



MOBILITY INDUSTRY AGENDA

2021



PRESIDENCY OF
THE REPUBLIC OF TÜRKİYE
**INVESTMENT
OFFICE**

EY
Building a better
working world

Mobility Industry Agenda 2021

December 2021

Copyright © The Investment Office of the Presidency of the Republic of Türkiye
and EY Turkey

All rights reserved. No part of this publication shall be processed/adapted, reproduced, circulated, re-sold, rent, lent, represented, performed, recorded, transmitted with cord/cordless or any technical, digital and/or electronic devices without prior written permission from the author(s)/rights holder subject to Article 52 of Law No. 4110 amended by Law No. 5846 for Intellectual and Artistic Works.

Credits:

Başak Avcı
Manager, Sectoral Activities Unit -
Investment Office of the Presidency of the
Republic of Türkiye

Onur Kanan
Expert, Overseas Offices & Activities Unit -
Investment Office of the Presidency of the
Republic of Türkiye
okanan@invest.gov.tr

İbrahim Ethem Tokgözlü
Expert, Sectoral Activities Unit -
Investment Office of the Presidency of the
Republic of Türkiye
etokgozlu@invest.gov.tr

Serdar Altay
Partner,
EY Turkey Mobility Industry Leader
serdar.altay@tr.ey.com

Arda Karaçelebi
Partner,
EY Turkey Advanced Manufacturing &
Mobility Leader, Supply Chain & Operations
Leader
arda.karacelebi@tr.ey.com

İnanç Engin
Senior Manager,
EY Turkey Consulting Services
inanc.engin@tr.ey.com

Mesrur Berk Uygur
Senior Consultant,
EY Turkey Consulting Services
berk.uygur@tr.ey.com

DISCLAIMER

The information provided in this guide is general and does not constitute legal advice. The information is not intended to create, nor does receipt of it constitute, a lawyer-client relationship. Whilst every effort has been taken to ensure the accuracy of this guide, the editors and authors accept no responsibility for any inaccuracies or omissions contained herein. Legal advice should always be sought before taking any legal action based on the information provided. Should you have any queries regarding the issues raised and/or about other legal topics, please contact the authors of this guide.

All information in this guide is up to date as of December 31, 2021.



Dear Readers,

A resilient, fast-growing economy, Türkiye offers business-friendly policies, a deep talent pool and global market access at the nexus of Europe, Asia and Africa to attract sustainable FDI. The globally-integrated nature of the Turkish automotive industry with a yearly export volume of more than 25 billion USD provides plenty of opportunities for multinational companies to use Türkiye as a R&D, design, manufacturing, export, logistics, and management hub. Global OEMs, together with numerous global suppliers, have built up a very competitive mobility ecosystem in Türkiye in the last 60 years.

Despite the pandemic, the Turkish automotive market grew by nearly 62% in 2020. Tightly integrated into the global supply chain, Türkiye ranked 4th in Europe and 14th worldwide in terms of total vehicle production. According to the first half of 2021 data, the country climbed to the 12th ranks. The automotive world is undergoing a significant transformation where fundamentals are changing; the future of mobility is electric, autonomous, and connected. It poses challenges as well as opportunities for both industry players and countries. Being one of the central players in the value chain, Türkiye is closely monitoring the ongoing developments and is taking major steps to ensure its dominant position remains unchallenged. In recent years, OEMs in Türkiye have continued to invest with a view to boosting their production capacities and modernizing their facilities. In addition, the production processes of Türkiye's Joint Venture Group Inc (TOGG) have been remodeled across all sectors to accommodate the new e-mobility solutions. In addition to OEMs, vendors and suppliers of automotive have improved their capabilities. As an example, Türkiye is set to

establish its first automobile battery manufacturing plant. All these improvements are a clear signal of the country taking necessary steps for electrification and digitalization of its mobility industry.

As the Turkish automotive industry is reinforcing its international standing every day, all stakeholders in the ecosystem need significant resources to take advantage of emerging opportunities. We believe that one of the prerequisites for capturing these opportunities that are transforming the automotive industry, especially with regard to electric and autonomous vehicles, is to have access to the right sources of information. In the third issue of the "Turkish Automotive Industry Agenda" Study, we have curated another detailed and comprehensive report for the benefit of all stakeholders in the automotive industry. I would like to express my gratitude to all those who have contributed to the preparation of this issue, especially EY Turkey, and all of relevant private sector representatives.

Türkiye, your resilient partner, welcomes investors from all around the world and supports them through lucrative incentive policies and institutional support. Türkiye presents unique opportunities as an ideal location for your next investment. We, as the Investment Office, also is at your service at every stage of your investments in Türkiye.

A. Burak Dağlıoğlu

President

The Presidency of the Republic of Türkiye Investment Office



Dear Automotive Industry Stakeholders,

Reflecting on the past two years in hindsight, the automotive industry has been going through a rather unusual span with a mingling of global developments, the effects of the pandemic, and Türkiye's unique dynamics.

The automotive industry has already been experiencing a tough time due to a pre-pandemic contraction in the European market as well as the advent of a span of inflation hikes, and the fluctuations in interest and exchange rates in Türkiye. On top of these, the predictability in the industry has decreased even further due to supply and demand imbalances and the deterioration in the supply chains caused by the pandemic. With these adverse factors still at play, the industry is striving to shape its future and keeping up with these new trends due to digitalization and the transition to electric vehicles.

In short, we are very pleased to share our report titled “Mobility Industry Agenda 2021” with our esteemed stakeholders at a time when the industry is going through an extremely active and volatile period clouded by uncertainties. As our valued stakeholders might recall, we, at EY Turkey; had the pleasure to compile the previous issues of this report back in 2018 and 2019 with the invaluable cooperation and contribution of the Investment Office of the Presidency of the Republic

of Türkiye. We are extremely happy and proud that we maintain this cooperation in 2021 and the following years upon the great interest and positive feedback from our stakeholders and the industry.

In this report “Mobility Industry Agenda 2021”, we will cover the following topics:

- Automotive Industry Statistics in Türkiye and the World
- Investment and Incentive Statistics of the Automotive Industry
- Interviews with the Leading Players and Institutions of the Industry
- Industry-Specific Trends such as the Chip Crisis and Connectivity

At EY Turkey Automotive Industry, we would like to express our gratitude to you for your interest in this issue, which, we hope, will be beneficial for all our readers who are interested in the automotive industry.

Serdar Altay

EY Turkey

Mobility Industry Leader

Contents

DISCLAIMER	3
EXECUTIVE SUMMARY	7
TURKISH MOBILITY INDUSTRY TREND ANALYSIS.....	8
Market Trends.....	9
EV Market Outlook.....	11
Industrial Identity (Number of Companies and Employment)	17
Production & Capacity, Production Comparison with Peer Countries.....	17
Exports.....	22
Number of R&D Centers, Employment and R&D Expenditure	24
GLOBAL MOBILITY INDUSTRY.....	26
Production and Sales	27
Evolving Position of Türkiye in the Global Mobility Industry	29
MOBILITY INDUSTRY RESEARCH	39
Ford Otosan.....	40
Farplas.....	44
Electra IC.....	47
OTEP Perspective - Understanding the Future of the Automotive Industry	51
KEY TRENDS	53
Persistent Semiconductor Shortage	54
EY Mobility Connected Car Framework.....	59
REFERENCES	70

EXECUTIVE SUMMARY

- Global passenger cars and commercial vehicles sales sank 13.8% in 2020 compared to the previous year, due to the effect of the pandemic and the chip crisis.

- Global passenger cars and commercial vehicles sales increased by 29.4% in the first half of 2021 compared to the same period of the previous year. The said rise in sales volume has mainly Africa to thank for, with a 50% increase on a regional basis. A breakdown of the percentile differentials of the volume increase places Africa at the forefront, followed by Central & South America, North America, and Europe. The rate of change in Russia, Türkiye & Other Europe was 3%.

- Despite the pandemic crisis in 2020, sales of passenger cars and commercial vehicles in Türkiye soared a record 61.8% compared to the previous year, knocking at the door of 800k unit sales. H1 2021 saw a 55.4% increase compared to the same period a year earlier. Electric vehicles (EV) accounted for the largest proportion of vehicle sale spike, with a gargantuan, quadruple change of 415%. Hot on their heels were hybrids, with a barely less impressive increase of 340%. Diesel vehicle sales, on the other hand, continued to dip.

- The global demand for EVs is climbing. Even in 2020, the global EV and hybrids market grew by 32.9% (IC only: -18.5%). By 2030, one out of every two vehicles sold is expected to be an EV.

- Europe Big 5 (Germany, UK, France, Italy, Spain) are expected to lead EV penetration compared to the US and China. While only 1 in every 25 vehicles sold in Europe Big 5 in 2030 is expected to be internal combustion engine (ICE) car, ICEs will still represent the better part of vehicle sales in the US by the 2030s. In Türkiye, EVs are forecast to make up 35% of vehicles sold in 2030.

- Türkiye's experience in the automotive industry, competitiveness, and geostrategic position have earned the country an attractive position in EV and EV-related equipment investments.

- 95.2% of 3,000+ companies operating in the Turkish automotive industry are micro- (56.2%), small- (27.1%), and medium-sized (11.9%) enterprises. However, approximately 90% of net sales are realized by large-scale companies that represent 5% alone.

- Developed economies' share in vehicle production narrowed to 45% (2008: 62%), while China's swallowed to 32% (2008: 13%). Automotive powerhouses in northern transatlantic countries that once prevailed

as global production centers saw their dominance fade as developing countries came to the fore as new alternatives.

- Despite a decreasing capacity utilization rate (CUR) as of 2017, made-in-Türkiye vehicle exports continued to rise. In the year when CUR touched a historical ceiling of 88% with production figures in the area of 1.7 million, 79% of the vehicles produced in Türkiye were exported. This rate increased to 86% in 2019.

- With the effect of the pandemic, the capacity utilization rate decreased to 65% in 2020, and the export rate of vehicles manufactured in Türkiye decreased to 71%. In the first half of 2021, vehicle production increased by 23.3% compared to the same period of the previous year, and the highest increase was seen in commercial vehicles with 43.1%.

