDP growth of ~6.8%), buoyant demand from OEMs and the replacement market.

OEM demand is expected to clock 11-13% CAGR between fiscals 2024 and 2029 on the back of robust production growth across asset classes in the medium term (on a low base) and aided by realisation growth via OEM price increases.

Commercial vehicle production is expected to grow 3-5% CAGR between fiscals 2024 and 2029 on account of higher infrastructure expenditure and lower penetration in light commercial vehicles. Demand is expected to increase during the period with medium and heavy commercial vehicle leading the growth in the upcoming five years. The growth can be attributed to an improvement in industrial activity, rising replacement volume and government's thrust on rural transportation.

Passenger vehicle segment production is expected to grow 6-8% in fiscal 2025. Production improved significantly in fiscals 2023 and 2024 due to easing supply conditions coupled with healthy demand for new models, primarily UVs. Capacity utilisation levels of PV manufacturers are likely to be higher this fiscal compared with 68-72% the preceding year.

Two-wheeler production growth is expected to grow 11-13% in fiscal 2025. Two-wheeler production grew 10% in April-February of fiscal 2024 owing to strong festive season demand and increasing EV adoption. Domestic wholesale volume is expected to grow 10-12% in fiscal 2025 after an expected 11-13 % growth in the preceding fiscal.

Tractor production will likely increase 4-6%, aided by a predicted normal monsoon boosted by the impact of La Nina in fiscal 2025. The increase Is after an expected 8-10% decline in fiscal 2024 due to lower domestic demand as poor distribution of monsoon, low reservoir levels, elevated inventory levels and impacted rural incomes restricted demand.

The proportion of manufacturing activity outsourced to auto component makers is highest for cars and utility vehicles, explaining this segment's high contribution to OEM revenue. Outsourcing in the commercial vehicle



segment is lower than for cars but is expected to increase in the future owing to growing technological spends by auto component players due to BS VI and safety norms. We expect localisation by certain OEMs to increase, in turn supporting growth in domestic OEM offtake.

Healthy replacement demand and higher realisations to support replacement demand

The auto component replacement market is projected to increase at 7-9% CAGR between fiscals 2024 and 2029. This is due to increased OEM demand between fiscals 2017 and 2019 with a two to three year of replacement cycle. Moreover, auto component players undertook price hikes in recent months to offset the uptick in commodity prices. Hence, rising realisation, to an extent, coupled with pent-up demand from fiscal 2021 wherein vehicular movement was restricted, is likely to aid demand growth. Besides, demand in the replacement market is expected to grow due to an increase in the penetration of cab aggregator services in the overall stock of passenger vehicles. Nonetheless, increased durability of components (better quality), better road infrastructure and increase in service intervals would restrict the robust growth.

'Make in India' push is likely to put brakes on import growth in the long term

Imports are expected to grow 8-10% between the fiscals 2024 and 2029. The government's focus on EVs and imports of batteries, cells and battery management systems (BMS) is expected to drive growth in the long term, although low EV penetration will restrict it in the near term. However, the PLI scheme would provide Rs 181 billion for advanced chemistry cell batteries, which is expected to increase localisation of battery manufacturing. This will reduce such imports going ahead.

Conclusion

The mobility industry is experiencing a transformative shift across the globe due to the increasing electrification of vehicles, significantly impacting powertrain solutions such as motors, gearbox/transmission systems, and integrated E-drive units. This shift is reshaping the competitive landscape, with a distinct advantage for players who possess expertise in high technology and integrated powertrain solutions. Products characterized by high performance, low noise vibration harshness (NVH), and lightweighting are becoming increasingly vital. These requirements are essential for the next generation of electric and hybrid powertrains, which require both high efficiency and superior performance.

Companies with robust research and development capabilities, strong technological prowess, and a healthy financial profile are emerging as industry leaders. The public transport segment, last mile mobility segment, e-two wheelers, e-bikes, and e-passenger vehicles are at the forefront of this global electrification trend, driving significant demand for design and development capabilities among solution providers. As the industry continues to evolve, companies that can leverage both design and development capabilities with a robust technological understanding will lead this technological evolution. Hero Motors is one of the few auto component companies that has access to advanced technology, has made strategic expansions, and built strong partnerships which places them well to take advantage of the evolving opportunities.


8 Overview of key product segments

Overview of components for gears and transmission

Gearbox



By meticulously adjusting speed and torque, gearboxes empower an array of machinery, from automobile engines to the drill in the toolbox. The gearbox landscape boasts of a diverse range of designs, each catering to specific applications and performance requirements. Some of the prominent gearbox types are:

Manual gearboxes

They provide a direct connection between the driver and machine. The driver, through a clutch and gear lever, manually selects the desired gear ratio, which grants precise control over the engine power and allows for manoeuvres such as engine braking. However, manual gearboxes demand a higher level of driver skill and engagement.





Advantages

Greater control: Drivers have a more precise control over the engine's power delivery by selecting the optimal gear ratio for the driving situation. This can be advantageous for tasks such as engine braking or navigating a challenging terrain.

Potentially improved fuel efficiency: Skilled drivers can achieve better fuel efficiency with manual transmissions by selecting the most appropriate gear for the situation. This allows the engine to operate in its most efficient revolutions per minute (RPM) range.

Considerations for manual gearboxes

Increased driver effort: Driving a manual transmission can be more demanding, especially in stop-and-go traffic. The constant use of the clutch pedal and gear lever, also in case of motorcycles, with the constant use of clutch and shift lever, can lead to fatigue on long journeys.

Potential for wear and tear: Improper gear changes or clutch operation can lead to premature wear and tear on the clutch components and gears.

Automatic gearboxes

Offering a more convenient driving experience, automatic gearboxes liberate the driver from the task of gear selection. They utilise a complex interplay of a planetary gearset, torque converter and a sophisticated control unit, which seamlessly changes gears to optimise performance and efficiency by analysing engine speed, vehicle load and other factors.

Advantages

Uninterrupted power delivery: Automatic transmissions eliminate the jolts and hesitations associated with gear changes in manual transmissions translating to a noticeably smoother and more comfortable driving experience, reducing fatigue, especially in stop-and-go traffic.

Potentially improved fuel efficiency: Modern automatic transmissions can be surprisingly fuel-efficient. The ECU (Electronic Control Unit) can optimise gear selection based on real-time data, keeping the engine operating in its most efficient RPM range.

Enhanced safety: With little need to focus on gear changes, drivers can focus on the road and potential hazards, improving the overall safety.

Considerations

Cost: Vehicles equipped with automatic transmissions typically come at a slightly higher initial cost, compared with their manual counterparts.

Maintenance: Automatic transmissions may require more frequent maintenance or specialised fluids, compared with manual gearboxes.

Potential for less driver engagement: Some drivers might find automatic transmissions less engaging, as they lack direct control over gears otherwise offered by manual ones. However, modern automatics often incorporate features, such as sport modes or manual shifting options to cater to such preferences.



Difference between Automatic and Manual Transmission in terms of internal complexity

Number of Moving Parts: Due to the simpler gear selection mechanism and clutch system, a manual transmission typically has less than 100 moving parts. Conversely, an automatic transmission, with its torque converter, planetary gearset, and intricate control system, can easily have several hundred moving parts.

Control System: Manual transmissions rely solely on the driver's physical input for gear changes. Automatic transmissions, on the other hand, require a sophisticated hydraulic and electronic control system that constantly analyzes driving conditions and makes automatic gear selections.

Moving Parts During Gear Changes: Manual transmissions require the clutch to interrupt power flow momentarily during gear changes, minimizing the number of moving parts actively engaged. In contrast, automatic transmissions utilize clutches and bands within the planetary gearset to change gears, keeping more parts moving throughout the process.

Continuously variable transmission (CVT)

CVTs represent a distinct and innovative technology within the realm of automatic transmissions. Unlike traditional gear-based automatic transmissions, CVTs allow to seamlessly adjust gear ratios, providing a driving experience characterised by remarkable smoothness and potentially enhanced efficiency. This section delves into the intricate workings of CVTs, exploring their key components, operational principles, advantages and considerations for implementation.



Core components and functional mechanism

The central mechanism of a CVT lies in its ingenious pulley system, which comprises two variable-diameter cones facing each other, known as the driving and driven pulleys. The driving pulley connects directly to the engine's crankshaft, while the driven pulley transmits power to the wheels. A high-strength belt, typically constructed from steel or composite materials, connects the pulleys and transmits the engine's rotational force.

The key to a CVT's operation lies in the dynamic adjustment of these pulley diameters. An ECU acts as the conductor of this process, meticulously monitoring various parameters, such as engine speed, vehicle load and driver input. Based on this real-time data, the ECU issues precise commands to modify the diameter of the pulleys. As engine revs increase, the driving pulley expands, pushing the belt outwards. Conversely, the driven pulley contracts, ensuring optimal tension on the belt.



This continuous and dynamic manipulation of pulley diameters translates into a constantly changing gear ratio. In essence, a CVT functions as if it possesses infinitely variable gears, with the ECU selecting the most efficient ratio for any given driving situation. This stands in stark contrast to traditional automatic transmissions, which rely on a fixed set of discrete gears.

Advantages

The continuous adjustment of pulley diameters in a CVT yields several significant benefits:

- Uninterrupted power delivery: Unlike traditional automatic transmissions with their distinct gear shifts, CVTs eliminate the jolts and hesitations associated with gear changes. Power flows smoothly and uninterruptedly, resulting in a comfortable driving experience. CVT helps in seamless power delivery, crucial for maintaining balance and control, particularly for e-bikes, ensuring a smoother riding experience
- Enhanced efficiency: By maintaining the engine within its optimal operating range, where it produces the most power with the least fuel consumption, CVTs can potentially improve fuel efficiency. For e-bikes, CVTs can potentially optimise motor operation by keeping it within its most efficient range increasing the battery range. By maintaining the motor in the "optimal spot" where it produces maximum power with minimal energy consumption, CVTs can extend the distance an e-bike can cover on a single charge. Similarly, for scooters with internal combustion engines, CVTs can contribute to improved fuel efficiency by maintaining the optimal engine RPM
- Simplified operation: For a relaxed and automatic driving experience, CVTs offer a significant advantage. Along with cars, both scooter and e-bike riders benefit from the ease of use offered by CVTs. By eliminating the need for manual gear changes, CVTs allow riders to focus on navigation, balance and comfort. This is particularly advantageous for new riders or those who prefer a less demanding riding experience. Additionally, while navigating through city traffic, a CVT allows riders to concentrate on manoeuvring through obstacles without the distraction of gear changes

Considerations for CVT implementation

While CVTs offer undeniable advantages, there are a few key aspects to consider:

Power handling capacity: CVTs in two-wheelers need to be meticulously designed to handle the specific power output of the engine or motor. This might be a limitation for high-performance scooters or e-bikes with powerful motors. As the power output increases, the design of the CVT needs to be adapted to ensure it can efficiently handle the forces involved. Also, due to linear power delivery, CVT transmissions are less responsive to sudden change in driver input.

Engagement factor: Enthusiasts who prefer manual gear changes or the distinct gear shifts of a traditional automatic might find CVTs less engaging. The seamless nature of the transmission can feel less interactive for some drivers.

Maintenance considerations: While generally reliable, CVTs might require more frequent maintenance or utilise specific high-performance lubricants, compared with some traditional transmissions. Consulting the owner's manual and adhering to the recommended maintenance schedule is crucial for optimal performance and longevity.

Weight and cost considerations: The added complexity of a CVT can contribute to a slight increase in weight and cost, compared with a traditional gearbox. However, the potential benefits in terms of comfort, efficiency and ease of use might outweigh these considerations for many riders. As CVT technology matures and production scales, the cost is expected to decrease, making it an even more attractive option for two-wheeler manufacturers.



DCT

DCTs employ two clutches, each pre-selecting the next gear. This allows for lightning-fast gear changes, virtually eliminating any lag or power interruption during gear shifts. However, DCTs are no longer exclusive to high-performance cars. This innovative technology is making significant inroads into the world of two-wheelers, particularly scooters and e-bikes, offering a paradigm shift in terms of riding experience and efficiency.



Advantages

While the advantages of DCTs are similar to that of CVT in terms of smoothness in riding experience, boosting efficiency and a simplified operation, compared with its manual transmission counterpart, as both the transmission systems offer automatic gear shifting, they might differ in terms of their fundamental operation. Key differentials between both the transmission systems are:

Feature	DCT	СVТ
Gear selection	Distinct gears pre-selected by clutches	Continuously variable ratio via pulley system
Shifting style	Rapid and precise gear changes	Seamless and uninterrupted power transfer
Efficiency	Potentially high efficiency by keeping engine/motor in optimal RPM range	Can be highly efficient at lower speeds, may lose some efficiency at higher speeds
Riding experience	Smooth with a more connected feel	Exceptionally smooth, ideal for stop-and-go traffic
Complexity	More complex design, potentially higher cost	Simpler design, potentially lower cost
Maintenance	Might require specialised maintenance or lubricants	Generally lower maintenance requirements

Considerations

- Jerky Shifts: May experience jerkiness at low speeds or in stop-and-go traffic.
- Higher Costs: Vehicles with DCTs often cost more upfront and potentially have higher maintenance costs.
- Less Smooth Cruising: Focus on performance might lead to a less smooth ride compared to CVTs in city driving.



Planetary gear sets

These compact and versatile gearboxes are widely used in bicycles, automatic transmissions and various power tools. They utilise a central sun gear surrounded by planet gears, all encased within a ring gear. By manipulating the engagement of these gears with different components, planetary gearsets can achieve a multitude of gear ratios within a confined space.

Advantages

High power density: Planetary gearsets transmit high torque within a compact space as the load is distributed among multiple planet gears, reducing stress on individual components. This makes them ideal for applications with limited space, such as in EV transmissions or power tools.

Smooth power delivery: The continuous meshing of gears in a planetary gearset translates to smooth and uninterrupted power transmission.

Multiple gear ratios: Planetary gearsets can achieve a wide range of gear ratios by altering the configuration of the sun, planet and ring gears. This versatility allows them to be adapted to specific application needs, optimising performance across different operating conditions.

High efficiency: Due to the minimised friction between gears and efficient load distribution, planetary gearsets boast of high overall efficiency.

Considerations

Complexity: The intricate design of planetary gearsets can make them more complex and potentially more expensive to manufacture, compared with simpler gear arrangements.

Maintenance needs: Depending on the application, some planetary gearsets might require specialised maintenance or lubrication procedures.

Lower speed applications: Planetary gearsets are not ideal for extremely high-speed applications due to potential limitations on bearing and lubrication capabilities.

Major components in a gearbox





While the specific components might vary based on the gearbox type, some core elements are ubiquitous:

Gears



Gears are typically made from high-strength steel or alloys to endure the wear and tear of power transmission. They come in various sizes and the ratio between the driving and driven gear dictates the output speed and torque. The number of teeth on each gear also plays a crucial role in determining the gear ratio.

Shafts



Shaft, in its most basic form, is a long, slender, cylindrical rod designed to transmit rotational motion or torque. It is essentially a mechanical axle that serves as a bridge for power transfer between various components in machines. These rotating axles serve as the backbone of the gearbox, supporting the gears and transmitting power between them. Gearboxes may employ multiple shafts, each with its own set of gears, to achieve a wider range of gear ratios.

Bearings



Integral to the efficient operation of gearboxes are bearings, precision components that minimise friction and ensure the smooth rotation of shafts. They prevent the catastrophic consequences of direct metal-to-metal contact between rotating shafts and the gearbox housing. Bearings achieve this by providing a low-friction interface, typically employing rolling elements or a lubricating film. This significantly reduces energy losses due to friction, leading to improved efficiency, quieter operation and extended lifespan for gears and other gearbox components.



Furthermore, bearings are crucial in maintaining a precise alignment between shafts and gears, which is essential for proper meshing and optimal power transmission within the gearbox. Without the mitigating effect of bearings, misalignment could lead to grinding, premature wear and even seizure of gears, ultimately compromising the functionality of the entire gearbox.

Seals



In the high-pressure world of gearboxes, seals act as guardians of lubrication. They stop precious oil from escaping, which would not only create a mess but also starve gears and bearings, leading to disaster. Seals also keep dust, dirt and moisture at bay, which can wreak havoc on gears and bearings, accelerating wear and tear. Gearboxes typically use lip, labyrinth or even double-layered cassette seals, depending on the location and pressure within the housing. Material selection is key, with nitrile rubber being common for affordability, while fluor elastomer offers superior heat resistance for tougher jobs. Seals ensure smooth operation, minimise friction and extend the lifespan of the entire gearbox.

Forks and shift mechanism



Within a manual transmission gearbox, a meticulously orchestrated interplay between forks and the shift mechanism facilitates gear changes. The shift forks, akin to a conductor's baton, serve the critical function of precisely positioning the desired gear for meshing with its partner. These typically C-shaped metal components straddle the collar or sleeve on a gear shaft, and their movement along designated grooves on the shaft achieves the necessary alignment.

The shift mechanism acts as the translator, meticulously converting the driver's input, manifested as movements of the gear lever, into precise linear motions. This linear motion, often a push or pull, is typically achieved through a shift rod within the system. The shift rod then directly connects to a specific fork, urging it along the designated



shaft groove. This coordinated movement ultimately results in the gear's collar or sleeve being positioned for smooth meshing with the selected gear.

Synchromesh (manual gearboxes)



The synchromesh gearbox is a critical component within manual transmissions, particularly in automobiles. It addresses the challenge of achieving smooth engagement between gears that are rotating at different speeds during gear changes. This process, if left unaddressed, would result in significant friction and gear wears, accompanied by audible grinding noises. The synchromesh system employs friction elements to meticulously synchronise the rotational speeds of the gears before they fully engage. This synchronisation minimises the drawbacks, leading to noticeably smoother gear changes, extending the lifespan of the transmission.

Torque converter (automatic gearboxes)



The torque converter occupies a critical position within automatic transmissions, serving a dual purpose. Primarily, it functions as a fluid coupling that transmits rotational motion from the engine to the transmission. This coupling action also facilitates a crucial secondary function of torque multiplication. By strategically utilising the fluid dynamics between a rotating impeller driven by the engine and a turbine connected to the transmission, the torque converter amplifies engine torque output, particularly at lower speeds. This torque multiplication provides the additional tractive force necessary for smooth vehicle launch, especially advantageous for heavier automobiles. Furthermore, the torque converter plays a vital role during gear changes. By momentarily interrupting the direct connection between the engine and transmission, it enables gear shifts to occur smoothly, eliminating the potential for jolting sensations associated with a rigid connection. In essence, the torque converter, through its ingenious design incorporating an impeller, turbine and sometimes a stator, orchestrates a seamless transfer of power between the engine and transmission, contributing to a more refined driving experience and enhanced longevity of the automatic drivetrain.



Mass market and high performance transmission systems

Within the realm of automotive technology, transmissions play a pivotal role in regulating the transfer of power from the engine to the wheels. Some of the key differences between manual/mass market and premium/high performance transmission systems are:

Technological innovation vs established reliability

Mass market transmissions: They prioritise functionality and cost-effectiveness, often employing well-established designs and robust materials, such as steel to ensure longevity. While reliable, these designs may not incorporate the latest advancements, potentially resulting in increased weight.

High performance transmissions embrace the future with advanced technologies and materials, some of the key points of which are:

- Lightweight construction: Components meticulously crafted from high-strength aluminium alloys or even composite materials can significantly reduce the overall transmission weight, enhancing fuel efficiency, a critical aspect in today's environmentally conscious landscape
- Friction reduction strategies: Advanced bearing designs and materials meticulously engineered to minimise friction losses within the transmission. Smoother-operating gears do not just provide a pleasurable driving experience but also result in a slight augmentation in fuel economy
- ECUs (Electronic Control Unit): ECUs function as the central nervous system of the transmission, analysing driving conditions in real-time. By processing a multitude of data points, including engine speed, vehicle load and driver input, the ECU can meticulously adjust shift patterns to optimise performance and efficiency

Functionality and performance:

Mass market transmissions: They strike a balance between functionality and cost. Gear changes might not be lightning-fast and some may lack features, such as automatic rev-matching (synchronising engine speed for smoother gear changes during downshifts). While they may not be known for their speed, they consistently deliver reliable performance.

High performance transmissions: Designed to cater to those expecting superior driving experience and peak performance. The following sets them apart:

- Rapid and seamless gear shifts: Advanced clutch control systems and meticulously designed gear selection mechanisms contribute to quicker and smoother gear changes. Instantaneous and effortless gear changes offer an engaging and exhilarating driving experience
- Diverse driving modes: These transmissions might offer a plethora of driving modes (e.g. sport, comfort and eco) that meticulously alter shift patterns and engine behaviour. It offers customisable transmission that adapts to driving in comfort or sport modes
- Automatic rev-matching prowess: Some premium transmissions are equipped with the ability to automatically adjust the engine speed to synchronise with the selected gear during downshifts. This eliminates the need for the driver to perform heel-toe manoeuvres (a specialised technique for matching revs), resulting in smoother downshifts, especially for performance driving



Durability and maintenance

Mass market transmissions: Built with reliable designs and robust materials, they are generally known for their longevity with proper maintenance. Scheduled maintenance intervals might be longer, compared with premium options, making them a suitable choice for those who prioritise a set-it-and-forget-it approach.

High performance transmissions: With their advanced features and lightweight materials, these transmissions may need more frequent maintenance or specific high-performance lubricants. While the advanced materials themselves can improve wear resistance in some cases, the complexity of the systems might necessitate more focused attention. However, the benefits of smoother operation and potentially improved performance can often outweigh the slightly increased maintenance needs.

Cost considerations

Mass market transmissions: They are generally less expensive to purchase and maintain due to their simpler designs and readily available components. They offer a solid value proposition for those who prioritise affordability and a straightforward driving experience.

High performance transmissions: They come at a premium price. The advanced technologies and materials employed in their construction translate into a higher initial investment. The cost of maintenance might also be slightly higher due to the potentially more intricate systems involved.

Major technologies used in the manufacturing processes of gears and transmission

Design-to-cost approach in powertrain solutions integrates cost considerations from concept to manufacturing, optimising design and material selection to meet cost, weight and performance targets. This approach streamlines production processes and supply chain management, enabling manufacturers to deliver high-quality, cost-effective transmissions throughout the product lifecycle.

Below is the detailing of processes for manufacturing of gears and transmission components:

Material selection

The cornerstone of the process lies in the meticulous selection of appropriate materials. High-strength steel alloys are frequently employed due to their inherent capacity to withstand significant loads. In instances where weight reduction is paramount, aluminium alloys offer a compelling alternative. This selection process meticulously considers critical factors, such as mechanical strength, weight optimisation, wear resistance and noise reduction properties.

Shaping the blank

Several established techniques are utilised to shape the initial gear blank:

- **Casting**: Molten metal is meticulously poured into a mold specifically designed to replicate the final gear form. This cost-effective approach is ideally suited for mass production of simpler gear designs
- **Forging**: The raw metal undergoes heating and subsequent shaping through the application of high pressure or forceful hammering. This process strengthens the grain structure of the metal, rendering forged gears particularly well-suited for high-stress applications
- **Blanking**: Sheet metal is precisely punched or stamped into the basic gear shape using a specialised die. This method is particularly advantageous for mass production of flat gears



Machining for precision

Once the blank has been appropriately shaped, the next step involves the creation of the gear teeth with unparalleled precision. Common machining techniques employed for this purpose include:

- **Milling**: A meticulously controlled rotating cutting tool removes excess material, thereby defining the precise profile of the gear teeth
- **Hobbing**: A specialised cutting tool, its surface engraved with the intricate gear tooth profile, replicates the profile onto the gear blank with exceptional efficiency
- **Broaching**: A long, multi-toothed tool progressively removes material to create the gear teeth, often utilised to produce internal gears

Heat treatment: Gears and transmission components undergo meticulously controlled heat treatment processes, such as hardening and tempering. These processes significantly enhance their overall strength, wear resistance and ability to withstand elevated loads and operating temperatures. The specific heat treatment profile employed is contingent upon the chosen material and the desired performance characteristics.

Quality control: Throughout the entire production process, rigorous quality control checks are implemented to ensure that the gears meet the predetermined specifications with unwavering consistency. These checks may encompass meticulous dimensional measurements, material verification and thorough surface quality inspections.

Inclusion testing: Non-destructive testing methods, such as ultrasonic testing or eddy current testing are employed to detect any internal defects or inclusions within the material that could potentially compromise the performance of the final product. This critical step is typically performed after the heat treatment process but prior to the finishing stage, ensuring that the material properties have not introduced any unforeseen flaws.

Finishing touches: The process continues with grinding, a step that ensures the gear teeth possess the precise profile and surface finish necessary for optimal performance. This meticulous refinement eliminates any machining imperfections and guarantees smooth meshing between gears during operation.

Inspection: Following the grinding stage, the gears undergo rigorous inspection for any defects or inconsistencies. This final quality check serves as a vital safeguard, ensuring that each gear meets the required tolerances and performance standards.

Assembly and testing: The meticulously produced gears and transmission components are then carefully assembled into the complete transmission system. Functional testing ensues to verify that the entire transmission operates smoothly, efficiently and meets all performance specifications. This testing might encompass evaluating gear engagement, shifting performance and noise levels.

Overview of components for bike powertrain

Transmission system for bikes and e-bikes

Derailleur systems

Derailleur systems reign supreme as the most ubiquitous transmission system for bicycles, both traditional and ebikes. Their ability to offer an array of gears makes them perfect for conquering diverse terrains, catering to amateurs and professional cyclists alike.





Following are some of the key advantages of a derailleur system:

- Derailleur systems boast of a wide gear range. This allows to climb steep stretches with lower gears and maintain high speeds on flat terrains with higher gears, making them ideal for diverse adventures
- Less expensive than internal gear hubs or automatic transmission systems, derailleurs offer a cost-effective solution for gear changes

Considerations for derailleurs:

- Maintenance needs: Regular care is crucial for optimal performance. Tasks, such as cable adjustments, derailleur alignment and chain lubrication need a regular check.
- Vulnerability factor: Exposed derailleurs are susceptible to damage from rocks or crashes on rough terrains
- Shifting efficiency: Derailleur systems might experience some efficiency loss under high torque situations, which can be a factor for powerful e-bikes

Shift in trend to alternative options

The transmission system in e-bikes has evolved. Early models employed rudimentary friction drives, later replaced by the adoption of traditional derailleur systems from bicycles. While derailleurs offered wider gear ranges, the additional stress from electric motors presented challenges. Consequently, contemporary trends favour two distinct alternatives: Internal gear hubs (IGH) and CVT.

Internal gear hubs

IGHs constitute a distinct transmission technology employed within bicycles and e-bikes. Unlike traditional derailleur systems that feature exposed components, IGHs are encapsulated units situated within the rear hub of the vehicle. This design offers numerous advantages, including low maintenance requirements and dependable gear shifting, making them a compelling alternative for riders prioritising these aspects. Among the numerous players, few prominent manufacturers namely, Shimano and Rohloff have established themselves in the internal gear hubs market for bicycles.





At the core of an IGH lies a planetary gearset. This ingenious mechanism incorporates multiple gears arranged in a configuration reminiscent of planets orbiting a central sun gear. By meticulously manipulating the engagement of these gears, the IGH achieves a spectrum of gear ratios, thereby enabling the rider to adapt to varying terrain demands.

Advantages of IGH:

Reduced maintenance needs: In stark contrast to derailleurs that necessitate frequent adjustments and cleaning due to their exposed components, IGHs are sealed units, minimising the requirement for routine maintenance. This significantly reduces the time for upkeep allowing one to enjoy the ride.

Shifting proficiency: IGHs offer the distinct advantage of enabling gear changes even when the bicycle is stationary. This functionality proves exceptionally beneficial in stop-and-go city traffic or when navigating technically demanding terrain where maintaining momentum is critical.

Enhanced durability: By virtue of their encapsulation within the hub, IGHs exhibit a greater degree of resistance to damage inflicted by external elements or crashes compared with their derailleur counterparts.

Considerations for IGH:

Weight: IGHs weigh more than derailleur systems, potentially posing a concern for riders who prioritise a lightweight bicycle.