- 2 out of every 100 vehicles produced in the world are of Turkish origin. According to global vehicle production performance, Türkiye is 4th in Europe (passenger cars: 6; commercial vehicles: 2) and 14th in the world (passenger cars: 15; commercial vehicles: 9)

- Türkiye is still leading among CEE countries in auto production as of 2020.

- Automotive sector exports reached the level of 25.5 USD billion. Since 2016, it has recorded an annual average growth of 1.6% in terms of USD. Approximately 8 out of every 10 vehicles produced in Türkiye are exported to Europe (including the UK). Türkiye is the second country that exports vehicles to Europe after the UK.

- Despite the pandemic, Türkiye was the 16th strongest country in automotive export values.

- R&D expenditures in the automotive sector have increased by 19.6% annually since 2010 and exceeded TRY 3.5 TRY billion in 2020. R&D expenditure in the automotive sector represents 17% of the total R&D expenditure in the manufacturing industry and 10% of all R&D expenditure.

- Following the new capacity development of OEMs and the sub-industry investments triggered by these new capacities, the net sales revenue of the automotive industry in Türkiye has approached the level of TRY 270 billion as of 2020. Nearly 200k employees are employed in the automotive sector.

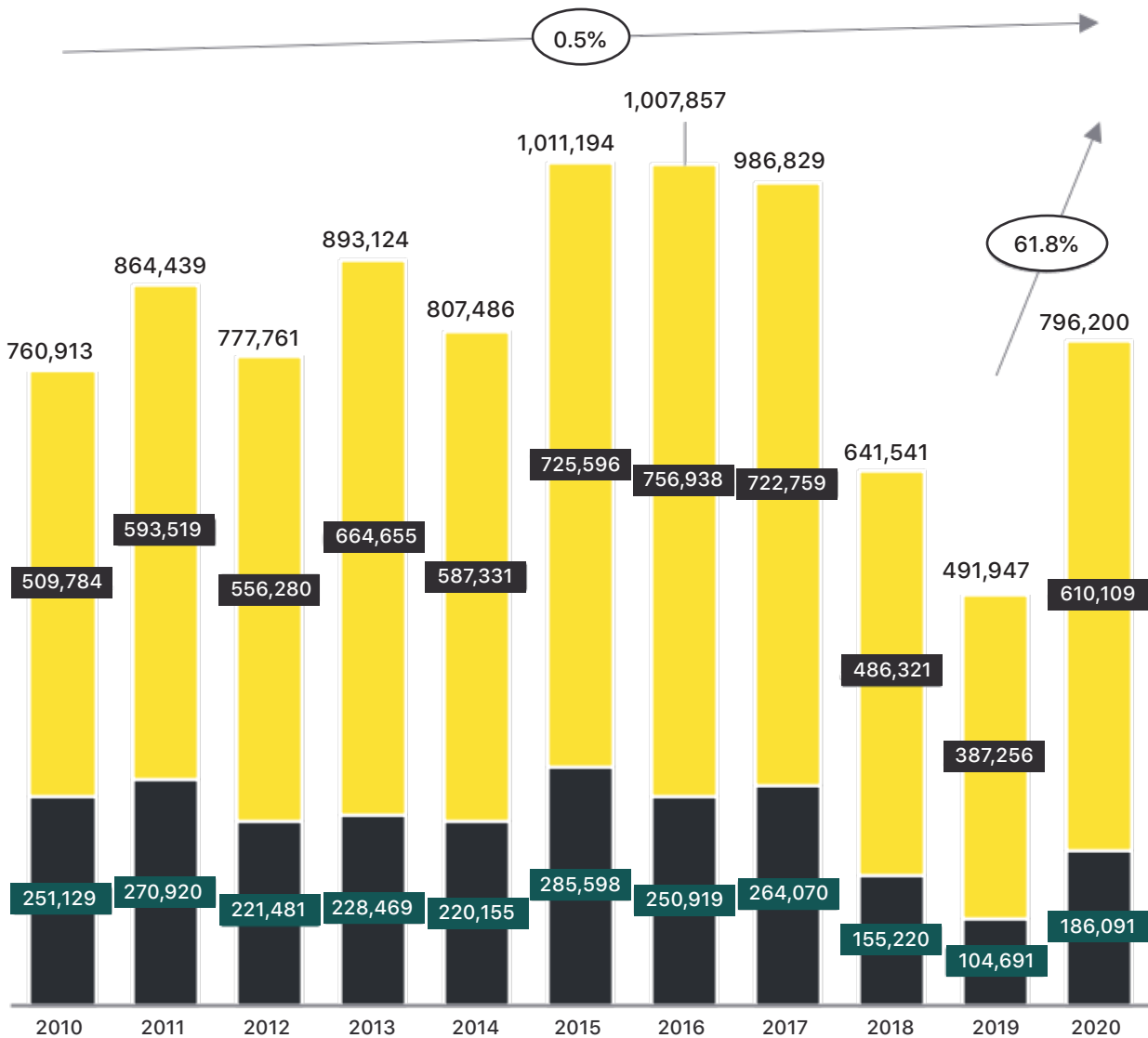
TURKISH MOBILITY INDUSTRY TREND ANALYSIS

The background of the page is a dark charcoal grey. On the right side, a series of thin, gold-colored lines radiate outwards from a single point, creating a fan-like effect that extends across the lower half of the image. The text is positioned on the left side, centered vertically, and is rendered in a clean, white, sans-serif font.

MARKET TRENDS

Unlike other markets, the Turkish automotive market displayed a trend that maintained its dynamism in 2020 despite the pandemic. According to the data of the Automotive Distributors' Association of Türkiye (ODD), **the Turkish automotive market grew by 61.8% in 2020, amounting to ca. 800k units. Passenger cars sales grew by 58% and light commercial vehicle (LCV) by 77% in 2020.**

TOTAL AUTOMOTIVE MARKET ANALYSIS, (TÜRKİYE, UNITS)



■ Passenger Cars
■ Commercial Vehicles

Source: Automotive Distributors' Association of Türkiye

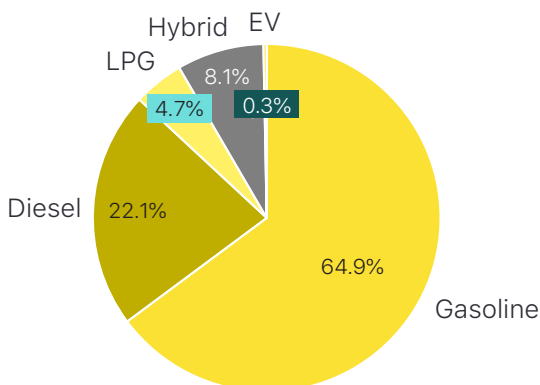
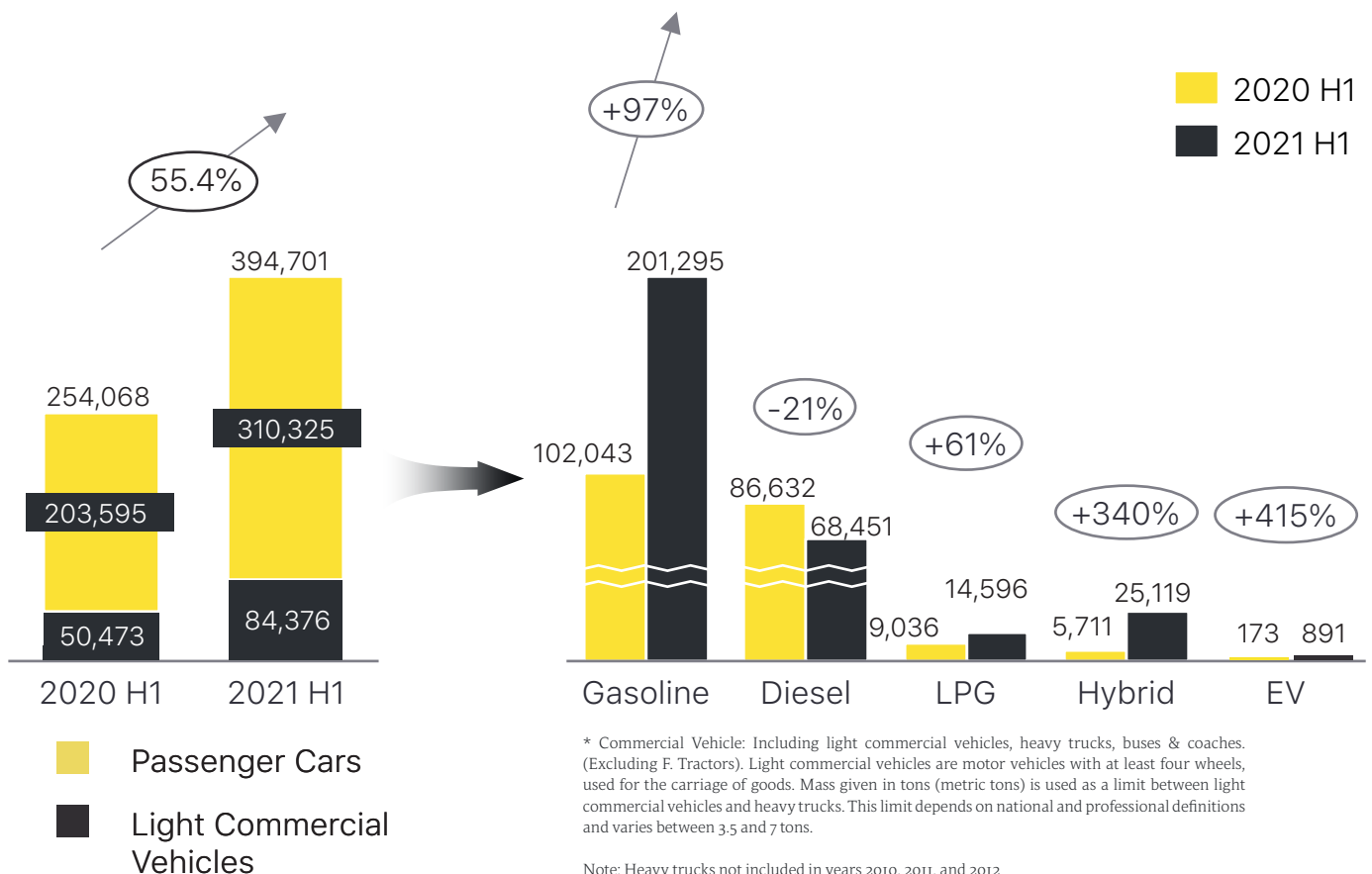
* Commercial Vehicle: Including light commercial vehicles, heavy trucks, buses & coaches. (Excluding F. Tractors). Light commercial vehicles are motor vehicles with at least four wheels, used for the carriage of goods. Mass given in tons (metric tons) is used as a limit between light commercial vehicles and heavy trucks. This limit depends on national and professional definitions and varies between 3.5 and 7 tons.

Note: Heavy trucks not included in years 2010, 2011, and 2012

In H1 2021, passenger car and LCV market increased by 55.4% compared to the same period of the previous year. Passenger cars sales increased by 52.4% to 310,325 units in the first half of 2021 compared to the previous year, while the commercial vehicles market increased by 67.2%, reaching 84,376 units.

Based on the engine type, when the passenger cars and commercial vehicles market in the first half of 2021 is compared to the same period of the previous year, there was an increase in the sales of all categories except diesel. The biggest increase in sales was observed in electric vehicles (415%) despite being still below 1000. It was followed by hybrid (340%), gasoline (97%), and LPG (61%). With the effect of being less competitive compared to the past, the decrease in diesel vehicle sales continued.

MARKET ACCORDING TO ENGINE TYPE, (PASSENGER CARS AND LIGHT COMMERCIAL VEHICLES, TÜRKİYE, UNITS)

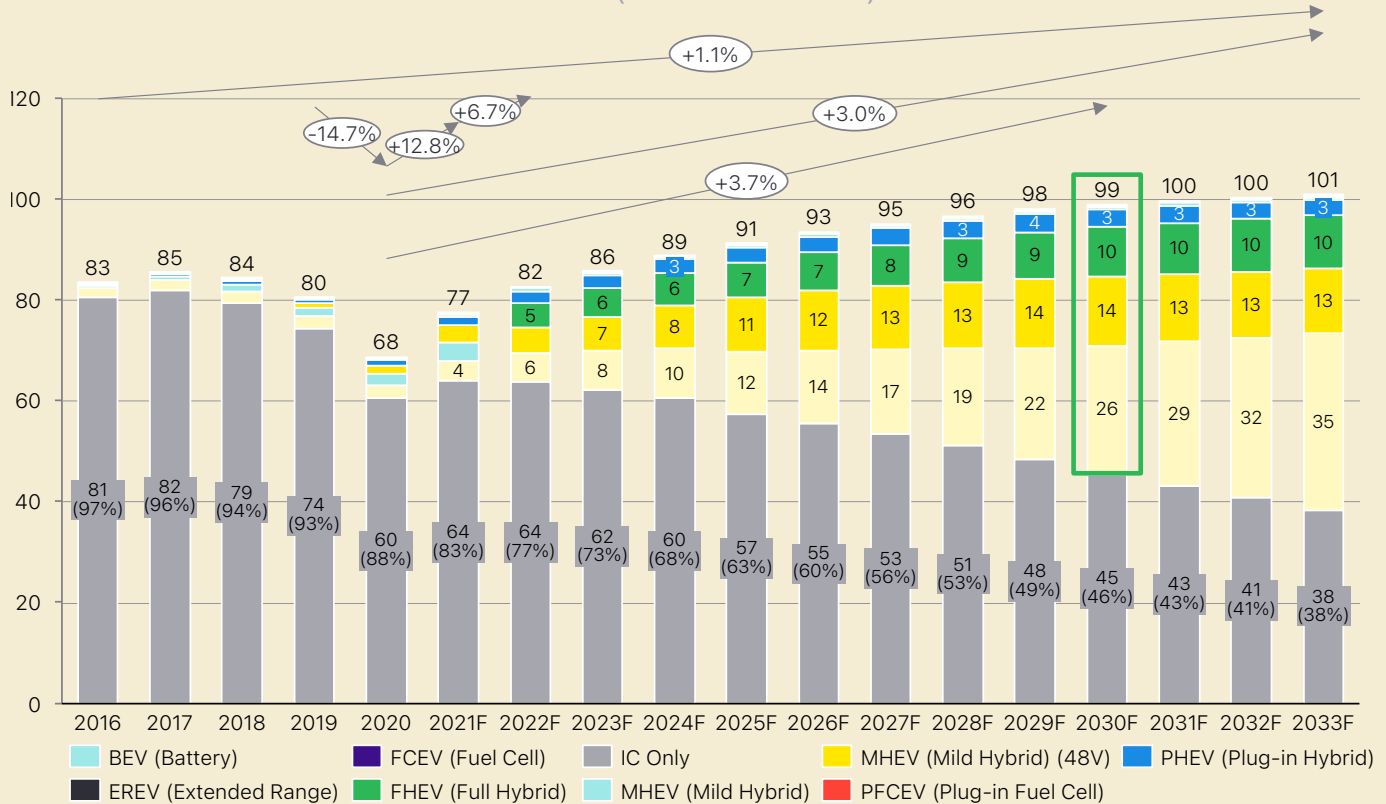


MARKET ACCORDING TO ENGINE TYPE (PASSENGER CARS AND LIGHT COMMERCIAL VEHICLES TÜRKİYE, %, 2021 H1)

Source: Automotive Distributors' Association of Türkiye

EV MARKET OUTLOOK

GLOBAL LIGHT VEHICLE OUTLOOK (MILLION UNITS)

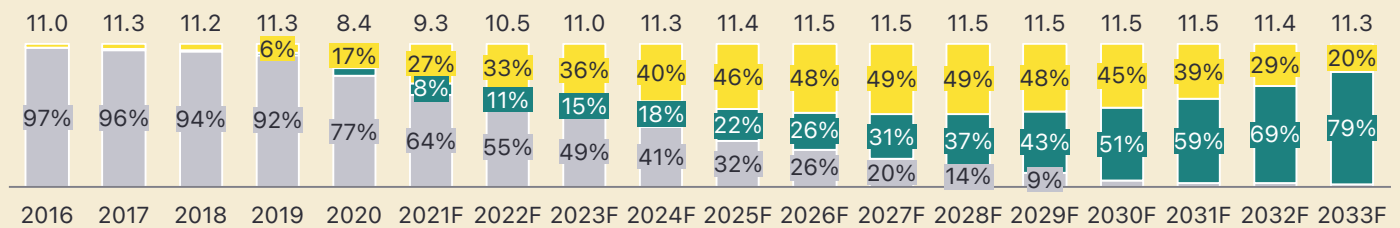


* All vehicles registered for personnel use are included. Light, medium and heavy commercial vehicles are not included.

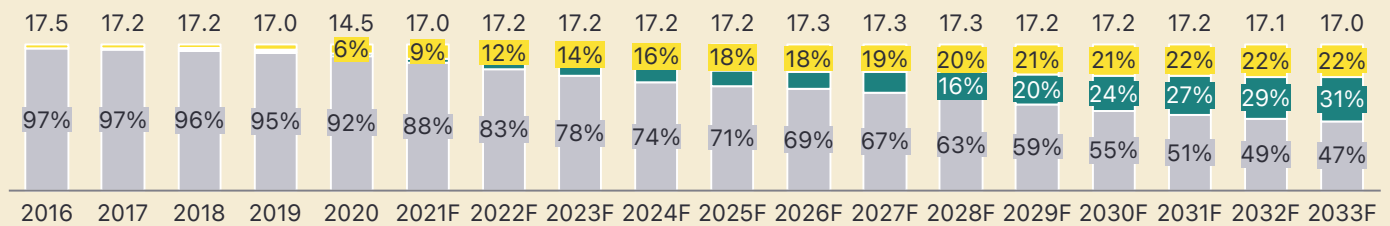
Source: EY Analysis, LMC Global Hybrid & Electric Vehicle Forecast – Quarter 2, 2021, Electric Vehicle Outlook 2021 (BloombergNEF)

- Electric vehicle uptake is forecast to rise gradually from year to year. More policy support, battery cost reduction, and OEMs' gearing up EV production lend a tailwind to this trend.
- With some of the largest automotive markets moving aggressively to improve emissions, more than half of the total global vehicle sales will be EVs by 2030.
- Electric and hybrid vehicle penetration rate is expected to grow at a significant pace compared to both ICE and overall light vehicle (LV) sales.
- Between 2016-2025, it is expected to grow by an annual average of 32.7% (global LV: 1%; ICE only: -3.7%).
- Between 2020-2030, it is expected to increase with an annual average growth rate of 21% (global LV: 3.7%; ICE only: -2.8%).
- Despite the pandemic, global EV and hybrids vehicle market grew by 32.9% in 2020 compared to the previous year (ICE only: -18.5%).
- In 2021, weathering the headwinds of the ongoing pandemic and microchip shortage crisis, EV and hybrid vehicle market is expected to grow 67.8% compared to 2020 (ICE only: 5.6%).