Limited gear range: While offering a sufficient range of gears for many riders, IGHs typically provide fewer gear options, compared with derailleurs. This limitation might render them less suitable for conquering exceptionally challenging terrains that demand a wider gear range for optimal performance.

Maintenance complexity: Although requiring less frequent maintenance, some IGHs might necessitate specialised servicing by a qualified mechanic, unlike basic derailleur adjustments that can often be performed by the rider.



СVТ



CVTs are emerging as a disruptive technology within the e-bike domain. Unlike the traditional derailleur systems that offer discrete gear ratios, CVTs provide a seamless spectrum of gear ratios, fundamentally altering the riding experience. Enviolo is the first to introduce commercially available CVT technology for bicycles in 2007 and has patented their technology. This analysis dissects the key advantages and considerations associated with CVTs in e-bikes.

Advantages of CVTs in e-bikes:

Unparalleled smoothness: CVTs eliminate the jolts associated with gear changes in derailleur systems, resulting in an exceptionally smooth riding experience. This is particularly noticeable during acceleration and hill climbing, translating to enhanced comfort and a more natural feel for the rider.

Effortless gear adjustment: Many CVTs incorporate automatic or semi-automatic functionalities that dynamically adjust the gear ratio based on factors, such as pedal cadence and terrain. This eliminates the need for manual gear changes, allowing riders to focus solely on the act of cycling.

Potential efficiency gains: By maintaining the electric motor within its optimal RPM range, CVTs have the potential to improve efficiency. This translates to a potentially maximised battery range, a crucial factor for e-bikes.

Reduced maintenance requirements: Due to a minimised number of moving parts, compared with derailleurs, CVTs eliminate abrupt gear shifts and promote consistent pedalling cadence, resulting in improved efficiency and reduced wear and tear over time.

Considerations for CVTs in e-bikes:

Cost factor: CVTs typically command a higher price point, compared with other alternative options.

Weight: While lighter than some internal gear hubs, CVTs can contribute to a slight weight increase in e-bikes, compared with derailleurs.



Electric drive unit (EDU)



The EDU is an integrated system with motor, battery and controller as key components and has a major impact on the overall performance and functionalities of end-applications, such as e-bikes or electric two-wheelers. This intricate system integrates several key components that function synergistically to propel the rider forward.

Electric motor: This is an essential component of the EDU, transforming electrical energy garnered from the battery into mechanical energy that drives the wheels. Brushless DC (BLDC) motors are vital in e-bikes, owing to their superior efficiency, reliability and quiet operation. The brushless design minimises friction and wear, contributing to an extended lifespan. BLDC motors function on the principle of magnetic interaction. Permanent magnets fixed to the rotor (the rotating component) interact with electromagnets (coils) on the stator (the stationary component). By electronically regulating the current flow within these coils, a rotating magnetic field is established. This magnetic field exerts a pulling force on the rotor, causing it to spin and propel the e-bike forward.

Battery: Functioning like the fuel tank of a conventional vehicle, the battery safeguards the electrical energy that energises the motor. Lithium-ion batteries are the predominant choice due to their exceptional energy density and extended lifespan. Battery capacity, quantified in watt-hours (Wh), determines the potential range achievable on a single charge. Consequently, a higher Wh rating translates to a greater travel distance.

Controller: This intelligent unit serves as the central nervous system of the EDU, meticulously regulating the flow of electricity from the battery to the motor. It receives signals transmitted by various sensors, including the pedal assist sensor or throttle and calibrates the motor's power output based on these inputs. The controller acts as an orchestra conductor, ensuring all components function in harmonious unison.

Pedal assist sensor: It plays a crucial role in initiating motor assistance. It meticulously detects the rider's pedalling motion. Upon commencement of pedalling, the sensor transmits a signal to the controller, instructing the motor to engage and provide supplementary power to augment the rider's effort. Certain e-bikes incorporate a throttle mode, enabling purely electric operation that eliminates the need for pedalling altogether.

Beyond these fundamental components, some e-bikes possess additional functionalities:

Drive modes: Many e-bikes offer a spectrum of power modes (eco, standard and sport) that calibrate the motor's assistance level to cater to the rider's preferences and the demands of the terrain. Eco mode furnishes a gentle assist ideal for extended rides, while sport mode delivers maximum power for conquering hills.



Display unit: This component functions as the e-bike's instrument panel, providing the rider with crucial information, such as the battery level, speed and selected assist mode. It serves as a window into the intricate workings of the EDU.

Supplementary sensors: Speed and torque sensors can further elevate the riding experience by furnishing more nuanced motor assistance. For instance, a torque sensor can detect the intensity of the rider's pedalling effort and adjust the motor's power accordingly.

Electric drive motor

E-bikes are becoming increasingly popular due to their ability to provide an environment-friendly and assisted ride. A key component of an e-bike is the electric drive motor, which provides the extra boost to propel the bike forward. The two main types of electric drive motors used in e-bikes are hub and mid-drive motors. Each type offers distinct advantages and disadvantages, making the choice dependent on riding style and needs.

Hub motors



Hub motors are a widely employed type of motor integrated within the wheel hub of an e-bike.

Advantages of hub motors:

Hub motors are significantly favoured by e-bike riders, owing to several compelling attributes:

- Their straightforward design facilitates integration into existing bicycles, making them a popular choice for converting conventional bicycles into e-bikes
- Compared with their mid-drive counterparts, hub motors possess a simpler design with fewer moving parts. This minimises downtime, in turn reducing maintenance, keeping riders focused on the road
- They are more affordable than mid-drive motors. This economic advantage makes them an attractive option for budget-conscious riders seeking an e-bike experience

Considerations for selection of hub motors:

While hub motors offer numerous advantages, there are aspects that warrant careful consideration:

Weight distribution: The concentrated weight within the wheel can influence the handling characteristics of an ebike, particularly for lighter models.

Hill climbing performance: While geared hub motors provide some assistance on inclines, they might not be the optimal choice for tackling extremely steep hills.



Sensor technology: Hub motors frequently utilise cadence sensors, which get activated based on the pedalling speed. This can result in a less natural riding experience, compared with torque sensors found in some mid-drive motors. Torque sensors respond to the force applied by the rider, offering a more intuitive feel.

Mid-drive motors



Mid-drive motors offer a unique and powerful e-bike riding experience, compared with their hub motor counterparts. Nestled within the frame, these motors work in concert with the e-bike's drivetrain, unlocking a world of possibilities for riders seeking performance and a natural riding feel.

Unlike hub motors, which reside directly in the wheel hub, mid-drive motors occupy a central location near the pedals. This strategic positioning offers several advantages:

- Mid-drive motors connect directly to the bike's drivetrain, integrating seamlessly with the existing gears
- This intimate connection with the drivetrain allows mid-drive motors to leverage the bike's existing gears leading to optimal power distribution on flat terrains and exceptional climbing ability on inclines
- Mid-drive motors typically have a higher power output, compared with hub motors
- Mid-drive motors result in better weight distribution as compared to hub motors that results in a comfortable feeling for riders

Considerations for selection of mid-drive motors:

Maintenance: The complex design of mid-drive motors, with their intricate gear interactions, might necessitate more frequent servicing, compared with hub motors.

Cost considerations: The intricate design and functionality of mid-drive systems make them more expensive than their hub motor counterparts.

Installation nuances: Integrating a mid-drive motor often requires professional assistance, especially for complex conversions. While some skilled riders might attempt do-it-yourself installations, professional help ensures proper integration and optimal performance.



Overview of components for alloys and metallics



Chaincase



Chaincase, also known as a chainguard, fulfils a critical function in ensuring the continued efficacy of the drivetrain and safeguarding the rider. Following are some of the features of a chaincase:

Preservation of the chain assembly: A primary function of the chaincase lies in its encapsulation of the chain and sprocket assemblies. This enclosure shields the chain from the negative impact of dirt debris, and moisture. By mitigating such exposure, the chaincase extends the operational lifespan of the chain and minimises the need for frequent cleaning and lubrication.

Enhanced rider safety: The chaincase serves as a vital safety element by preventing inadvertent contact between the moving chain and the rider's extremities or loose articles of clothing. This safeguard is particularly important for new cyclists or children, who may be unfamiliar with the potential hazards of an exposed chain.

Protection of attire: The chaincase acts as a barrier, preventing the chain from coming into contact with the rider's clothing. This not only prevents unsightly and potentially persistent grease stains but also eliminates the possibility of snagged clothing, thereby contributing to a more comfortable and aesthetically pleasing cycling experience.

Varieties of chaincases

Chaincases come in two principal configurations:

- **Full chaincases**: These meticulously crafted enclosures completely encompass the entirety of the chain, offering the most comprehensive protection against dirt, debris and accidental contact. They are a prevalent feature on utility bicycles, cruisers, and certain cargo bikes workhorses designed for enduring demanding conditions
- **Partial chainguards**: These chainguards prioritise a lighter weight and a more streamlined appearance. Typically, they shield only the lower segment of the chain near the chainrings, providing a degree of protection while minimising weight and maintaining a sleek aesthetic. Partial chainguards are sometimes found on hybrid and comfort bicycles

Materials

The choice of material for a chaincase hinges on factors such as weight and durability. Common materials include:

- **Plastic:** The most widely used material, offering a balance between affordability and adequate protection
- **Metal:** While less frequently employed due to the added weight, metal chaincases provide unparalleled strength and resilience
- **Composite materials:** High-end chaincases may incorporate composite materials, achieving a combination of lightweight construction and impressive strength

Swing arm



A swingarm is a key component of a motorcycle's suspension system. It is a single or double-sided mechanical device that:

- Attaches the rear wheel of a motorcycle to its body: The swingarm pivots at its front attachment point, allowing the rear wheel to move up and down as the motorcycle travels over bumps and uneven terrain
- Holds the rear axle: The rear axle of the motorcycle is secured within the swingarm, allowing the wheel to rotate freely
- Acts as a mounting point for the rear suspension: The shock absorber(s) and linkage system of the rear suspension are typically connected to the swingarm. This allows the suspension to compress and rebound, absorbing impacts, and providing a smoother ride



Swingarm types

There are two main types of swingarms:

- **Double swingarm:** This is the more traditional design, consisting of two parallel tubes or beams that connect the rear axle to the frame's pivot point
- **Single-sided swingarm:** This is a more modern design that uses a single, larger arm on one side of the motorcycle to connect the rear axle to the frame

Materials

Swingarms are typically made from lightweight and strong materials such as:

- Aluminium: A common choice due to its good balance of strength and weight reduction
- Steel: Used in some motorcycles for its durability but can be heavier than aluminum
- **Carbon fibre:** Used in high-performance motorcycles for its exceptional strength-to-weight ratio; but it is also the most expensive option

Mainstand



A mainstand, also sometimes called a centerstand, is a kickstand located in the centre of a bicycle or motorcycle providing upright support for the entire vehicle. When deployed, the mainstand lifts the rear wheel of the bicycle or motorcycle off the ground, keeping the entire vehicle upright and stable. Following are some of the featured of a mainstand:

- **Parking and maintenance:** The mainstand allows for secure parking on uneven surfaces or soft ground where a side stand may sink in. It is also crucial for maintenance tasks such as cleaning the drivetrain, repairing punctures or adjusting brakes since both wheels are accessible when the bike is upright
- **Loading and unloading:** The mainstand facilitates easier loading and unloading of cargo or passengers, especially on heavier motorcycles where a side stand may cause problems
- **Security:** Some mainstands incorporate locking mechanisms to prevent the bike from being easily rolled away, offering an additional layer of security

Types

• **Single-leg mainstand:** This is the most common type, comprising a single leg that folds out from the frame and pivots on a hinge point



• **Double-leg mainstand:** Less common, this type utilises two legs for added stability, particularly on heavier motorcycles

Considerations:

- While offering advantages, mainstands can add some weight to the bicycle or motorcycle
- Some bicycles, particularly lightweight racing models, may not have mainstands due to weight concerns

Rims



The rim plays a critical role in keeping the wheels of a motorcycle or bicycle rolling smoothly.

Role of rims:

- Shaping the ride: Rims provide the defined shape for the tyre. This not only allows the tyre to maintain its inflated form but also influences its overall performance. A wider rim can offer better grip and stability for certain riding styles, while a narrower one might prioritise aerodynamics.
- Spoke sanctuary: The tiny holes drilled into the rim serve as the anchor points for the spokes, which are the thin metal rods that connect the rim to the hub at the centre of the wheel. The interaction between the spokes and the rim creates a tensioned structure, transferring the pedalling power from the hub all the way to the ground, propelling forward movement.

Materials:

The choice of rim material significantly impacts the performance of the wheels. Here's a breakdown of the most common options:

- Aluminium alloy: Alloy rims offer a balance of weight, strength and affordability. They are a versatile choice for a wide range of riders
- Steel: Steel rims are renowned for their durability. However, they are heavier than alloy rims, which can impact performance, especially for weight-conscious cyclists
- Carbon fibre: Light in weight, carbon fibre rims are the most preferred by many cyclists seeking peak efficiency. However, their delicate nature makes them more susceptible to damage from impacts and they are expensive.

Braking considerations:

The way in which a bike brakes can also influence rim choices:



- Clincher rims: They are designed for use with clincher tyres. These tyres have a bead that hooks onto the rim for inflation and a separate braking surface on the sidewall for use with traditional rim brakes
- Tubular rims: Lighter than clinchers and favoured by weight-weenies, tubular tyres are glued directly onto the rim. This creates a more aerodynamic profile but requires special tools and expertise for installation and removal. Tubular rims typically don't have a braking surface as disc brakes are most common with them
- Disc brake rims: A growing trend, disc brake rims are specifically designed for disc brake systems. These brakes utilise a separate braking system that clamps onto a rotor attached to the hub, eliminating the need for a braking surface on the rim itself. Such rims often have a wider profile, compared with clincher or tubular rims to accommodate the disc brake system

Engine guard



An engine guard, also sometimes called a crash bar or bull bar, is a metal frame or bar attached to a motorcycle or scooter specifically designed to protect the engine and other critical components in the event of a crash or fall.

Key functions and benefits of engine guards:

- Protection in case of a fall: The primary function of an engine guard is to absorb impact and deflect blows away from the engine block, oil filter, exhaust pipes and other vulnerable parts of the motorcycle. This can help minimise damage and prevent costly repairs in case of a fall
- Reduced damage during low-speed tip-overs: Engine guards can also offer some protection during lowspeed tip overs, preventing the engine from directly contacting the ground and potentially cracking the crankcase or other components
- Improved off-road capability: For off-road enthusiasts, engine guards provide additional protection against rocks, debris and other hazards encountered on rough terrains
- Aesthetics and style: Some engine guards can enhance the visual appeal of a motorcycle, giving it a rugged and aggressive look

Types of engine guards:

Engine guards are available in two main types:

• Engine case guards: They typically attach directly to the engine mounting points and provide the most comprehensive protection for the engine block and surrounding components. They are often preferred for off-road riding and situations where there is a higher risk of falls

Highway bars/crash bars: They typically attach to the frame of the motorcycle at multiple points and offer a more relaxed protection style. They might not fully enclose the engine block but can still deflect impacts and protect vital components, such as the radiator and exhaust pipes

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Materials:

Engine guards are typically constructed from strong and durable materials such as:

- Steel: The most common material, steel engine guards offer a good balance of strength, affordability and weight
- Aluminium: A lighter alternative to steel but may not be as strong in all situations
- Stainless steel: Offers good corrosion resistance and a sleek appearance but can be more expensive than other options

Handlebars



Handlebars are a crucial component for bicycles and motorcycles that help the rider steer and control the direction of the vehicle. Typically made from lightweight and strong materials, such as steel, aluminium or carbon fibre, they connect to the stem (bicycles) or the upper yoke (motorcycles) of the frame. There are different handlebar styles for bicycles and motorcycles:

Bicycles:

- Drop bars: Preferred by cyclists for their curved design that allows for a more aerodynamic, tucked-in position, these bars offer multiple hand positions for comfort and control during extended rides
- Flat bars: These straight handlebars provide an upright riding posture, making them popular for comfort bikes, hybrids and mountain bikes, offering good control and maneuverability
- Bullhorn bars: They are similar to drop bars but have shorter drops, commonly used on time trial and triathlon bikes for optimal aerodynamics
- Butterfly bars: These wide, flared handlebars offer a comfortable upright position, often seen on comfort and touring bikes, providing leverage for steering and stability
- Mountain bike handlebars: Wider and risen more than flat bars, they provide increased control and leverage for navigating rough terrain



Motorcycles:

- Standard handlebars: These straight or slightly angled bars offer an upright riding position, common on standard motorcycles and cruisers
- Beach bars: They are similar to standard handlebars but with a more relaxed backward sweep, promoting a laid-back riding posture often seen on cruisers
- Clip-on handlebars: These comprise two separate bars clamped onto the fork tubes, allowing for a tuckedin, aerodynamic position favoured by sportbike riders
- Ape hangers: They are tall handlebars, offering a unique look and more leverage for low-speed riding, but potentially affecting handling at higher speeds

Materials:

- Handlebars are typically constructed from lightweight and strong materials such as:
- Aluminium: The most common material, offering a good balance of weight, strength and affordability
- Carbon fibre: Lighter than aluminium but more expensive, it offers a high-performance option for weightconscious riders
- Steel: Strong and durable, but heavier than others. It is less common nowadays due to weight concerns

Saree guard



The primary function of a saree guard is to safeguard loose-flowing and long clothing while riding a motorcycle or scooter. It acts as a physical barrier, preventing the rider's garment from getting entangled in the wheels or chain. This not only protects the garment from potential tears, snags or grease stains but also addresses a crucial safety concern.

Safety first: Loose clothing poses a significant risk when it comes to riding a two-wheeler. If a long skirt or dress gets caught in the moving parts of the motorcycle, such as the wheels or chain, it could cause a serious accident. The saree guard effectively eliminates this risk by maintaining a safe gap between the rider's clothing and the moving components of the vehicle.

Types:

Saree guards have two main configurations, each catering to different needs:

Fixed saree guards: These permanent fixtures are typically attached to the frame of the vehicle, usually on one side. They offer a sturdy and reliable barrier but might not be suitable for all riders or vehicle types. For those who do not wear long garments frequently, a fixed saree guard might be less desirable

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• Detachable saree guards: These guards offer more flexibility as they can be easily attached and removed when needed. They are made of metal but are also available in plastic or composite materials. Detachable saree guards are a good option for riders who like to switch between using the saree guard and preferring a neat look for their vehicle.

Additional considerations:

- Footrests: Some saree guards, particularly those that are fixed, may incorporate a footrest for the pillion wearing a long garment
- Style: Saree guards come in various styles and finishes, allowing riders to choose the one that complements the aesthetics of their vehicle. For some, a saree guard can even become a way to personalise their ride

Major technologies used in the manufacturing processes of alloys and metallics

The type of manufacturing technology mainly depends on the desired properties (weight, strength and cost), production volume and design complexity of the component. Technologies used for some key parts, along with separate considerations for each:

Chaincase, main stand, swingarm (bikes with motors)

Manufacturing technologies:

- Sheet metal stamping: This is a common and cost-effective method. Sheet metal is punched and formed into the desired shapes using dies and presses and is often used for chaincases and main stands, owing to its speed and affordability
- Metal injection moulding: This technique is suitable for creating complex shapes. Metal powder is mixed with a binder, moulded into shape and then heated to remove the binder and fuse the metal particles. This can be used for some chaincases and swingarms on motorbikes

Considerations:

Material selection (steel or aluminium) significantly impacts the final product's weight, strength and cost.

Rims

Manufacturing technologies:

- Extruded aluminium: The most widely used method, aluminium billets are heated and forced through a die to create a long continuous profile, which is then cut and welded to form the rim
- Carbon fibre layup: This method is used for lightweight, high-performance rims. Carbon fibre sheets are layered in a specific orientation and bonded together with resin. This requires a specialised mold and curing process

Considerations:



The choice of material (aluminium or carbon fibre) has a major influence on the rim's weight, strength and overall cost.

Engine guard (motorcycles)

Manufacturing technologies:

- Tube bending: This is a common technique, also used for handlebars. Metal tubes are heated and bent using mandrels or dies to form the desired shape. This is used for engine guards on motorcycles as it offers good strength and allows for customisation
- Computer numerically controlled (CNC) machining: This method is used for complex shapes or highprecision components. CNC machines precisely remove material from a solid block of metal to create the desired form. This can be used for some engine guards with intricate designs

Considerations:

Material selection (typically steel) and design complexity are key factors affecting the manufacturing process chosen for engine guards.

Handlebars

Manufacturing technologies:

- Tube bending: This is the most common method for metal handlebars. Metal tubes are heated and bent using mandrels or dies to form the desired shape
- Forging: This method is used for high-strength handlebars, such as those on some mountain bikes. Metal is heated and hammered into shape using dies

Considerations:

Material selection (steel or aluminium) is important, along with the handlebar type (flat, drop or other styles).

Saree guard

Manufacturing technologies:

- Sheet metal stamping (as mentioned above): This is a common choice for saree guards, especially those that are fixed, owing to its affordability and ability to create simple shapes
- Metal bending: This can be used for curved sections of a saree guard, especially for those that are fixed, which wrap around the frame
- Welding: This is used to join different metal components of a saree guard, especially for those fixed

Considerations:

Material selection (steel or aluminium) is a factor, along with determining if the saree guard is fixed or detachable.

Impact of electrification on all components (combined for gears and transmission, bike powertrain and alloys & metallics)

The EV revolution is causing a ripple effect throughout the automotive industry and the component manufacturing sector is no exception. While the demand for traditional engine and drivetrain components, such as engine gears,



chaincases and carburettors will plummet, several other component categories will see a significant shift. Essential components, such as handlebars, safety features and frames will be crucial for EVs, albeit potentially with some design modifications. Suspensions, wheels and instrument clusters might require adjustments to accommodate the unique characteristics of EVs.

Adoption of electric vehicles (EVs) necessitates a paradigm shift in the design and function of gears and transmission components. The multi-speed gearboxes associated with internal combustion engines are likely to be supplanted by simpler designs in EVs. This includes single-speed reduction gears, optimized for efficiently matching the high RPM of electric motors to the optimal operating speed of the wheels. Alternatively, limited-speed gearboxes with a focus on a select range of well-spaced ratios might be employed in high-performance EVs or those designed for substantial towing capacity. This evolution towards a more streamlined transmission translates to a lighter overall weight, potentially contributing to improved vehicle range and efficiency. However, the emphasis on simplicity does not diminish the critical role of high-quality gears. Electric motors generate significant torque from a standstill, placing immense stress on transmission components. Consequently, the continued focus on robust materials and precision manufacturing remains paramount to ensure reliable operation.

Furthermore, the regenerative braking systems prevalent in EVs introduce the challenge of bi-directional power flow through the transmission. This necessitates gears with exceptional wear resistance and durability to handle this reversed power flow without compromising performance or longevity. In essence, the electrification of the automotive industry compels a shift towards high-quality, efficient transmissions specifically designed to address the unique demands of electric motors.

However, the most exciting opportunities lie in the development and production of entirely new component categories. Electric motors, inverters, battery management systems and power electronics will be important for EVs and their demand is poised to surge. Additionally, the rise of EVs necessitates the creation of new charging infrastructure components, such as stations, connectors and related hardware. This transition presents a significant challenge, but also a golden opportunity for component manufacturers who can adapt to and innovate new technologies. By catering to the evolving needs of the electric mobility revolution, the industry can ensure a smooth shift towards a cleaner and more sustainable future.

9 Market sizing and outlook of components

Gears & transmissions

Market sizing for gears & tranmissions components (CY23E-CY29P)



Note: 1. Above figures comprise of values for gear components (global) and gear-box assembly (domestic & global)

2. Gear components compromise of values for India, United States, EU, and ASEAN and vehicle segments included for market sizing are motorcycles, passenger cars, e-3W and ATV

3. Gear components segment covers - Engine Gear and Transmission gear, shafts, and gear-set assemblies

4. Gear-box assembly (domestic) compromise of values for India and vehicle segments included for market sizing are cars and e-3W

5. Gear-box assembly (global) comprise of values for United States, EU, and ASEAN and vehicle segments included for market sizing are motorcycles (>600 cc) and ATV

Source: Mordor Intelligence, CRISIL MI&A

The size of the market for gears & transmissions is estimated to clock a CAGR of 4.5-6.5% between calendar years 2023 and 2029. In calendar 2023, the estimated market size is anticipated to be in the range of Rs 3,150-3,250 billion, whereas in calendar 2024, it is expected to marginally increase 1-3% to Rs 3,200-3,300 billion.

For the two wheeler segment, gears & transmissions is estimated to clock a CAGR of 5-7% between calendar years 2023 and 2029. In calendar 2023, the estimated market size is anticipated to be in the range of Rs 377-387 billion, and the market size is expected to expand to Rs 500-520 billion by 2029.

On the other hand for the passenger vehicle segment, gears & transmissions is estimated to clock a CAGR of 4.5-6.5% between calendar years 2023 and 2029. In calendar 2023, the estimated market size is anticipated to be in the range of Rs 2,665-2,885 billion, whereas in calendar 2024, , and the market size is expected to expand to Rs 3,700-3,900 billion by 2029.





Share of vehicle categories for market sizing of gears & tranmissions

Source: Mordor Intelligence, CRISIL MI&A

Among the major contributors, passenger vehicles emerge as the top contributors and are likely to be a key growth driver for the gear components market. The global passenger vehicles industry is expected to grow at a 3-5% CAGR between calendar years 2023 and 2029. Other contributors include motorcycles with engine capacity 'less than 600 cc', which is expected to grow at a 2-4% CAGR between calendars 2023 and 2029; however, growth for 'above 600 cc' motorcycles is expected to be higher at 7-9% CAGR during the same period.

The gears & transmissions market is expected to be fuelled by the rapid pace of inovation and technology advancements in order to meet customer requirments as well as balance environmental concerns. Within the highly competitive market, few key players such as ZF Friedrichshafen AG, Musashi Co. Ltd., BorgWarner Inc. and GKN PLC stand out and are recognized for their advanced technologies, innovative solutions and strong market presence.

Electric vehicles might restrict demand for traditional engine gears in certain vehicle segments, new opportunities shall emerge for EV-specific components. Electric Vehicles (EVs) require an integrated transmission system to optimize their performance, efficiency, and driving experience. Unlike traditional multi-gear systems, these advanced single or multi-speed gearboxes enhance acceleration, energy efficiency, and overall vehicle functionality. While providing these features, EVs also require high efficiency for improved range and have strict noise, vibration, and harshness (NVH). Therefore, while electric motors are silent, electric transmission must meet these NVH requirements.

Detailed assessment of the gear component market and gear-box assembly market is provided below.



Gear components

Market sizing for gear components (CY23E-CY29P)



Note: 1. Above figures comprise of values for India, United States, EU, and ASEAN

2. Vehicle segments included for market sizing of gear components are motorcycles, passenger cars, three-wheelers and ATV

3. Gear components segment covers - Engine Gear and Transmission gear, shafts, and gear-set assemblies

Source: Mordor Intelligence, CRISIL MI&A

The size of the market for gear components is estimated to clock a CAGR of 4.5-6.5% between calendar years 2023 and 2029. In calendar 2023, the estimated market size is anticipated to be in the range of Rs 2,800-2,900 billion, whereas in calendar 2024, it is expected to marginally increase 1-3% to Rs 2,840-2,940 billion. Global markets are going to drive the gear components market in the next five years, with an ~80-85% share by 2029, leaving India with the remaining share of ~15-20%, orRs 3,800-3,900 billion in calendar 2029.



Share of vehicle categories for market sizing of gear components

Among the major contributors, passenger vehicles emerge as the top contributors and are likely to be a key growth driver for the gear components market. The global passenger vehicles industry is expected to grow at a 3-5% CAGR between calendars 2023 and 2029. Other contributors include motorcycles with engine capacity 'less than

Source: Mordor Intelligence, CRISIL MI&A



600 cc', which is expected to grow at a 2-4% CAGR between calendars 2023 and 2029; however, growth for 'above 600 cc' motorcycles is expected to be higher at 7-9% CAGR during the same period.