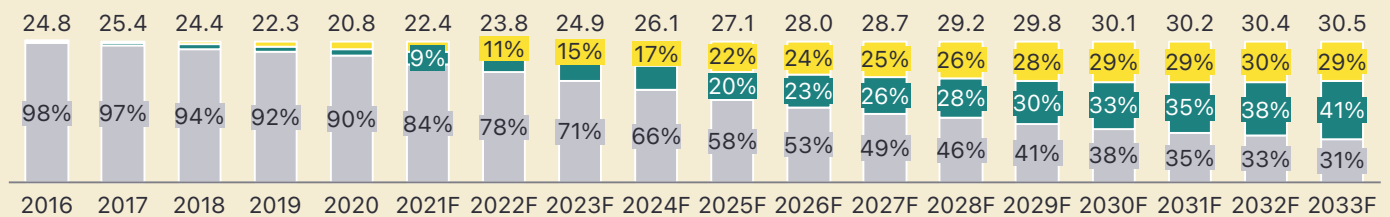
LIGHT VEHICLE SALES POWERTRAIN SPLIT IN EUROPE BIG 5 (2016–2033, MN)



LIGHT VEHICLE SALES POWERTRAIN SPLIT IN THE US (2016–2033, MN)



LIGHT VEHICLE SALES POWERTRAIN SPLIT IN CHINA (2016–2033, MN)



¹Europe Big 5: Germany, UK, France, Italy, Spain
 Hybrid: FHEV + MHEV + MHEV (48V) + PHEV
 Electric: BEV + EREV + FCEV

Source: EY Analysis, LMC Global Hybrid & Electric Vehicle
 Forecast – Quarter 2, 2021,

Hybrid Electric IC

- The Global EV market is booming, but the EV adoption in Türkiye is expected to be slower than European countries, the US, and China:

- Europe, Türkiye's main vehicle export market, is expected to be the key EV market

- Turkish EV market is expected to reach more than 1,5m EVs in 2030 (to reach c. 10% of the total car park)

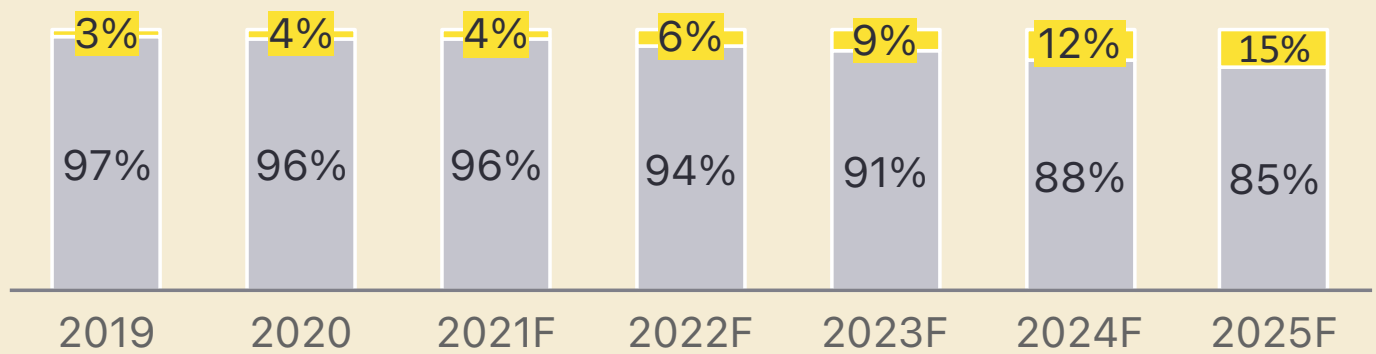
- Leading European countries and China are expected to dominate the EV market compared to the US. It is expected that the positive effects of policy changes to increase electric vehicle penetration in the US will begin to be seen from the second half of the 2020s. In addition, the US is more rural than Europe, and is difficult to expand and scale electrification infrastructure (charging points and so on.) in the short term, thus

EV penetration in the US will be slower than the Big 5 European countries.

- On the other hand, low expectations of electric vehicle penetration rate in other developing countries (likewise Türkiye) affect the global penetration rate negatively. One of the main barriers to EV adoption in Türkiye is the lack of a sufficient EV charging ecosystem.

- According to the data of the Energy Market Regulatory Authority, there are approximately 6 thousand electric vehicles and over 2 thousand charging stations in Türkiye. It is anticipated that there will be more than 75,000 electric vehicles and 12,500 charging sockets in Türkiye by 2023¹.

LIGHT VEHICLE SALES POWERTRAIN SPLIT IN TÜRKİYE (2019–2030)



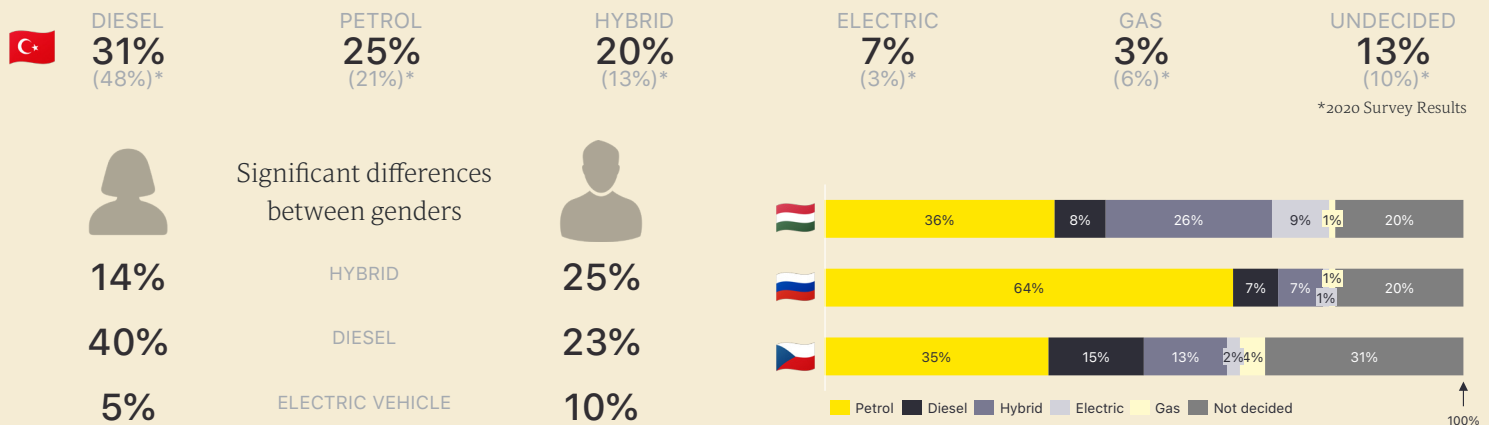
TR annual automotive sales are expected to reach

1.5m by 2030, 35% comprised by EV

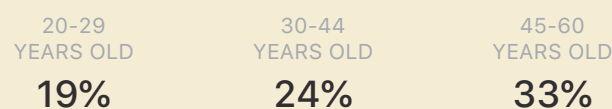
Source: EY Analysis, Automotive Distributors' Association of Türkiye, Marketline Industry Profile Hybrid & Electric Cars in Türkiye - April 2021

Hybrid Cars IC Cars

What engine will the car that you plan to buy as your next one to have?



A Vehicle With An Alternative Drive Is To Be Purchased By



Source: Expectations of automotive customers when buying and using vehicles, EY Survey, November 2021

A study conducted by EY in November 2021 to survey customers' opinion on significant innovations in the automotive industry also prove that customers' expectations are changing in terms of vehicle purchase.

The survey study that included Türkiye sampled participants, 20-60 years old, across different education and income levels. 32 different questions posed to participants aimed to examine the changing trends among customers, especially with regard to electromobility and digitalization.

The research findings signal a waning interest in diesel vehicle among Turkish customers, as sales figures have taken on a downward trend. Although 2021 results showed

Interest in conventional engines has been declining for a long time. Compared to Hungarians, Russians and Czechs, the percentage of undecided respondents is lowest among Turks with 13%.

as many as 31% of them quoted diesel engines as their top preference when asked, "What type of engine would you prefer for your next car?", the seemingly high percentage of diesel enthusiasts registered a sharp fall from a year earlier (2020: 48%). However, the Turks came to the fore among those who would prefer a diesel engine.

The rate of those who stated that they would prefer alternative drive (hybrid and EV) increased to 27% (Hybrid: 20%; EV: 7%) among Turkish respondents. A year ago, the overall ratio was a timid 16% (2020 Hybrid: 13%; EV: 3%). In the hybrid preference, the Turks followed Hungarians.

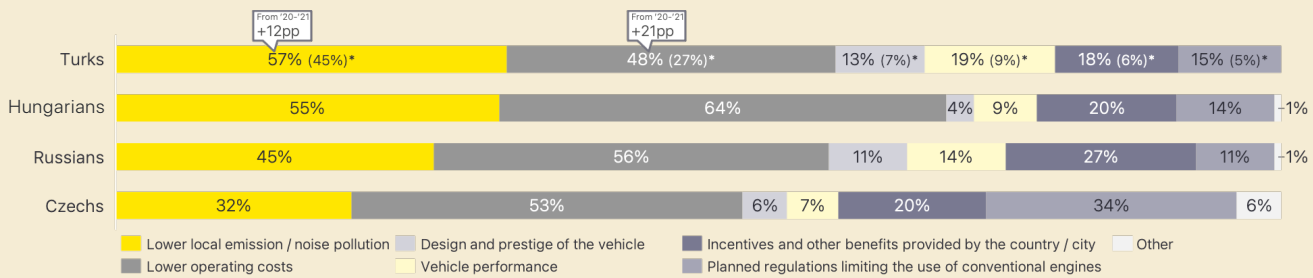
Compared to Hungarians, Russians and Czechs, the percentage of undecided respondents is lowest among Turks with 13%. There are also significant differences between male and female respondents in vehicle preference. Turkish women mostly prefer conventional engines when compared with Turkish men. While 40% of Turkish women quote diesel as their next vehicle choice, the rate stands at 23% for men. In alternative drive preference, this rate climbs to 35% in men (Hybrid: 25%,

EV: 10%) but lags behind at 19% for women (Hybrid: 14%; EV: 5%).

As in other countries, the rate of preference for alternative drives is directly proportional to income levels among Turks. A breakdown of responses shows that one out of every two people with the highest gross monthly income prefer an alternative drive (hybrid and EV).

Why is an electric vehicle attractive for me?

Why are you mainly interested in buying an electric car?



**) The question was posed only to those who had expressed an interest in buying an electric car. Respondents chose multiple options.