The global automotive gear component market is accelerating, fuelled by trends such as automation and the rise in the volume of vehicles translating into a direct increase in demand for various gear components. This benefits manufacturers of transmissions and other drivetrain systems, especially those catering to popular segments such as passenger cars. Consumers' increasing preference towards availing of private transportation, the growing urbanisation rate, and the rising adoption of sports utility vehicles (SUVs) are contributing to the surge in demand for passenger cars, which, in turn, positively impact the market for gear components.

Within the motorcycle segment, greater than 600 cc motorcycles are ICE-driven, which require the integration of efficient gear components, thereby contributing to the growth of gear components market. Consumers from Europe and North America will form a major customer base for motorcycles with more than 600 cc, due to the growing disposable income. Moreover, the penetration of e-motorcycles is significantly lower, with major manufacturers still in the research and development phase.

While EVs might restrict some demand for traditional engine gears in certain vehicle segments, new opportunities shall emerge for EV-specific components, such as electric motor gears that will continue to drive the overall gear components market.

Gear-box assembly



Market size of for gear-box assembly - India (CY23E - CY29P)

Note: 1. Above figures comprise values for India

2. Vehicle segments included for market sizing of gear-box assembly are cars and e-3W *Source: Mordor Intelligence, CRISIL MI&A*

The market size of gear-box assembly for Indian markets is estimated to clock a CAGR of 6-8% during calendars 2023 to 2029. In calendar 2023E, the estimated market size is anticipated to be in the range of Rs 280-320 billion, whereas in calendar 2024E, it is expected to increase a marginal 0-2% on-year. Cars are going to dominate the overall market value with over ~90% share. The market value in calendar 2029P is expected to reach Rs 430-470 billion.



India's influence on the global automotive gearbox assembly market will be a mixed bag. The country's rapid vehicle production growth, particularly for budget-oriented vehicles, shall remain a key driver for traditional gearboxes in the next five years. The passenger vehicle industry is expected to grow at a 4.5-6.5% CAGR between fiscals 2024 and 2029, majorly driven by compact and mid-size SUVs (7-10% CAGR during the same period).

On the other hand, the Indian three-wheelers industry (ICE) is expected to witness a de-growth of 3-5% CAGR between fiscals 2024 and 2029. Growth will likely be outweighed by the broader shift towards electrification.



Market sizing for gear-box assembly – global (CY23E - CY29P)

Note: 1. Above figures comprise of values for United States, EU, and ASEAN

2. Vehicle segments included for market sizing of gear-box assembly are motorcycles (>600 cc) and ATV

Source: Mordor Intelligence, CRISIL MI&A

The market size of gear-box assembly for global markets is estimated to clock a CAGR of 3-5% during calendars 2023 to 2029. In calendar 2023E, the estimated market size is anticipated to be in the range of Rs 65-75 billion, whereas in calendar 2024E, it is expected to be Rs 70-80 billion market size. Motorcycles (>600 cc) are anticipated to dominate the overal market with more than ~70% overall share, thus reaching a market size of Rs 85-95 billion in calendar 2029P.

Gearbox assembly components for ICE (internal combustion engine) operated motorcycles with more than 600 cc are crucial components since they assist in housing essential components, such as gears, shafts, bearings, and casings, which allows the motorcycle to amplify low-speed torque to facilitate its movement. As manufacturers' have started to focus more on producing higher cc motorcycles, thus the need for advanced gearbox assembly components shall see a surge in the coming years leading to significant technological upgradations from the manufacturers. Electrification of motorcycles is less likely to impact the 'greater than 600 cc' segment, hence it is expected to grow at a faster pace of 7-9% CAGR between calendars 2023-29 compared with '<600 cc' segment.



Body components for two-wheelers

Market sizing for body components (CY23E - CY29P)



Note: 1. Above figures comprise of values for India, United States, EU, and ASEAN

2. Vehicle segments included for market sizing of body components are scooters, e-scooters, and motorcycles

3. Body components segment covers - swing arm, mainstand, chaincase, rims, engine guard, handlebars, sariguard

Source: Mordor Intelligence, CRISIL MI&A

The market size of body components is estimated to clock a CAGR of 5-7% during calendars 2023 to 2029. In calendar 2023, the overall estimated market size is anticipated to hover in the range of Rs 430-450 billion, whereas in calendar 2024, it is expected to decline a marginal 0-2%, because of the expected decline in motorcycle volumes. Both global and Indian markets are anticipated to equally drive the body components market with India expected to hold the majority share with ~55-60% and remaing share to be contributed by the US, Europe and ASEAN, and is thus estimated to reach a market size of Rs 615-635 billion in calendar 2029.





With the integration of e-scooters in the market and the investment to develop charging infrastructure worldwide, the body-components market for e-scooters is expected to showcase surging growth during the forecast period.

Source: Mordor Intelligence, CRISIL MI&A



The e-scooter industry is expected to grow at a 30-32% CAGR between calendars 2023 and 2029. The share of contribution of motorcycles (both <600cc and >600 cc) is expected to decline marginally, mainly driven by slow growth for 'less than 600 cc' vehicles. However, 'above 600 cc' motorcycles are expected to grow at a faster rate of 7-9% CAGR between 2023 and 2029, driven by the increasing per-capita disposable income of consumers and the growing preference for availing of luxury motorcycles for aspirational purposes, thus resulting in improved share for the body-components market.

The growth of body components market will be fuelled by a rising middle class, increasing disposable income, and urbanisation, leading to a boom in vehicle production. There is a rapid shift toward utilising lightweight materials to manufacture body components for two-wheelers, which helps in reducing the vehicle weight and carbon emissions. Therefore, two-wheeler manufacturers increasingly prefer aluminium for body components, due to its higher strength-to-weight ratio, heat dissipation, and corrosion resistance. Moreover, the interatom of electric two-wheelers further benefits the demand for advanced body parts and components. A few key manufacturers in India such as Badve Group, Sandhar Technologies, Munjal Auto Industries and Mangum Inc. have played a pivotal role in the growth of the body components industry and have made pioneering advancements to match the industry requirements.

Growing safety awareness also fuels demand for sturdier handlebars, engine guards, and components meeting stricter safety regulations. However, there will be some challenges for a few components that are not EV-agnostic, as the electric revolution in two-wheelers is going to be a key monitorable across all geographies.

Electric drive motors for e-scooters and e-three wheelers



Market sizing for electric drive motors (CY23E-CY29P)

Note: Above figures comprise of values for India, United States, EU, and ASEAN *Source: Mordor Intelligence, CRISIL MI&A*

The market size of electric-drive motors is estimated to clock a CAGR of 30-35% during calendars 2023 to 2029. In calendar 2023, the overall estimated market size is anticipated to hover in the range of Rs 50-70 billion. The market is expected to witness a double-digit growth of 10-15% in calendar 2024 to Rs 60-80 billion. Faster adoption of electrification in the automotive segment is going to be a key driver for electric-drive motors with major geographies shifting their focus to clean mobility. Owing to that, the market value of electric-drive motors in calendar 2029 is estimated to be in the range of Rs 320-340 billion.





Share of vehicle categories for market sizing of electric drive motors

E-scooters is the prominent segment that majorly contributes to the overall market value of electric drive-motors, with over ~90% share both in calendars 2023 and 2029. The e-scooter segment is estimated to witness a robust uptick of a 30-32% CAGR between calendars 2023 to 2029. The rising demand for food-delivery services and the government's increasing focus on decarbonising the transportation sector are contributing to the growth of the electric-scooters market. The advent and adoption of electric scooters in the market led to an increasing demand for electric drive motors, as they form a crucial component in powering the motion of these scooters. Apart from their usage in the private transportation medium, e-scooters are being increasingly deployed for ride-hailing services, which, in turn, positively impact the growth of electric-drive motors to sustain the rising sales of e-scooters.

Electric three-wheelers are increasingly preferred for last-mile delivery services and passenger transportation. To cater to the growing demand, various component manufacturers are ramping up their production capacity of electric drive motors, which is the key component in these vehicles.

Public and private investments to enhance the electric vehicle infrastructure, coupled with innovations in batteryswapping technology, will positively impact the demand for electric vehicles worldwide, thereby contributing to the growth of electric drive motors.

Source: Mordor Intelligence, CRISIL MI&A


CVT hubs



Market sizing for CVT hubs (CY23E-CY29P)

Note: 1. Above figures comprise of values for India, United States, EU, ASEAN and Japan 2. Vehicle segments included for market sizing of CVT Hubs are bicycles and e-bicycles *Source: Mordor Intelligence, CRISIL MI&A*

The market size of CVT hubs is estimated to clock a significant CAGR of 30-35% during calendars 2023 to 2029. In calendar 2023, the overall estimated market size is anticipated to hover in the range of Rs 5-7 billion, whereas in calendar 2024, it is expected to hover in the range of Rs 6-8 billion, which is an increase of 10-12% on-year. Increasing global demand for e-bikes is going to be a key driver for the continuous variable transmission (CVT) hubs market. Owing to that, the market value of CVT hubs in calendar 2029 is projected to be in the range of Rs 32-34 billion.

Bicycle riders can choose between a CVT or internal gear hubs that assist in operating these bicycles. Essentially, riders increasingly prefer CVT hubs due to their benefit of automatically changing gears based on speed and the pathway. Furthermore, silent operation makes it a compelling choice for cyclists seeking a hassle-free and enjoyable ride, setting it apart from traditional gear systems that often require manual gear changes, frequent adjustments, and are prone to wear-related issues. With a substantial sale of electric bicycles (12-14% CAGR growth between CY23-29), various manufacturers in the ecosystem are actively strategising to integrate CVT hubs in their electric bicycles to provide seamless transportation service to customers and enable the incorporation of the latest technology in their products. The growth of CVT hubs is incentivised with the market's shortage of options to meet performance and reliability demands of e-bike riders in current times.

E-CVT system breaks these barriers by combining motor and CVT functionalities at competitive price points, catering specifically to rear-drive motor e-bikes. The hub-motor bicycle market is estimated to grow by 11-13% CAGR during calendar years 2023-2029, thus enabling the fast-paced acceptance of CVT products and resulting in rising penetration level by up to 2.5 times in the coming 5-6 years.

Thus, the increasing popularity of e-bikes, advantages offered by CVT hubs in terms of rider experience and efficiency, and advancements in CVT hub technology leading to potentially lower costs and lighter weight will all contribute to this growth.



Electric drive motors for e-bikes

Market sizing for electric drive motors (CY23E - CY29P)



Note: Above figures comprise of values for India, United States, EU, ASEAN and Japan Source: Mordor Intelligence, CRISIL MI&A

Market size of electric drive motors is estimated to clock a significant CAGR of 14-16% during calendars 2023 to 2029. In CY23, the overall estimated market size is anticipated to hover in the range of Rs 115-135 billion whereas in calendar 2024E, it is expected to witness a growth of 7-9% on-year. As electric bicycles are experiencing significant change in consumer demographics with an increasing spending capacity of people, the rise of electric drive motor market is inevitable. Thus, the market value of electric drive motors in calendar 2029 is expected to be in the range of Rs 275-295 billion.

The burgeoning electric bicycle market is acting as a significant catalyst for growth in the electric drive motor market. With consumers' rising preference for healthy living and increasing demand for recreational activities, there is a massive demand for electric bicycles worldwide. Furthermore, this market is undergoing a diversification of styles and functionalities. This encompasses everything from utilitarian cargo bikes to high-performance models, each requiring specific electric drive motors tailored to optimize power, efficiency, and the overall riding experience. This diversification presents exciting opportunities for a wider range of electric drive motor manufacturers to cater to these niche markets. Technological advancements are another key driver of growth. Continuous improvement in electric motor technology is leading to the development of lighter, more efficient, and more powerful motors. Electric vehicles require high efficiency for improved range and have strict noise, vibration, and harshness (NVH), which is served efficiently by electric motors that are relatively silent and meet NVH requirements.

Cost considerations are a primary concern. Electric drive motors are expensive which adds up to the production costs for manufacturers, potentially impacting the affordability of electric bicycles for some consumers. Despite that, the electric drive motor market for electric bicycles is projected to experience substantial growth in the next five years. This growth will be driven by government's aggressive push toward promoting sustainable mobility and manufacturers investing hefty sums in developing advanced electric bicycle models which will in-turn push motor manufacturers to provide cost-effective customized solutions.



Electric drive unit for e-bikes

Market sizing for electric drive unit (CY23E - CY29P)



Note: 1. Above figures comprise of values for India, United States, EU, ASEAN and Japan 2. Electric drive unit for e-bikes segment covers - Battery, motor and controller

Source: Mordor Intelligence, CRISIL MI&A

The market size of electric drive units is estimated to clock a significant CAGR of 14-16% during calendar 2023 to 2029. In calendar 2023E, the overall estimated market size is anticipated to hover in the range of Rs 230-250 billion, whereas in calendar 2024E, it is expected to hover in the range of Rs 245-265 billion. Electric drive units are the primary component of an e-bike consisting of several other components, such as motors, battery and sensors. Thus, the overall growth of EDU depends on the growth of these individual components. The market value of electric drive unit in calendar 2029P is expected to be in the range of Rs 520-540 billion.

The e-bikes market is experiencing rapid growth due to increasing demand, but the supply chain ecosystem is still evolving which poses a constraint in finding a comprehensive cost-effective EDU solution. E-Bike OEMs currently procure individual components for these drive units and to ensure seamless operation of the bike, the components must communicate effectively with one another. However, since these components were originally developed independently, it poses a significant challenge for OEMs to achieve the desired integration within the available development timeline. At present, there are few providers offering fully integrated systems, and those that do offer only a limited range of options. Hence, among the crucial components of an e-bike, the drive unit stands out as the most critical. Electric drive units in electric bicycles are the major source that generates power to propel the vehicles without pedaling, such as throttle-based e-bikes. In recent years, an increasing preference for electric-propelled bicycles has contributed to the market's growth.

The global EDU market is not just riding the wave of e-bike popularity in global geographies, technical advancements within EDUs themselves are further fuelling this expansion. Motor technology is at the forefront, with permanent magnet synchronous motors (PMSMs) emerging as a more efficient and powerful alternative to traditional brushed DC motors. This translates to a longer range and improved hill-climbing ability for e-bikes, making them even more appealing to riders. Gearing systems are also evolving. Modern EDUs are becoming increasingly sophisticated with the integration of advanced sensors, such as torque and speed sensors.



Increasing investments by the government to construct pathways specifically for riding bicycles across Europe serve as a significant determinant for the growing sales of e-bicycles. Additionally, the rising preference of consumers for mountaineering and adventurous activities is facilitating the growing sales of e-bicycles since these bicycles help them to utilize less workforce and can easily scale a mountainous road. All these factors will collectively boost demand of electric drive unit in the coming years and providing cost effective solution may help such solution providers to meet the customer requirements and penetrate the market.

Body components for bicycles



Market sizing for body components (CY23E-CY29P)

Note: 1. Above figures comprise of values for India, United States, EU, ASEAN and Japan

2. Body components included for market size are alloy frames, suspension forks, rims, handlebars, seats, grips *Source: Mordor Intelligence, CRISIL MI&A*

The market size of alloy frames, suspension forks, handlebars, seats, grips is estimated to clock a CAGR of 5-7% during calendars 2023 to 2029. In calendar 2023E, the overall estimated market size is anticipated to hover in the range of Rs 390-410 billion, whereas in calendar 2024E, it is expected to hover in the range of Rs 395-415 billion. As the popularity of e-bikes projects an increasing trajectory along with wider acceptance, these components are going to be directly benefitted, thus taking the market value to Rs 540-560 billion in calendar 2029P.

The popularity of bicycles by consumers, who prefer lower-priced mobility options for short-distance travel and grocery shopping, is fueling the demand for this market segment. Furthermore, the government's aggressive focus on improving the existing bicycle infrastructure to promote a greener and safer mode of transportation is expected to contribute to the growing sales of bicycles.

The market is witnessing a focus on forming partnerships between parts and components manufacturers and bicycle manufacturers to develop advanced products to cater to the increasing consumer demand for electric bicycles. Due to the presence of leading companies in the European region, the e-bicycle parts and components export-import market has also witnessed massive growth in recent years.

Increase in the volumes of bicycles and e-bicycles in the global markets as more geographies increasingly favour these vehicles owing to several reasons with regards to fitness, convenient mode of transportation, government support; all these factors are anticipated to primarily drive the market for body components.



10 Financial profiling of key automotive component companies

CIE Automotive India Limited

Background and overview

CIE Automotive India Ltd. (Earlier known as Mahindra CIE Automotive Limited (MCAL) is part of the CIE Automotive Group of Spain and is the CIE Automotive Groups vehicle for its forgings business globally. The company has 29 manufacturing facilities including 4 manufacturing facilities in Europe and one1 in Mexico. The company, therefore, draws from the vast and varied experience of the CIE group in partnering and co-developing products for the rapidly evolving automotive industry. The company largely operates in the automotive markets of Europe and India. In Europe, the Company supplies components mainly to the light vehicles and heavy truck markets with a comparatively small business in the offroad sector. In India, the company is more diversified and supplies components to the light vehicles segment (both passenger vehicles and light commercial vehicles), two wheelers, tractors, medium and heavy commercial vehicles, in order of dependence.

In calendar 2023, CIE India's consolidated sales (excluding the German forgings operations) were Rs 88,120 million, 7% higher than that in calendar 2022. The company's mitigation plan is to start producing aluminium forged parts and steel suspension products for cars. Almost 40% of the new orders that the car forgings vertical acquired in calendar 2022 were in the BEV space. Forged aluminium parts are expected to constitute a significant part of car forgings sales by 2027. CIE India's European vertical which makes gears for off road and tractors, will not be much affected by electrification. But here too, they have acquired significant business for BEV transmission parts. Electric vehicles will mean a greater emphasis on stamped, plastic, and aluminium parts compared to forged, cast, or machined parts. As the supplier ecosystem for EVs is at a nascent stage, EV Original Equipment Manufacturers (OEMs) are looking to partner with suppliers who have quality and pedigree. Therefore, the transition to EVs may be more of an opportunity rather than a risk.

Key product segments

Product category	Products	End Use Segments
Forgings	Crankshafts, CV joints, knuckles, diff crowns	Cars and utility vehicles, tractors
Aluminium	Crank case, pump house, turbo cover, brake panels	Two-wheelers, cars and utility vehicles
Gears	Gears and shafts, e-drive components, flanges, clutch hubs	Tractors, off-road and utility vehicles
Iron castings	Crank shafts, differential and turbines and axle housings, gear carriers	Commercial vehicles and utility vehicles
Composites	Front lids, wind shields, electric boxes, top trays, front bumpers	Electricals and switchgears
Stampings	Chassis & Structural Parts, BIW Panels, Cross Car Beams, Safety Assembly, Fuel Tank	Cars & Utility Vehicles

Source: Company website, CRISIL Market Intelligence & Analytics



Manufacturing facility

CIE Automotive India Ltd has manufacturing facilities at 11 locations in India. Its forging facility is located at Pune, Bangalore, Haridwar and Coimbatore, whereas its stamping facility is located at Pune, Nashik, Rudrapur, Zaheerabad and Nagpur. Manufacturing facilities for other products are spread across Pune, Rajkot, Aurangabad and Pantnagar.

A new unit is being added at the gears plant in Pune to cater to EV parts, while the Rajkot gears plant was also expanded during 2022. A new forgings and machining line was installed by Bill Forge at Bengaluru to cater to EV transmission parts. The crankshaft machining capacity at the forgings plant in Chakan, Pune was augmented and an additional 4000T press is being put up to enhance forgings capacity. The new plant being built by the Aluminium vertical at Aurangabad was completed last year, it will cater to four-wWheeler EV parts, among others. The stampings plant at Pune continues to add more robotic-welding capabilities to increase value add.

Endurance Technologies Limited

Background and overview

Endurance is a leading global automotive components manufacturer with a diversified product base including aluminium die castings, transmissions, braking systems, and suspension products. Starting with two aluminium die casting machines in 1985, they have grown to 31 manufacturing facilities strategically located near their Original Equipment Manufacturers (OEMs), in India and overseas. They are known for their aluminium die-casting products and are currently serving the two-wheeler, three-wheeler, and four-wheeler original equipment manufacturers (OEMs). The company also has presence in Europe, through its overseas subsidiaries in Italy and Germany. It is making continuous efforts to increase the share of value-added products in its product mix, including products for EVs. The company's established products of brakings, suspensions, and aluminium die-casting components are EV-agnostic. Endurance markets such EV components to both the established Original Equipment Manufacturers (OEMs) and the new two-wheeler and three-wheeler EV OEMs.

During fiscal 2023, consolidated total income grew by a significant 16.6% over fiscal 2022, mainly on account of the industry growth, order intake, capacity creation, and higher metal prices. Consolidated EBITDA grew by 7.6%, while consolidated EBITDA margin was at 12.2% and net profit grew by 4.1%. Indian operations accounted for 77% of our consolidated total income, and the remainder was from overseas operations.

The company sees huge growth potential in the EV space. Its current EV product portfolio includes suspension front forks and rear shock absorbers, disc brakes, ABS, driveshaft, and different types of aluminium castings, including case transmissions, battery housings, motor housing. To harness the huge EV opportunity, Endurance acquired a 51% equity stake in Maxwell Energy Systems Private Limited and the balance 49% stake will be acquired in a phased manner. Maxwell is in the business of advanced electronics, particularly in the battery management space (BMS) for automobile EVs and stationary storage.

Key product segments

Product Category	Products	End Use Segments
Aluminium die casting	Crank cases, transmission cases, clutch housings, alloy wheel disc brakes, wing arms	Cars and utility vehicles, two-wheelers and commercial vehicles
Suspension	Front forks, suspensions, shock absorbers	Two-wheelers, cars and utility vehicles and three-wheelers



Product Category	Products	End Use Segments
Transmission	Continuous variable transmission, clutch assembly	Two-wheeler and three-wheeler
Braking systems	Disc brake systems, tandem master cylinders, ABS, CBS, drum brake assemblies	Two-wheelers

Source: Company website, CRISIL Market Intelligence & Analytics

Manufacturing facility

Endurance Technologies Ltd manufacturers in three countries globally and has 31 plants and exports to 31+ countries.

Endurance has technologically advanced manufacturing facilities, focused on quality-driven processes, across India and Europe. Its 19 manufacturing facilities in India are strategically located across Maharashtra, Gujarat, Uttarakhand, Tamil Nadu, and Karnataka. In Europe, eight facilities are in Italy and three in Germany. It has five state-of-the-art R&D facilities in Maharashtra. Their expanded plant facility at Chakan, Pune, became operational and started supply of alloy wheels since July 2022. It has increased alloy-wheel supplies from 240,000 to 380,000 alloy wheels a month to service new orders. Their second brakes plant at Waluj, Aurangabad, is now operational and is catering to the increase in volumes in the brake assembly business. New Electronics R&D Centre in Bengaluru is established. This centre is designed to help Endurance in integrating cutting-edge technology into an existing product and developing next-generation electronics products for its customers. They have added new and more advanced equipment, and upgraded some of the existing machines, to boost R&D.

Sona BLW Precision Forgings Limited

Background & Overview

The journey of the company started in 1995 as Sona Okegawa Precision Forgings, which was a 75:25 joint venture between the Sona Group and Mitsubishi Materials and the pioneer of warm forged near net-shaped gears manufacturing technology. The Sona Group, after acquiring Thyssen Krupp's forging business (which acquired BLW, the inventor of warm forging) and 25% stake of Mitsubishi, renamed the company to Sona BLW Precision Forgings, which became a renowned manufacturer of forged gears. In 2019, Sona BLW acquired Comstar Automotive, a designer and manufacturer of starting and charging systems for automobiles and created a new identity.

The company is engaged in the production of differential assemblies, differential gears, conventional and microhybrid starter motors, belt starter generator (BSG) systems, electric vehicle (EV) traction motors, such as brushless direct current (BLDC) and permanent magnet synchronous motors (PMSM) and motor control units. Its driveline technology products include precision forged gears and couplings, and e-drive, among others. Its products offer application across various vehicle categories includes electric vehicles, conventional passenger vehicles, commercial vehicles, off-highway vehicles, electric cars, electric light commercial vehicles, and electric two and three wheelers. As of 2023, majority of the company's revenue is generated from the passenger vehicle business (70%), followed by commercial vehicles (14%), off-highway (10%) and electric two-wheelers and electric threewheelers (6%).

The company's revenue, EBITDA, and PAT have grown 27%, 25%, and 9% respectively in fiscal 2023. The company's BEV revenue share rose to 26%, with a 33% growth in absolute revenue, reaching 67 billion in fiscal 2023. Sona anticipates exponential growth in this domain as both the number of EV programmes and EV

customers globally have increased 1.4 times compared with the previous year, now totalling 42 programmes and 26 electric vehicle customers, respectively.

Key product segments

Product Category	Products	End Use Segments
Driveline	Precision forged gears, couplings, differential assembly, e-drives	Cars and utility vehicles, commercial vehicles, off-highways, electric vehicles
Motors	Controller, hub-wheel motors, starter motors, drive motors, BSG	Cars and utility vehicles, commercial vehicles, off-highway, electric vehicles
Sensor & Software	ADAS, AGV, electronic control units	Cars and utility vehicles, commercial vehicles, off-highway, electric vehicles

Source: Company website, CRISIL Market Intelligence & Analytics

Manufacturing facility

Sona BLW Precision Forgings Limited has nine manufacturing and assembly facilities across India, China, Mexico and the US, of which six manufacturing facilities are in India. The facilities in Chennai, China, Mexico and the US focus on production of electrical business products and the other facilities in India are focused on production of driveline business products. While the facilities in India are manufacturing plants, the facilities in US, Mexico and China operate as satellite final assembly and finishing plants. The newly added business vertical of Sensors and Software has three engineering capability centres. Besides the manufacturing and engineering capabilities, the company also has four R&D centres located across India and Serbia and 8 warehouses located across India, the US, Germany and Belgium.

They company has a production capacity of over 8 million units per year. The company's commitment to quality and innovation is reflected in its certifications, including ISO 9001, ISO 14001, and IATF 16949.

In addition to its core business of automotive powertrain systems, they are also involved in the development of next-generation technologies, such as autonomous driving and connected vehicles. The company has a dedicated team of engineers and researchers who are working on cutting-edge solutions that will shape the future of mobility. They recently inaugurated their plant in Chakan, Pune. This plant has a production capacity of 11.8 million gears and is expected to reach 20.1 million by the end of calendar 2024. Their capex plans also includes development of new technologies and products for development of drivetrain and powertrain products for electric vehicles and testing equipment. Setting up of manufacturing capacity for various products meant for use in EV drivetrain and powertrain. It also includes R&D capex for development of such products.

Uno Minda Limited

Background & Overview

Uno Minda Group started its journey in the year 1958, which subsequently led to establishment of Uno Minda Limited ('Uno Minda' or 'The Company') in 1992. They are a prominent manufacturer and supplier of proprietary automotive solutions and systems to Original Equipment Manufacturers (OEMs). The company has a well-diversified product portfolio with client base, both globally and domestically. Over years, the company has diversified its products (acoustics, switches, castings, lighting, seatings, and others), segments (four-wheeler, two-wheeler, three-wheeler & commercial vehicle) and geographies (international and domestic) and channels (replacement & OEMs). Uno Minda have also built formidable electric vehicle specific products portfolio, leading the automotive industry transition into electric mobility. The company manufactures and supplies over 20 categories of



automotive components and systems to leading Indian and international OEMs based in India, Asia, South and North America and Europe.

The company demonstrated excellent performance with 35% growth in annual revenue to Rs 112.37 billion in fiscal 2023 as against Rs 83.13 billion in the previous fiscal. EBITDA for the same period in fiscal 2023 was Rs 12.42 billion compared with Rs 8.85 billion in fiscal 2022. EBITDA margin was higher at 11.1% in fiscal 2023, as against 10.7% in in the previous fiscal, due to benefits of operating leverage, partially offset by higher material costs. As the adoption of electric vehicles grows, the distribution networks for automotive electrical systems will progress. Uno Minda has a diverse product portfolio catering to both global and domestic markets. Uno Minda has been steadily expanding its footprint by adding capacity, products and channels while focusing on infrastructure, technology and research and development. The company has a robust in-house product development capability including localisation of products, aided by a team of over 1000 engineers, filling more than 375 patent applications and over 340 design registrations.