LOWER LOCAL EMISSION / NOISE POLLUTION

MALE
56%
(41%)*

WOMEN
59%
(49%)*

30-44
YEARS OLD
57%
(45%)*

Majority of Turks are interested in an electric car because of lower local emission / noise pollution and lower operating costs

*2020 Survey Results

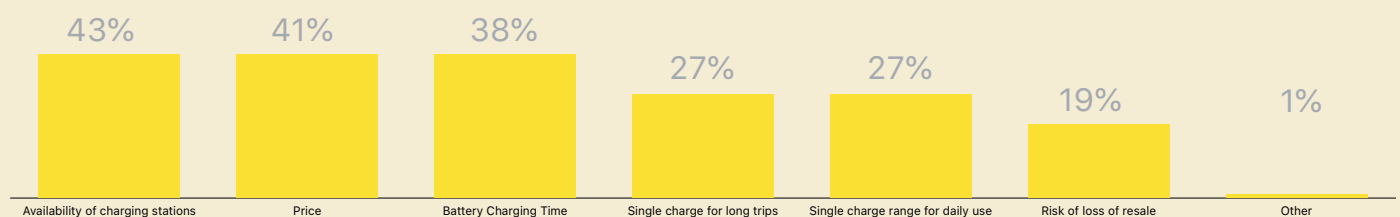
Source: Expectations of automotive customers when buying and using vehicles, EY Survey, November 2021

Even under different conditions, interests in buying an electric car converge in respondents. Lower operating costs stand out as the primary reason for Hungarians, Russians and Czechs' in buying an electric car. Although lower operating costs feature prominently among the reasons for preference among Turks (48%), lower

local emission / noise pollution comes first (57%) as the primary reason for Turks' interest in electric vehicles. The importance attributed to lower local emission / noise pollution has increased among Turkish audiences when compared to responses in 2020.

What puts me off electric mobility?

WHAT ATTRIBUTES OF AN ELECTRIC CAR DISCOURAGES YOU FROM BUYING IT THE MOST*

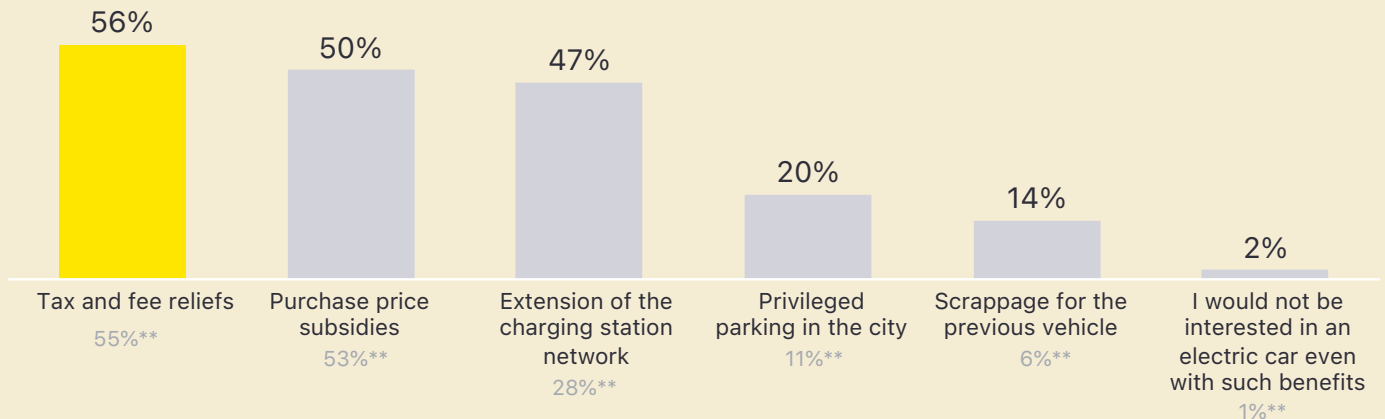


* Respondents chose multiple options.

Source: Expectations of automotive customers when buying and using vehicles, EY Survey, November 2021

WHICH GOVERNMENT MEASURES WOULD INCREASE YOUR INTEREST IN BUYING AN ELECTRIC VEHICLE?*

*Max. 2 Answers Possible



**2020 Survey Results

2%

of drivers would **not be interested** in an electric vehicle even with **abovementioned benefits**

69%

of drivers from households with income of more than USD 5,6k would be increasingly interested in **electric vehicles** in case the **charging station network was extended**

EXTENSION OF THE CHARGING STATION NETWORK WOULD BE APPRECIATED BY



28% - Czechs



51% - Russians



30% - Hungarians

Turks are mainly discouraged the most by the limited availability of charging stations and purchase price of an electric car. More than half would welcome government support in the form of tax and fee reliefs.

Source: Expectations of automotive customers when buying and using vehicles, EY Survey, November 2021

Although electric vehicles seem to be an attractive option for customers, there are situations that cause customers to keep their distance from these as well. 43% of the Turkish respondents pointed to the **availability of charging stations** when asked, "What factors put you off buying an electric car the most?". The ongoing concern about the lack of sufficient charging stations was followed very closely by price (41%) and the time required to recharge the battery (38%).

More than half of Turkish respondents would welcome government support in the form of tax and fee reliefs (56%). The expectation was very similar in the previous year. However, compared to 2020, the extension of the charging station network would be more appreciated in 2021, not only among Turkish (47%) but also among Russian (51%), Hungarian (30%) and Czech (28%) respondents.

As the electric vehicle charging infrastructure strengthens, the preference for electric cars is expected to take off at greater rates.

Türkiye's advanced production capacity in the automotive industry, competitive labor market, and strategic location close to the European and Middle Eastern markets make it a very attractive position in the production of electric vehicles and equipment. In this context, it is possible to encounter important investment news in the production of battery packs and components, and so on. For instance, Türkiye's domestic automobile enterprise, Türkiye's Automobile Joint Venture Group (TOGG), will soon start a 20GWh battery investment in cooperation with Farasis. Negotiations with other battery manufacturers are also ongoing. It is expected that TOGG's first vehicle will come off the mass production line by the end of 2022².

Ford Otosan, another important company in the Turkish automotive industry, has recently announced an investment plan for electric vehicles and equipment. In addition to undertaking the production responsibility of Ford E-Transit, the first fully electric commercial vehicle to be produced in Türkiye, a battery assembly plant investment will be made in the same facility and will be implemented by 2022³.

Under the leadership of the Ministry of Industry and Technology, studies on charging infrastructure that will support the spread of electric vehicles have gained

momentum. In this context, the relevant technical standards have been published, and the needs of province and district charging stations have been determined and support mechanisms have been designed. It is foreseen that the legislative infrastructure regarding charging service will be completed before the end of the first half of 2022 and Energy Market Regulatory Authority (EMRA) will start charging service. Within the scope of the legislation, the charging service will be similar to the fuel distribution licenses in Türkiye^{4,5}.



INDUSTRIAL IDENTITY (NUMBER OF COMPANIES AND EMPLOYMENT)

SCALE	# OF COMPANIES (2020)	# OF EMPLOYEES (2020)	NET SALES (X1000 TRY, 2020)	(%)
Micro (size: 1-9)	1,796 (56.2%)	4,795	1,476,171.4	0.5%
Small (size: 10-249)	865 (27.1%)	17,345	8,075,119.0	3.0%
Mid (size: 50-249)	381 (11.9%)	37,625	17,955,312.5	6.7%
Large (size: 250+)	152 (4.8%)	137,842	241,185,582.2	89.8%
Total	3,194	197,607	268,692,185.0	

Note: Data includes all companies in the motor vehicle industry, i.e. NACE 29: Manufacture of motor vehicles, trailers and semi-trailers. The current scope of the Sector Balance Sheet Statistics consists of companies with a representation share of approximately 88% when compared to the turnover size of the annual industry and service statistics published by TURKSTAT.

Source: CBRT

According to the data of 2020, SMEs representing micro, small and medium-sized enterprises constituted 95.2% of the total enterprises operating in the automotive industry. In contrast, they represented 30.2% of employment in the industry and 10.2% of net sales.

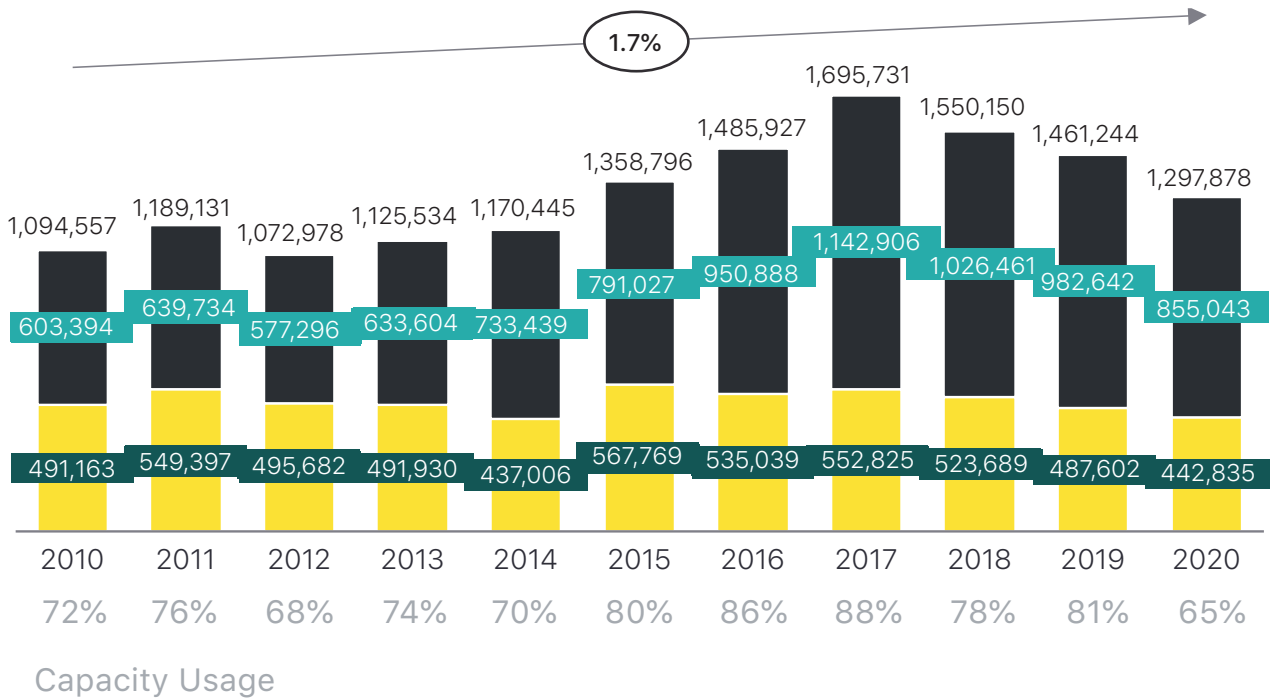
PRODUCTION & CAPACITY, PRODUCTION COMPARISON WITH PEER COUNTRIES

Due to the impact of the pandemic, which started in the last quarter of 2019 on a global scale, contractions were recorded in vehicle production. Global automotive manufacturers, who had to stop their production in the early stages of the pandemic, faced greater problems in the first half of 2020. The capacity utilization rate in Türkiye was also recorded at the lowest level since 2010 (65%). However, the Turkish automotive market was affected relatively less negatively in terms of production performance. Along with the update in the Special