Key product segment

Product Category	Products	End Use Segments
Switch	Automotive switches, Combination Switch, FNR Switch, Lever Combination	Cars, Two-wheeler, Three-wheeler, Commercial vehicles & Off-road
Seating	Seat Head Rest, Seat Recliner, Automotive Seat	Cars, Two-wheeler, Three-wheeler, Commercial vehicles & Off-road
Lighting	Automotive Lighting, DC Converter, Lamps	Cars, Two-wheeler, Three-wheeler, Commercial vehicles & Off-road
Casting	Wheel cover, Alloy wheels	Passenger Vehicle and Two-wheeler
ADAS	Motor Controller	Electric two-wheeler & three-wheeler

Source: Company website, CRISIL Market Intelligence & Analytics

Manufacturing facility

Uno Minda Limited has over 73 manufacturing plants globally with overseas manufacturing facilities in Indonesia, Vietnam, Spain and Mexico. In India, its major plant locations are at Manesar, Pune, Pantnagar, Aurangabad, Hosur and Chennai, catering to all vehicle segments, such as four-wheelers, two-wheelers, three-wheelers, commercial vehicles and off-road vehicles. They have around 33 R&D and Engineering centres in India, Germany and Spain, working on advanced technologies.

Four-wheelers with lighting Gujarat plant has been commissioned. Besides, they have completed land acquisition for their new lighting plant announced in November 2022. The lighting plant will be set up in Khed city, Pune.

For the alloy wheels division, the company also commissioned 30,000 expansion line in Gujarat, expanding its capacity from 295,000 wheels per month to 325,000. During the year, it started the commercial production of 30,000 line in Gujarat plant and 60,000 line in Bawal. Aggregate four-wheeler alloy wheel capacity at Gujarat and Bawal now stands at 3.2 lakh wheels per month of GDC technology and 25,000 wheels of LPDC technology. They are in process of further enhancing capacity at Bawal.

In fiscal 2023, The board approved the formation of a JV with Buehler with a 50.1% stake held by Uno Minda, to manufacture traction motors for two-wheeler and three-wheeler EVs. It has also approved the formation of JV with Tachi S with a 51% stake held by Uno Minda to manufacture recliners and other seating mechanisms in phased manner. It has approved a total capex outlay of Rs 4 billion. The board has approved to set up a new plant at Farukhnagar under the subsidiary, Mindarika Private Limited, with an initial outlay of Rs 1.10 billion. Mindarika



Private Limited ("MRPL") is a material subsidiary of the company engaged in manufacturing of four-wheeler automotive switches. MRPL has proposed the expansion of its existing manufacturing plant in Chennai, due to new customer requirement in southern India. The total approved project cost is Rs 728.9 million.

Varroc Engineering Limited

Overview

Varroc Engineering Limited is a global tier-1 automotive component company who commenced operations in India with polymer business in 1990. The company designs, manufactures, and supplies exterior lighting systems, plastic and polymer components, electrical-electronics components, and precision metallic components to passenger car, commercial vehicles, two-wheelers, three-wheelers and off-highway vehicle OEMs directly worldwide.

Varroc's strong R&D capabilities and technological partnership has helped it to develop products and serve customers as per the emerging mega trends of safer, greener, smarter and connected vehicles in automotive space. With over three decades of relentless commitment to excellence and performance, Varroc offers the best design solutions that provides its customers a competitive edge in its markets.

Consolidated revenue from continued operations was Rs 68.73 billion in fiscal 2023, registering a growth of 17.4% on-year. Consolidated EBITDA margin for continued operations for fiscal 2023 was 8.1%, up 175 bps on-year. The group filed 15 patents during fiscal 2023. The company has also commercialised its products developed by its R&D, such as electronic fuel injection (EFI) for ICE vehicles, and various products, such as traction motors, traction controllers, transmission control unit (TCU)s, and DC-DC convertors for electric vehicles.

Product Category	Products	End Use Segments
Polymer	Air vents, mirror assemblies, seat assembles, shrouds, load bars, roof rails, bumpers and body side claddings	Cars, two-wheelers, three-wheelers, commercial vehicles
Electrical	Switches, side stand sensors, USB chargers, EFJ, traction motors, telematics control units, BMS, RR, DC converters, CDI and TCI units	Cars, two-wheelers, three-wheelers, commercial vehicles
Metallic	Spool, engine valves, pump gears, EV motor shafts, gears, sun and planetary shafts, crankshafts, connecting rod, flanges, starter clutch, camshafts and crankpins	Cars, two-wheelers, three-wheelers, commercial vehicles and off-road
Lighting Systems	Automotive LED lamps, AFS projectors, AFS reflectors, ADB projectors, laser boost modules, DMD/DLP modules, scanning mirrors and 3D lighting effects	Cars, two-wheelers, three-wheelers, commercial vehicles
IMES	Link, sprocket segments, half rollers, jet heads, cones, generator rings/balance wheels	Cars, two-wheelers, three-wheelers, commercial vehicles

Key product segments

Source: Company website, CRISIL Market Intelligence & Analytics



Manufacturing facility

Varroc has a vast network of 36 operating manufacturing facilities, 7 technical centres, and over 6,500 employees spread across 7 countries. The company's capabilities span across product development, manufacturing, and delivery. It has end to-end capabilities across design, engineering, testing/validation, tooling, manufacturing, and delivery.

Polymer & plastics segment has 13 facilities across India and has technical centre set up in Pune as well as in Aurangabad. Electrical electronics (including lighting) has 10 facilities across India and has technical centre in Pune where more than 400+ engineers work. Metallic transmission & valves has 5 facilities in India all located in Aurangabad. Aftermarket includes both the product produced by the company inhouse and contract manufacturing. The company has over 700+ distributors in 260 cities in India and exports to more than 28+ countries. It has state of the art warehouse of 120 thousand sq ft in Aurangabad.

European operation is divided into three segments -global lighting, electronics, and metallic (IMES). With three manufacturing facilities, the global lighting segment is a leading supplier of exterior lighting systems for two-wheeler OEMs and luxury passenger vehicles. The electronics segment focuses on ADAS, Lighting Electronics (light engines & light control units), and Electronics Manufacturing Services (EMS). They also have 2 manufacturing facilities for the metallic (IMES) segment, manufacturing hot steel forged parts for the construction and oil & gas industries. China is responsible for supplying exterior lighting systems for passenger vehicle and aftermarket. This is facilitated through two manufacturing facilities in China.

Hero Motors Ltd.

Overview

Hero Motors is a part of HMC group, led by Mr. Pankaj Munjal. It is one of India's leading automotive technology companies designing, manufacturing, and supplying highly engineered powertrain³ solutions catering to automotive OEMs in US, Europe, India and ASEAN regions. It is amongst the few companies in India that operates an international product development and design center.

Their components cater to various vehicle segments, such as two-wheelers, passenger vehicles, e-bikes and ATVs. In two-wheelers, Hero Motors is among the few companies in India with a global and premium⁴ customer base that includes companies like Ducati, Harley Davidson, and BMW to name a few. Over the past five years, the company has expanded its market presence across automotive segments and has grown to become one of the preferred choices for premium two-wheeler OEMs⁵ globally. Hero Motors is recognised for its leadership in the development and production of continuously variable transmission (CVT) technology, electric vehicle transmissions, electric motors, integrated drive units and gear sets. The company's expertise in precision gear components and the full

³ Powertrains are integrated systems designed to propel a vehicle by converting energy into motion. They include the engine or motor, energy storage systems, the transmission, driveshaft, and other related components that work together to deliver power to the vehicle's wheels.

⁴ The Premium/High Performance ICE Segment includes vehicles known for their luxury features or strong performance, sometimes both. These vehicles are designed to offer a satisfying driving experience, featuring powerful engines, advanced technology, quality construction, and comfortable -user experience. Generally, motorcycles with engine sizes over 600cc and cars with engine sizes above 2 liters fall into this category

⁵ Premium OEMs in the two-wheeler segment refers to manufacturers who position their vehicles at the higher end of the market in terms of quality, features, and pricing. These OEMs typically offer vehicles with advanced technology, superior performance, and luxurious amenities compared to mainstream or budget brands. Examples of premium OEMs in the two-wheeler segment include Harley-Davidson, Ducati, BMW Motorrad, Triumph, and Yamaha's higher-end models, among others.



transmission system experience, powertrain neutral⁶ A&M products, has developed them as one of the few players in India to benefit with the accelerated electrification trends.

Hero Motors is the only player manufacturing and exporting CVT hubs to global e-bike OEMs from India and are the only manufacturer of integrated electric powertrain products for e-bikes in India. It was among the first companies in India to capitalise on the global e-bike powertrain opportunity and has a distinct first-mover advantage in this industry.

Beyond electric vehicles, Hero is among the few companies that addresses requirements of the premium ICE and performance ICE segment that require high-performance transmission systems capable of handling tough torque needs while keeping components lightweight.

The company's joint venture, HYM Drive Systems (HYM), is of one the companies in the global hub motor product segment, where two automotive brands are combined to develop high-quality products.

To expand its presence in the UK, Hero Motors acquired a strategic stake in the UK-based company called, Hewland Engineering, in fiscal 2021 and majority stake in fiscal 2023. The UK company specialises in transmission design technology and has an established motorsport customer base. The company's revenue from operations increased from Rs 9,142 million in fiscal 2022 to Rs 10,644 million in fiscal 2024, growing by 16.43%. They are one of India's leading solutions providers to the global e-mobility⁷ industry, with their revenue from sales to the emobility industry as a percentage of total revenues being 19.58% in fiscal 2022, 22.10% in fiscal 2023, and 12.03% in fiscal 2024.

Product Category	Products	End Use Segments
Gears & Transmissions	Shafts, bearings, chain sprockets, seals, engine gears, transmission gears, gear box assemblies	Cars, two-wheelers ⁸ , three-wheelers ⁹ , ATVs, Motorsport ¹⁰ , Performance Automotive ¹¹ and Aerospace
Bike powertrains	Continuously variable transmission (CVT), Electronic Drive Unit (EDU), Electric drive motors	E-bikes, Electric two-wheelers and Electric three-wheelers
Alloys & Metallics	Chaincases, swing arms, mainstands, rims, Engine guards, handlebars, sariguards	Two-wheelers and bicycles/e-bikes

Key product segments

Source: Company website, CRISIL Market Intelligence & Analytics

⁶ **Powertrain Neutral Components**: Powertrain Neutral components refer to vehicle components that are not specific to a particular type of powertrain (internal combustion engines, electric motors, or hybrid systems). These components are used across the vehicles with different types of powertrains.

⁷ *E-mobility*: *E-mobility* encompasses electric-powered transportation, including vehicles like e-bikes, cars, buses and aircrafts.

⁸ **Two-wheeler**: Two-wheeler is a self-propelled vehicle with two wheels, including motorcycles and scooters, designed for personal transportation.

⁹ **Three-wheeler**: A three-wheeler is a self-propelled vehicle with three wheels, including vehicles such as tricycles, auto rickshaws, and certain small electric vehicles, designed for personal or commercial transport.

¹⁰ Motorsport: Motorsport is competitive racing and driving involving motorized vehicles, including disciplines like Formula 1, MotoGP, and rally racing.

¹¹ **Performance Automotive**: Performance automotive refers to vehicles designed or modified for enhanced speed, handling, and overall driving dynamics. These vehicles typically feature advanced engineering, higher power outputs, and specialized components to deliver superior performance compared to standard models.



Manufacturing facility

The company has six state-of-the-art manufacturing facilities and two technology centres in India, Thailand, and the UK. In India, the company has plants in Greater Noida and Ludhiana. Globally, it has two plants in Bangkok, Thailand and Maidenhead, the UK each. All the units are located at strategic locations for the unique advantages that each place offers.

Financial parameters

Player-wise financial comparison (domestic)

Particulars	Hero Motors Limited	Uno Minda Limited	Varroc Engineering Limited	CIE Automotive India Limited	Endurance Technologies Limited	Sona BLW Precision Forgings Limited
Operating income (Rs million)	10643.86	140308.90	75519.37	92803.49	102408.71	31847.70
Gross Profit (Rs million)	4193.70	47718.40	28186.10	43695.20	41637.20	18091.38
Gross Margin (%)	39.40	34.01	37.32	47.08	40.66	56.81
Adjusted EBIDTA (Rs million)	1222.71	18044.50	8246.14	18844.38	14135.99	9244.98
Adjusted EBITDA Margin (%)	11.49	12.86	10.92	20.31	13.80	29.03
EBITDA (Rs million)	828.10	18310.70	8246.14	18858.23	14135.99	9173.29
EBITDA Margin (%)	7.78	13.05	10.92	20.32	13.80	28.80
Profit after tax (Rs million)	170.36	9247.10	5320.75	11251.49	6804.90	5177.76
Return on Capital Employed (%)	22.14	29.84	27.68	34.20	31.08	37.45

Note: Consolidated financials are considered for all the companies.