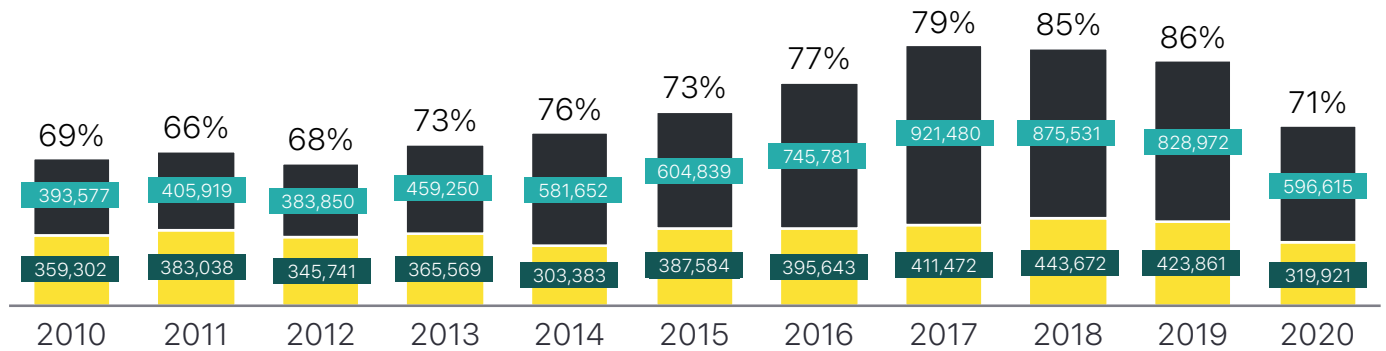
Consumption Tax (SCT) rates, the increasing demand for domestically produced vehicles in the domestic market also had an impact on this. While 86% of the vehicles produced by automotive manufacturers were exported in 2019, this rate decreased to 71% in 2020.



VEHICLE PRODUCTION PERFORMANCE OF TÜRKİYE IN RECENT YEARS (UNITS)



VEHICLE EXPORT PERFORMANCE OF TÜRKİYE IN RECENT YEARS (UNITS)



Commercial Cars

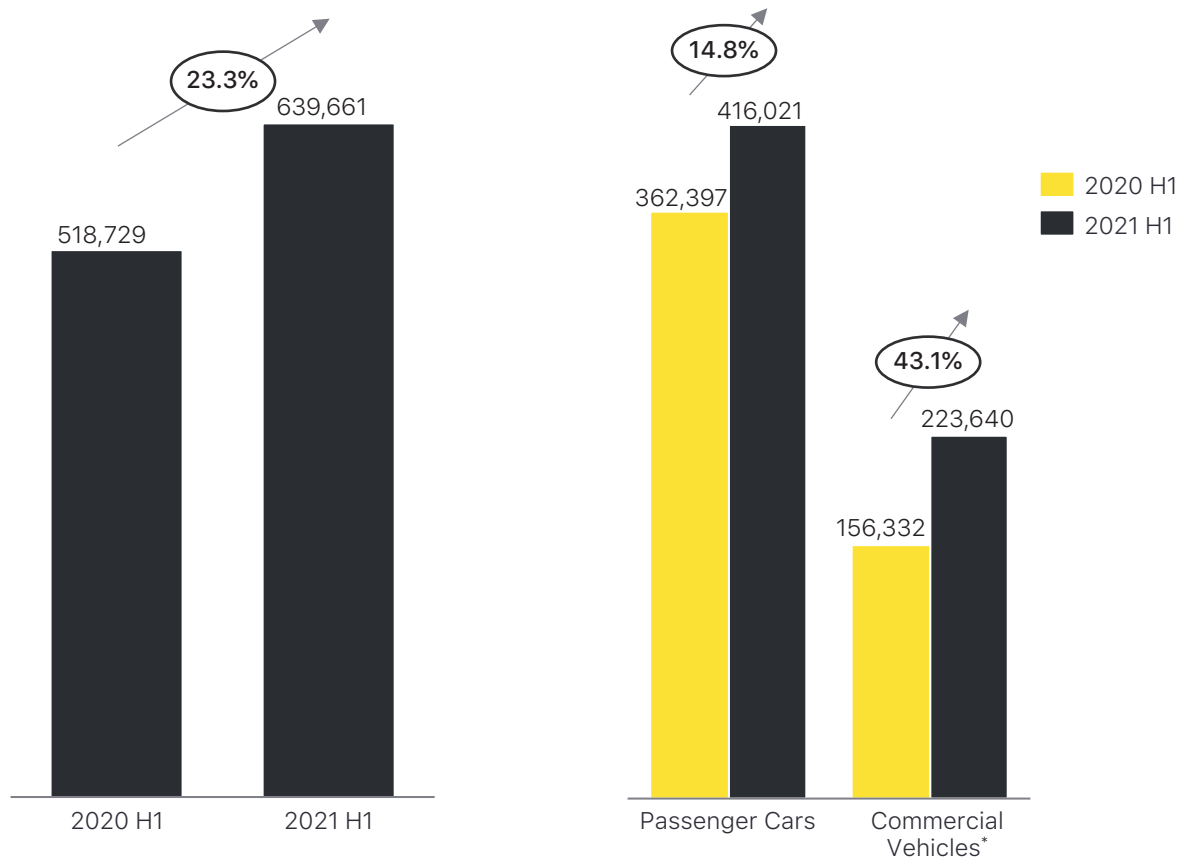
Passenger Cars

* Commercial Vehicle: Including light commercial vehicles, heavy trucks, buses & coaches. (Excluding F. Tractors). Light commercial vehicles are motor vehicles with at least four wheels, used for the carriage of goods. Mass given in tons (metric tons) is used as a limit between light commercial vehicles and heavy trucks. This limit depends on national and professional definitions and varies between 3.5 and 7 tons.

Source: The Automotive Manufacturers Association of Türkiye

In the first half of 2021, the total production increased by 23.3% reaching 639,661 units (2020 H1: 518,729). Compared to the same period of the previous year, passenger car production increased by 15% and commercial vehicle production by 43.1%.

2020/2021 PRODUCTION (TÜRKİYE, UNITS)

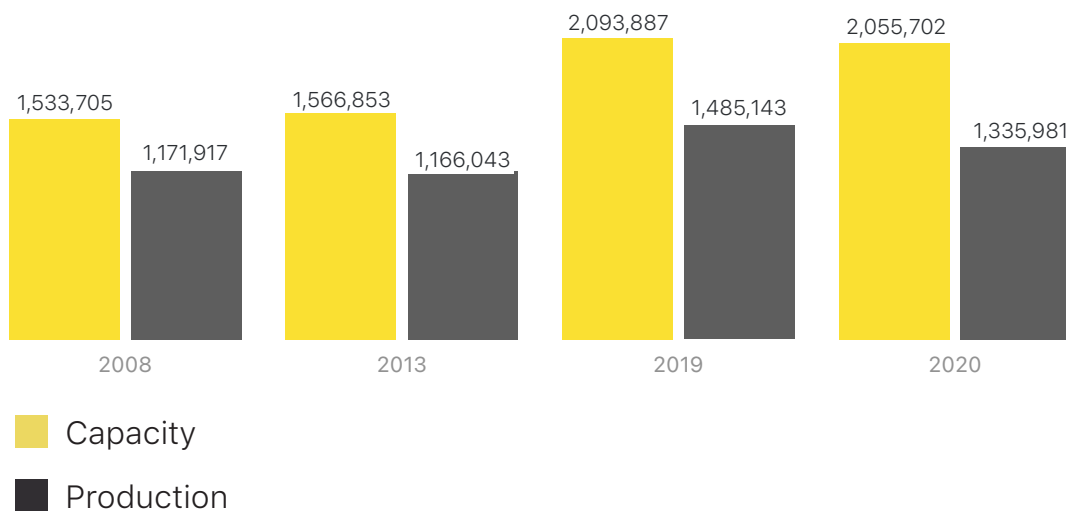


* Commercial Vehicle: Including light commercial vehicles, heavy trucks, buses & coaches. (Excluding F. Tractors). Light commercial vehicles are motor vehicles with at least four wheels, used for the carriage of goods. Mass given in tons (metric tons) is used as a limit between light commercial vehicles and heavy trucks. This limit depends on national and professional definitions and varies between 3,5 and 7 tons.