Note Consolidated financials for CIE Automotive India Limited is for CY23, whereas financials for all other companies is for FY24

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Player-wise financial comparison (domestic) - Additional KPIs

Companies	Revenue from operations (Rs million)			Revenue from operations growth (%)			Profit after tax (Rs million)		
	FY22	FY23	FY24	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Ltd.	9,039.79	10,546.23	10,643.86	28.05	16.66	0.93	978.73	405.08	170.36
UNO Minda Ltd.	83,130.00	112,364.90	140,308.90	30.43	35.17	26.58	4,126.40	7,002.30	9,247.10
Endurance Technologies Limited	75,491.40	88,040.46	102,408.71	15.31	16.62	16.32	4,607.00	4,795.00	6,804.90
Varroc Engineering Ltd.	58,442.01	68,912.13	75,519.37	33.62	17.92	9.59	-11,067.27	-8,171.25	5,320.75
Sona Blw Precision Forgings Ltd	21,306.40	26,550.10	31,847.70	36.03	24.61	19.95	3,615.43	3,952.97	5,177.76

	CY21	CY22	CY23	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	83,867.00	87,530.37	92,803.49	38.62	4.37	6.02	3,929.00	-1,361.66	11,251.49

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Componies	Net Debt to EBITDA (in times)					
Companies	FY22	FY23	FY24			
Hero Motors Limited	1.99	1.59	1.76			
UNO Minda Ltd.	0.56	0.77	0.73			
Endurance Technologies Limited	0.00	0.00	0.17			
Varroc Engineering Ltd.	-2.26	-5.32	1.31			
Sona Blw Precision Forgings Ltd	-0.01	0.21	-0.04			
	CY21	CY22	CY23			
CIE Automotive India Ltd.	1.13	1.90	0.26			

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	R	eceivable Day	/S	Inventory Days			
Companies	FY22	FY23	FY24	FY22	FY23	FY24	
Hero Motors Ltd.	77	87	67	57	68	62	
UNO Minda Ltd.	60	56	54	46	43	0	
Endurance Technologies Limited	47	48	45	34	34	31	
Varroc Engineering Ltd.	32	32	24	38	36	33	
Sona Blw Precision Forgings Ltd	76	84	74	62	44	40	
	CY21	CY22	CY23	CY21	CY22	CY23	
CIE Automotive India Ltd.	29	36	25	59	50	46	

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	Tra	de Payable D	ays	Cash Conversion Cycle			
Companies	FY22	FY23	FY24	FY22	FY23	FY24	
Hero Motors Ltd.	80	51	47	55	103	82	
UNO Minda Ltd.	0	55	52	106	44	2	
Endurance Technologies Limited	60	59	57	21	23	19	
Varroc Engineering Ltd.	0	63	59	71	4	-3	
Sona Blw Precision Forgings Ltd	38	34	34	101	94	80	
	CY21	CY22	CY23	CY21	CY22	CY23	
CIE Automotive India Ltd.	84	89	76	3	-3	-5	

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	Fixed	asset turnove	r ratio	Asset turnover ratio		
Companies	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Limited	5.19	2.96	2.19	1.34	1.06	1.00
UNO Minda Ltd.	2.64	3.11	4.70	1.22	1.35	1.50
Endurance Technologies Limited	3.00	3.00	3.27	1.29	1.29	1.39
Varroc Engineering Ltd.	2.69	3.15	3.58	0.53	1.49	1.66
Sona Blw Precision Forgings Ltd	1.39	1.38	1.54	0.82	0.87	0.82
	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	1.25	1.55	1.58	0.84	0.88	0.95

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	Gros	ss Profit (Rs mil	lion)	Gross Margin (%)		
Companies	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Ltd.	2,781.51	3,360.73	4,193.70	30.77	31.87	39.40
UNO Minda Ltd.	28,786.00	35,695.10	47,718.40	34.63	31.77	34.01
Endurance Technologies Limited	31,290.00	34,746.00	41,637.20	41.45	39.47	40.66
Varroc Engineering Ltd.	19,948.46	24,606.66	28,186.10	34.13	35.71	37.32
Sona Blw Precision Forgings Ltd	11,850.82	14,339.21	18,091.38	55.62	54.01	56.81
	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	43,788.00	39,770.46	43,695.20	52.21	45.44	47.08

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	Adjusted	d EBITDA (Rs	s million)	Adjusted EBITDA Margin (%)		
Companies	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Ltd.	1,004.42	1,107.02	1,222.71	11.11	10.50	11.49
UNO Minda Ltd.	10,432.60	13,908.00	18,044.50	12.55	12.38	12.86
Endurance Technologies Limited	10,056.76	10,816.93	14,135.99	13.32	12.29	13.80
Varroc Engineering Ltd.	-6,356.03	-2,460.18	8,246.14	-10.88	-3.57	10.92
Sona Blw Precision Forgings Ltd	6,123.27	7,036.85	9,244.98	28.74	26.50	29.03
	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	9,890.00	4,003.08	18,844.38	11.79	4.57	20.31

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	EBI	TDA (Rs milli	ion)	EBITDA Margin (%)		
Companies	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Ltd.	1,679.34	973.51	828.08	18.37	9.23	7.78
UNO Minda Ltd.	10,134.90	13,908.00	18,310.70	12.19	12.38	13.05
Endurance Technologies Limited	9,742.26	10,714.08	14,135.99	12.91	12.17	13.80
Varroc Engineering Ltd.	-6,420.46	-2,458.27	8,246.14	-10.99	-3.57	10.92

Sona Blw Precision Forgings Ltd	5,923.97	7,040.36	9,173.29	27.80	26.52	28.80
	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	9,878.00	4,300.81	18,858.23	11.63	4.91	20.32

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies	Adjusted	d EBITDA Gro	owth (%)	PAT Margin (%)		
Companies	FY22	FY23	FY24	FY22	FY23	FY24
Hero Motors Ltd.	30.68	10.21	10.45	10.83	3.84	1.60
UNO Minda Ltd.	30.75	33.31	29.74	4.96	6.23	6.59
Endurance Technologies Limited	-8.00	7.56	30.68	6.10	5.45	6.64
Varroc Engineering Ltd.	-191.51	61.29	435.18	-18.94	-11.86	7.05
Sona Blw Precision Forgings Ltd	45.76	14.92	31.38	16.97	14.89	16.26
	CY21	CY22	CY23	CY21	CY22	CY23
CIE Automotive India Ltd.	77.78	-59.52	370.75	4.68	-1.56	12.12

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Companies		RoCE (%)		RoE (%)			
Companies	FY22	FY23	FY24	FY22	FY23	FY24	
Hero Motors Ltd.	29.06	25.43	22.14	62.38	12.01	4.55	
UNO Minda Ltd.	27.03	28.22	29.84	10.96	15.79	18.00	
Endurance Technologies Limited	26.61	26.17	31.08	12.00	11.00	14.14	
Varroc Engineering Ltd.	-12.12	-7.36	27.68	-54.95	-81.37	34.86	
Sona Blw Precision Forgings Ltd	33.10	33.54	37.45	18.07	17.26	18.49	
	CY21	CY22	CY23	CY21	CY22	CY23	
CIE Automotive India Ltd.	16.49	7.13	34.20	7.56	-2.67	18.79	

Note: Consolidated financials are considered for all the companies.

Source: Company financial reports, CRISIL Market Intelligence & Analytics

Player-wise financial comparison (Global)

Particulars	Bafang Electric (Suzhou) Co. Ltd	Linamar Corporation	MAHLE GmbH	Musashi Co. Ltd.	Robert Bosch GmbH	Shimano Inc
Year	CY 2023	CY 2022	CY 2023	FY 2022	CY 2023	CY 2023
Currency	CNY	CAD	EUR	JPY	EUR	JPY
Total Revenue (million)	1,647	7,917	12,817	36,213	91,596	4,74,362
Net Income (million)	127	426	(34)	981	2,101	61,142
Operating Profit (Rs million)	84	565	246	1,747	4,495	83,654
Gross Profit Margin (%)	26.71	12.31	15.08	24.20	31.25	38.48
Return on Common Equity (%)	4.56	9.06	(2.14)	3.63	4.68	7.93

Particulars	Bafang Electric (Suzhou) Co. Ltd	Linamar Corporation	MAHLE GmbH	Musashi Co. Ltd.	Robert Bosch GmbH	Shimano Inc
Year	CY 2023	CY 2022	CY 2023	FY 2022	CY 2023	CY 2023
Currency	CNY	CAD	EUR	JPY	EUR	JPY
Return on Assets (%)	1.53	4.42	1.86	2.58	2.69	6.16
Return on Equity (%)	4.56	9.06	1.58	3.63	5.58	7.95
Current Ratio (times)	3.91	1.71	1.22	2.30	1.63	10.56

Source: Company Reports, Crisil Market Intelligence & Analytics

Player-wise financial comparison (public listed top 10 auto-component companies by market capitalisation)

Companies/Particulars	Operating Income	Net Profit	Operating Margin	Net Profit Margin	ROCE
Unit	Rs. billion	Rs. billion	Per cent	Per cent	Per cent
Bosch Ltd.	149.29	14.26	12	10	18
UNO Minda Ltd.	112.37	7.00	11	6	21
Sona Blw Precision Forgings Ltd	26.76	3.95	26	15	31
Endurance Technologies Limited	88.04	4.80	12	5	16
Motherson Sumi Wiring India Ltd.	70.57	4.87	11	7	55
Sundaram Fasteners Ltd.	56.63	5.00	16	9	19
CIE Automotive India Ltd.	93.04	11.25	16	12	39
Ramkrishna Forgings Ltd.	31.95	2.48	22	8	18
Varroc Engineering Ltd.	68.73	-8.17	8	-12	-19
Craftsman Automation Ltd.	31.83	2.51	22	8	21

Note: Consolidated financials are considered for all the companies.

Note: Consolidated financials for CIE Automotive India Limited is for CY23, whereas financials for all other companies is for FY23 *Source: Company Reports, Crisil Market Intelligence & Analytics*

Research & Development Expenditure (public listed top 10 auto-component companies by market capitalisation)

Componies	R&D Expenditure
Companies	(as % of revenue)
Hero Motors Ltd.	7.45%
Bosch Ltd.	2.84%
UNO Minda Ltd.	2.50%
Sona Blw Precision Forgings Ltd	2.49%
Endurance Technologies Limited	0.68%



Componies	R&D Expenditure	
Companies	(as % of revenue)	
Motherson Sumi Wiring India Ltd.	0.40%	
Sundaram Fasteners Ltd.	0.20%	
CIE Automotive India Ltd.	0.03%	
Ramkrishna Forgings Ltd.	0.25%	
Varroc Engineering Ltd.	2.20%	
Craftsman Automation Ltd.	0%	

Note: Calculated as revenue expenditure and capital expenditure classified under R&D head divided by total consolidated revenue of the company for FY24 and CY23 in case of CIE Automotive India Ltd.

Source: Company Reports, Crisil Market Intelligence & Analytics

Risk profiling of OEMs

Latest outstanding credit rating

Company name	Credit rating agency	Short term outstanding rating	Long term outstanding rating	Date of credit rating
CIE Automotive India Limited	CRISIL	CRISIL A1+	CRISIL AA-	November 2023
	ICRA	ICRAA1+	ICRA AA	April 2024
Endurance Technologies Limited	CRISIL	CRISIL A1+	CRISIL AA+	December 2023
	ICRA	ICRAA1+	ICRA AA+	September 2023
Sona BLW Precision Forgings Limited	India Ratings & Research	IND A1+	IND AA	FY23
Uno Minda Limited	ICRA	ICRAA1+	ICRA AA+	August 2023
Varroc Engineering Limited	India Ratings & Research	IND A1	IND A+	April 2023

Source: CRISIL Ratings, ICRA, CARE, India Research & Ratings, Company websites, Crisil Market Intelligence & Analytics



11 Threats and Challenges

Demand Side Challenges

1. Market Fluctuations

- Economic Cycles: Economic downturns can lead to reduced consumer spending, impacting demand for bicycles and two-wheelers.
- Seasonal Variations: Demand can be seasonal, with peaks and troughs that are difficult to predict and manage.

2. Consumer Preferences

- Changing Trends: Shifts in consumer preferences, such as a move towards electric vehicles or alternative modes of transportation, can affect demand.
- Quality Expectations: Increasing consumer demand for high-quality and reliable components can pressure manufacturers to improve their offerings.

3. Competition

- Market Saturation: High competition in the market can lead to price wars, reducing profit margins.
- New Entrants: Entry of new competitors with innovative products can disrupt market dynamics.

4. Technological Advancements

- Innovation: Rapid advancements in technology can render existing products obsolete, requiring continuous innovation.
- Adoption Rates: Slow adoption of new technologies by consumers can delay market growth.

5. Regulatory Changes

- Emissions Standards: Stricter emissions and environmental regulations can drive demand towards more efficient or electric components.
- Safety Regulations: New safety standards can necessitate redesigning, affecting demand for current products.

6. Distribution Network

- Channel Partners: Dependence on distributors and retailers can affect market reach and sales performance.
- Supply Chain Integration: Inefficiencies in the distribution network can impact the ability to meet market demand promptly.

7. Global Market Dynamics

• Trade Policies: Tariffs and trade barriers can affect international demand and market access.



• Currency Fluctuations: Exchange rate volatility can impact pricing and demand in different regions.

8. Pricing Pressure

- Cost Sensitivity: High sensitivity to price changes among end-users can limit the ability to pass on increased costs to customers.
- Discounting: The need to offer discounts or promotions to stimulate demand can affect profitability.

Supply Side Challenges

1. Raw Material Availability and Costs

- Scarcity: Limited availability of essential raw materials like metals (steel, aluminum, copper) can disrupt production schedules.
- Price Volatility: Fluctuations in raw material prices can impact manufacturing costs and profit margins.

2. Supplier Reliability

- Quality Issues: Inconsistent quality of supplied materials can lead to defects in final products.
- Delivery Delays: Unreliable suppliers might fail to meet delivery timelines, causing production halts.
- Dependency: Over-reliance on a single supplier can be risky if that supplier faces any disruptions.

3. Global Supply Chain Disruptions

- Geopolitical Factors: Tariffs, trade restrictions, and political instability can disrupt global supply chains.
- Natural Disasters: Events like earthquakes, floods, or pandemics can interrupt supply chain operations.

4. Logistics and Transportation

- Freight Costs: Rising costs of transportation and logistics can affect overall expenses.
- Infrastructure Issues: Poor transportation infrastructure can delay the supply of raw materials and distribution of finished goods.

5. Technological Challenges

- Integration: Integrating new technologies into the supply chain can be complex and costly.
- Obsolescence: Rapid technological advancements may render existing equipment and processes obsolete.

6. Regulatory Compliance

• Environmental Regulations: Adhering to stringent environmental regulations can increase operational costs.



• Trade Regulations: Complying with international trade regulations and standards can be challenging, especially when dealing with multiple countries.

7. Labor Issues

- Skilled Workforce Shortage: A lack of skilled labor can hamper production efficiency and quality.
- Labor Costs: Increasing labor costs can impact the overall cost structure of manufacturing.

8. Supplier Diversification

• Risk Management: Balancing the need for multiple suppliers to mitigate risk against the complexity and costs of managing a diverse supplier base.

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