Source: The Automotive Manufacturers Association of Türkiye

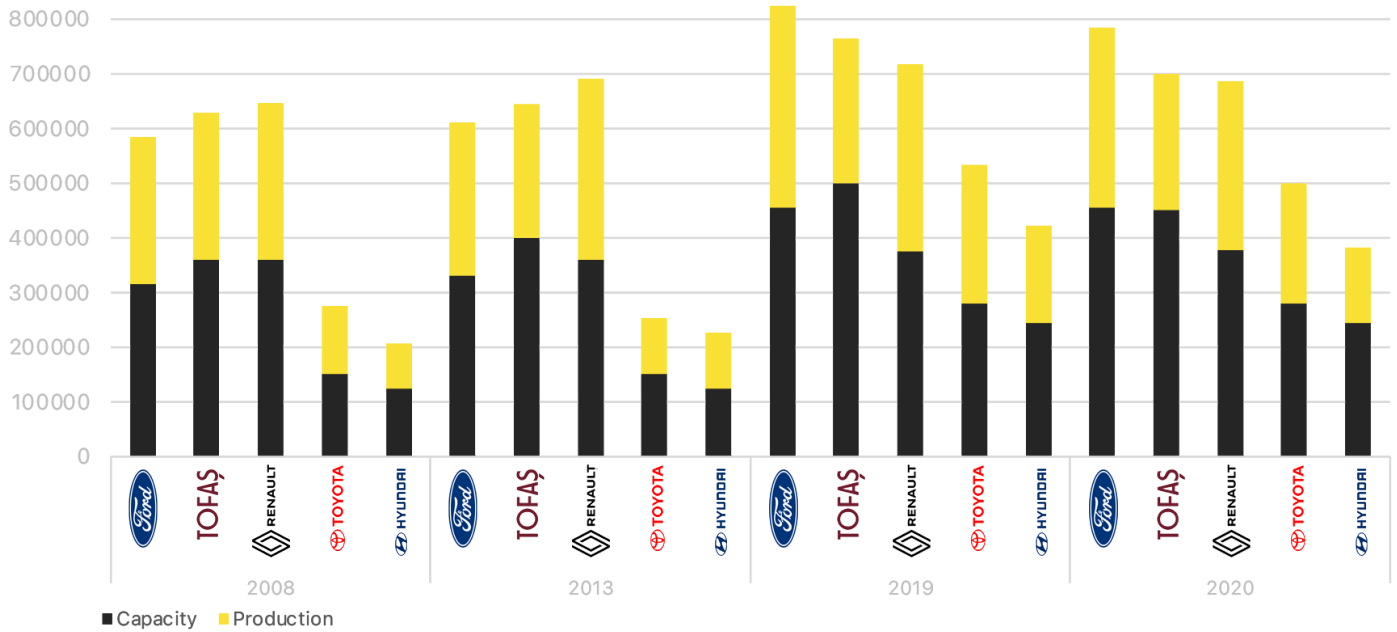
Capacity in Türkiye has increased from 1.53 million units in 2008 to 2.09 million units in 2019 and saw a slight decrease in 2020 due to the pandemic and was realized at 2.05 million units. In parallel, 1.48 million units of vehicles were produced in 2019 and 1.33 million in 2020.

CAPACITY VS. PRODUCTION OF TURKISH AUTOMOTIVE INDUSTRY



Source: The Automotive Manufacturers Association of Türkiye

Capacities and productions of some of the largest vehicle manufacturers in Türkiye in the years of 2008, 2013, 2019 and 2020 can be followed from the tables below.

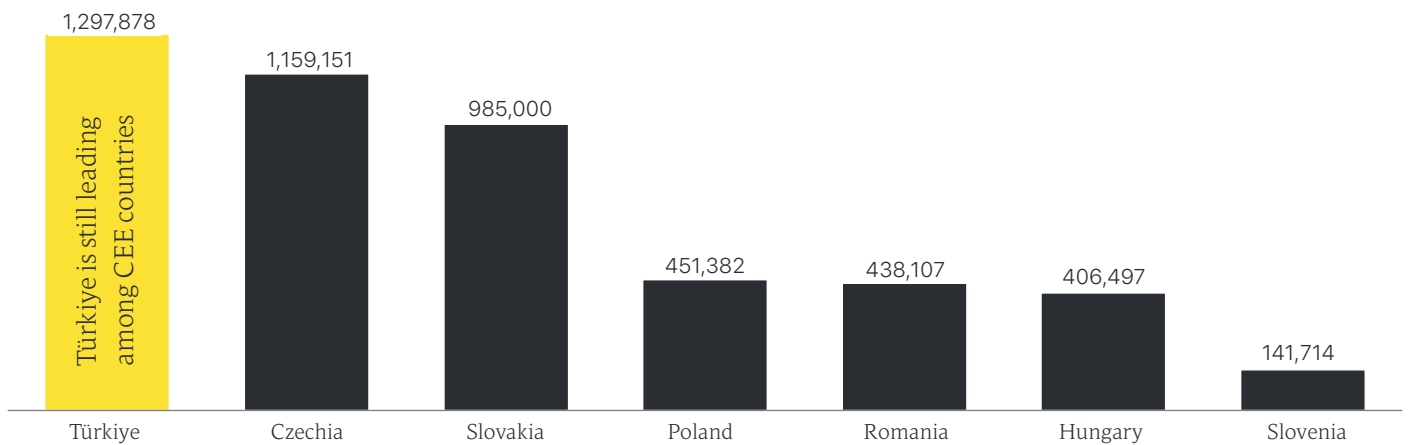


Source: The Automotive Manufacturers Association of Türkiye

It can be inferred from the comparisons of the two tables above that companies got closer to their production capacities continuously increasing their yearly production. Yet almost all the companies saw a decline in their production in 2020 due to the pandemic and the global chip crisis.

Türkiye maintained its position as the largest vehicle manufacturer in its region in 2020 as well.

AUTO* PRODUCTION IN 2020 (UNITS)



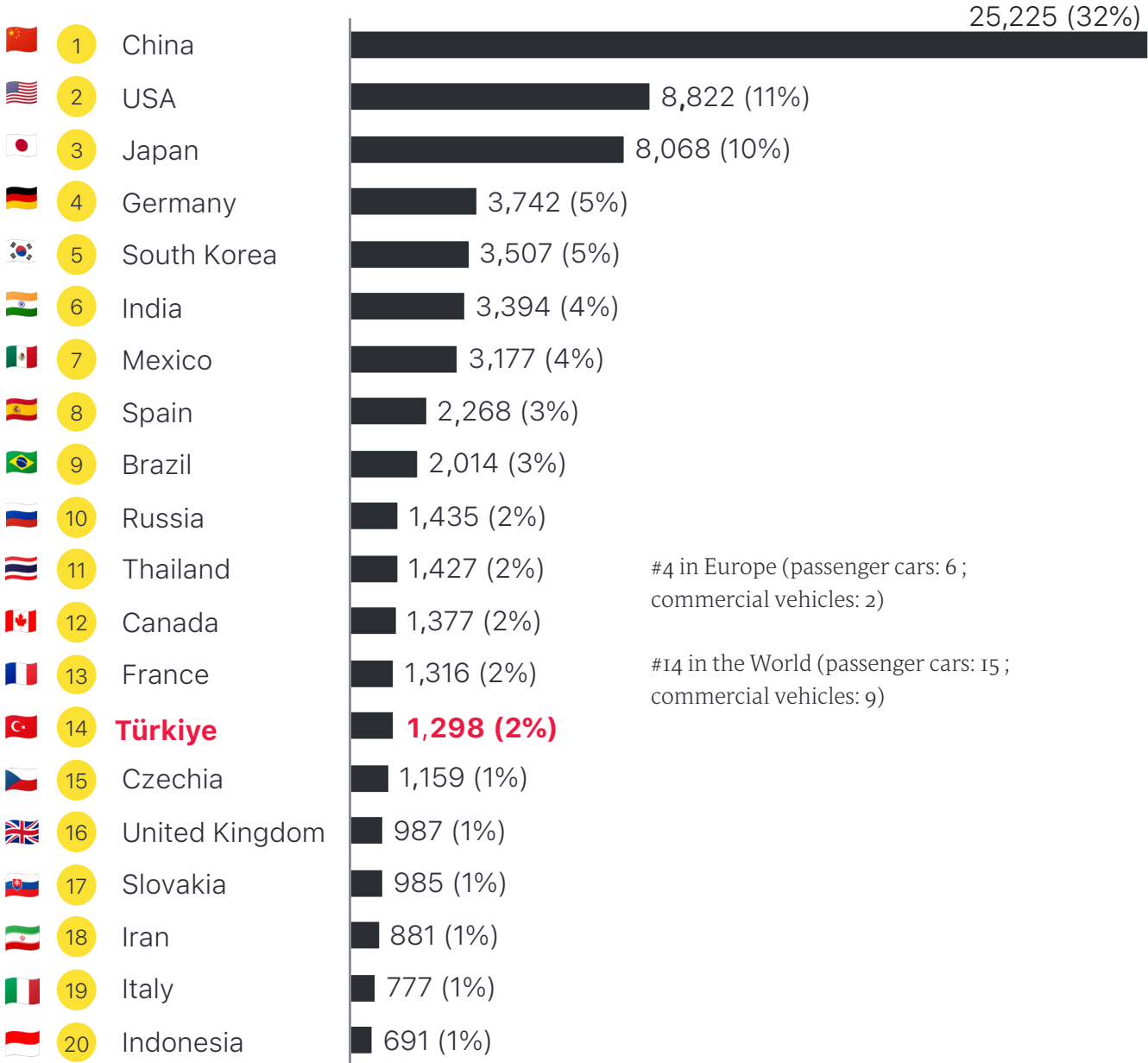
* Automotive: Passenger cars and commercial vehicles. Commercial vehicles include light commercial vehicles, heavy trucks, buses & coaches. (Excluding F. Tractors).

Source: (1) The Automotive Manufacturers Association of Türkiye; (2) OICA

Türkiye, which meets 2% of the total vehicle production on a global scale, ranked 4th in Europe and 14th in the world according to the data of 2020. In the production of commercial vehicles, it broke the ground, ranking 2nd in Europe, where Spain comes 1st, and 9th in the

world, where the US comes 1st. Türkiye has a potential to become one of the top 10 producers in a short time replacing Russia, which is in 10th place of the list.

WORLD AUTO* PRODUCTION IN 2020 (THOUSAND UNITS)



* Automotive: Passenger cars and commercial vehicles. Commercial vehicles include light commercial vehicles, heavy trucks, buses & coaches. (Excluding F. Tractors).

Source: The Automotive Manufacturers Association of Türkiye; (2) OICA

EXPORTS

Exporting nearly 1 million vehicles since 2015, Türkiye has realized an export of USD 25.5 billion in 2020 including automotive, suppliers, and OEMs. Compared to 2019, the export value has decreased by 16.7%, while the export value has grown by an average of 1.6% annually since 2016.

In 2020, as in previous years, Türkiye's largest export market was formed by European countries with a rate of 76% (EU 17 with 67% and the UK with 9%). Half of the exports to EU countries were to Germany, France, and Italy, respectively.

Türkiye also continued to be one of the EU's largest export partners in the automotive field. **Despite the pandemic and the chip crisis, Türkiye was in 2nd place, accounting for 17.6% of EU automotive imports in 2020 following the UK.** The EU is the top destination for UK cars as 52.6% of the exports went to the EU in 2018 and Türkiye comes 5th on the list.

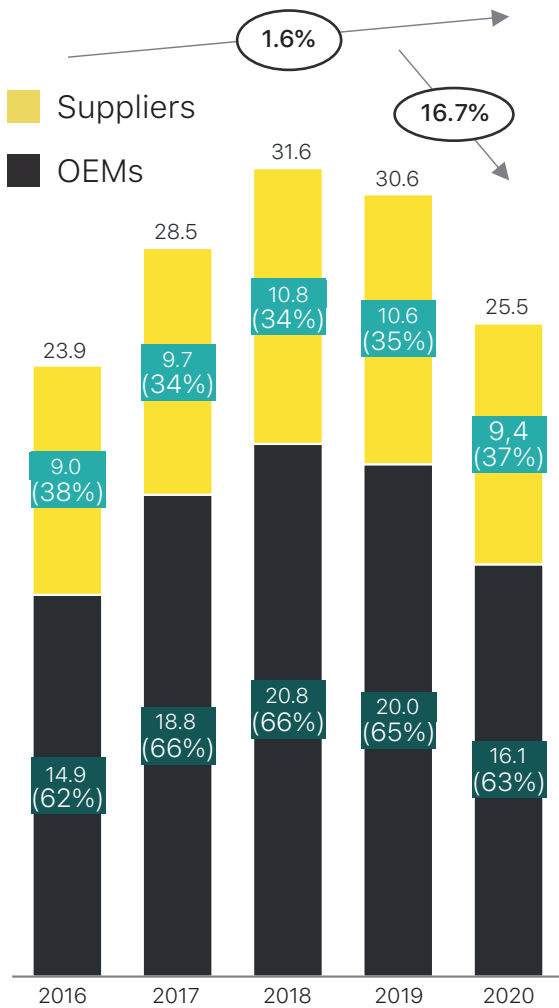
As one of the important trade partners of both Türkiye and the EU, the UK should be given a special attention to.

The UK is one of the important trade partners of the EU and Türkiye, especially in the automotive industry. The EU dominates the UK's vehicle import market. According to 2020 data, 78.1% of the vehicles imported to the UK are delivered from the EU. The EU is followed by Japan with 7.3%, South Korea with 4.2% and Türkiye with 3.1%. The UK imports 93.9% of LCVs and this represents an important opportunity for Türkiye, which is the leader in commercial vehicle production. Türkiye has an important place in the UK's automotive exports. 2.6% of the vehicles produced in the UK are exported to Türkiye. The EU is at the top of the list with 53.5%.

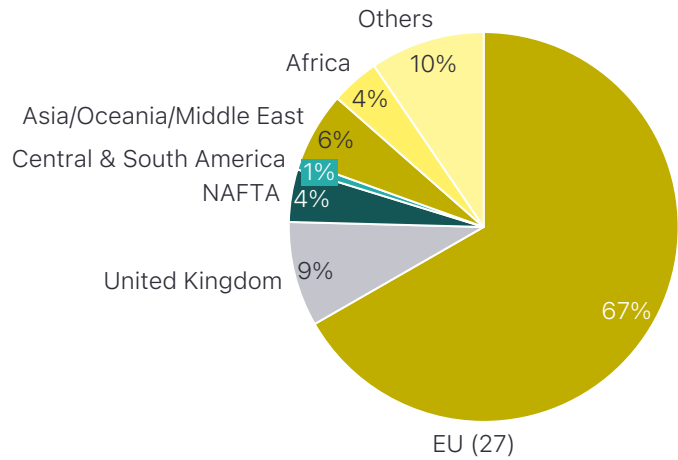
Before the Brexit, until the UK was evaluated in the list of EU member states, Türkiye was in the first place in the list of countries exporting the most vehicles to the EU. Although it experienced the biggest contraction among the top 5 countries in imports to the EU compared to 2019, it has the potential to quickly recover from this situation in the upcoming period.



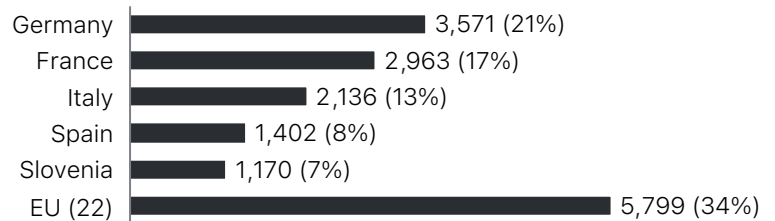
TÜRKİYE'S EXPORT OF THE INDUSTRY (USD BN) ¹



TÜRKİYE'S MAIN INDUSTRY EXPORT MARKETS ² (2020)



TÜRKİYE'S TOP EXPORT MARKETS IN EU ² (USD MN, 2020)



EU: UK excluded






Asia / Oceania / Middle East: Israel, Saudi Arabia, United Arab Emirates, Australia, South Korea, Taiwan, Kazakhstan, China, Japan, Kuwait, Uzbekistan, India, New Zealand, Malaysia, Pakistan, Vietnam, Thailand, the Philippines, Indonesia

NAFTA: United States, Canada, Mexico

Central & South America: Argentina, Brazil, Chile, Colombia, Ecuador, Peru

Source: (1) Automotive Industry Exporters' Association of Türkiye; (2) Turkish Exporters Assembly

DELIVERIES TO THE EU MARKET (2020) ³

			% Change 20/19	% Share 2020
1		United Kingdom 872,146 units	-8.9	23.5
2		Türkiye 654,612 units	-29.6	17.6
3		Japan 485,371 units	-28.2	13.1
4		United States 393,728 units	10.7	10.6
5		South Korea 318,917 units	-28.1	8.6

Source: (3) ACEA; (4) SMMT

EU is the top destination for UK cars (52.6% of their exports (2018)), Türkiye is in top 10 (5th)

EU dominates car imports in the UK (77.8% of the total as of 2018 main EU members namely: Germany, Spain, France, Czechia). Türkiye ranks 4th by representing 3.8% (2: Japan(6.5%), 3: South Korea (5.2%)) ⁴

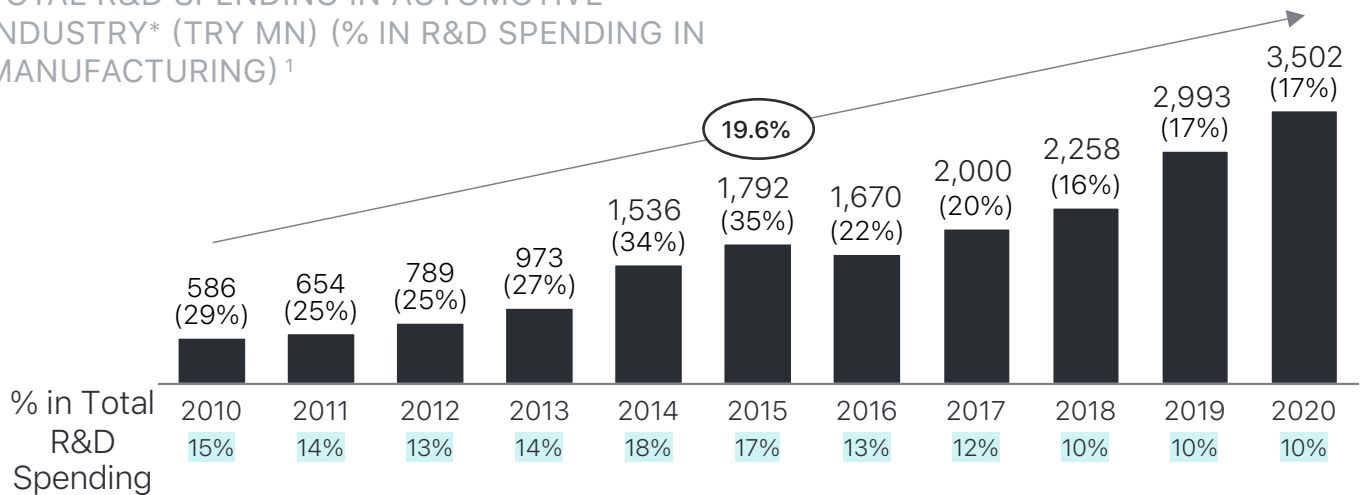
NUMBER OF R&D CENTERS, EMPLOYMENT AND R&D EXPENDITURE

Global players in automotive production have a high share of R&D expenditure in the automotive sector compared to the total R&D expenditure. For example, the ratio of R&D expenditures in the automotive sector to total R&D expenditures in Germany is 38%. **Motivated to develop its R&D competencies, in Türkiye, the R&D expenditures provided for the main automotive sector have increased by 19.6% on average annually since 2010 and reached the level of TRY 3.5 billion in 2020.** This ratio represents 17% of the total R&D expenditure

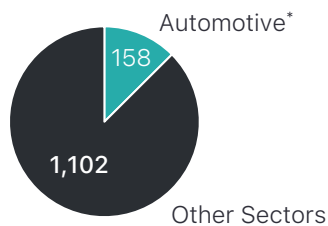
in the manufacturing industry and 10% of the total R&D expenditure in the country.

Although the total R&D expenditures in CEE countries are at much lower levels compared to Türkiye, the ratio of automotive R&D expenditures to total R&D expenditures in Slovakia, Romania, Czechia, and Hungary was ahead of Türkiye.

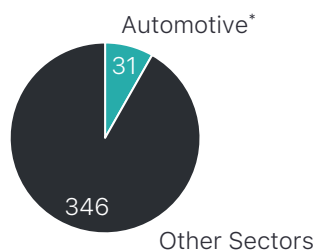
TOTAL R&D SPENDING IN AUTOMOTIVE INDUSTRY* (TRY MN) (% IN R&D SPENDING IN MANUFACTURING)¹



NUMBER OF R&D CENTERS² (2021)



NUMBER OF DESIGN CENTERS² (2021)



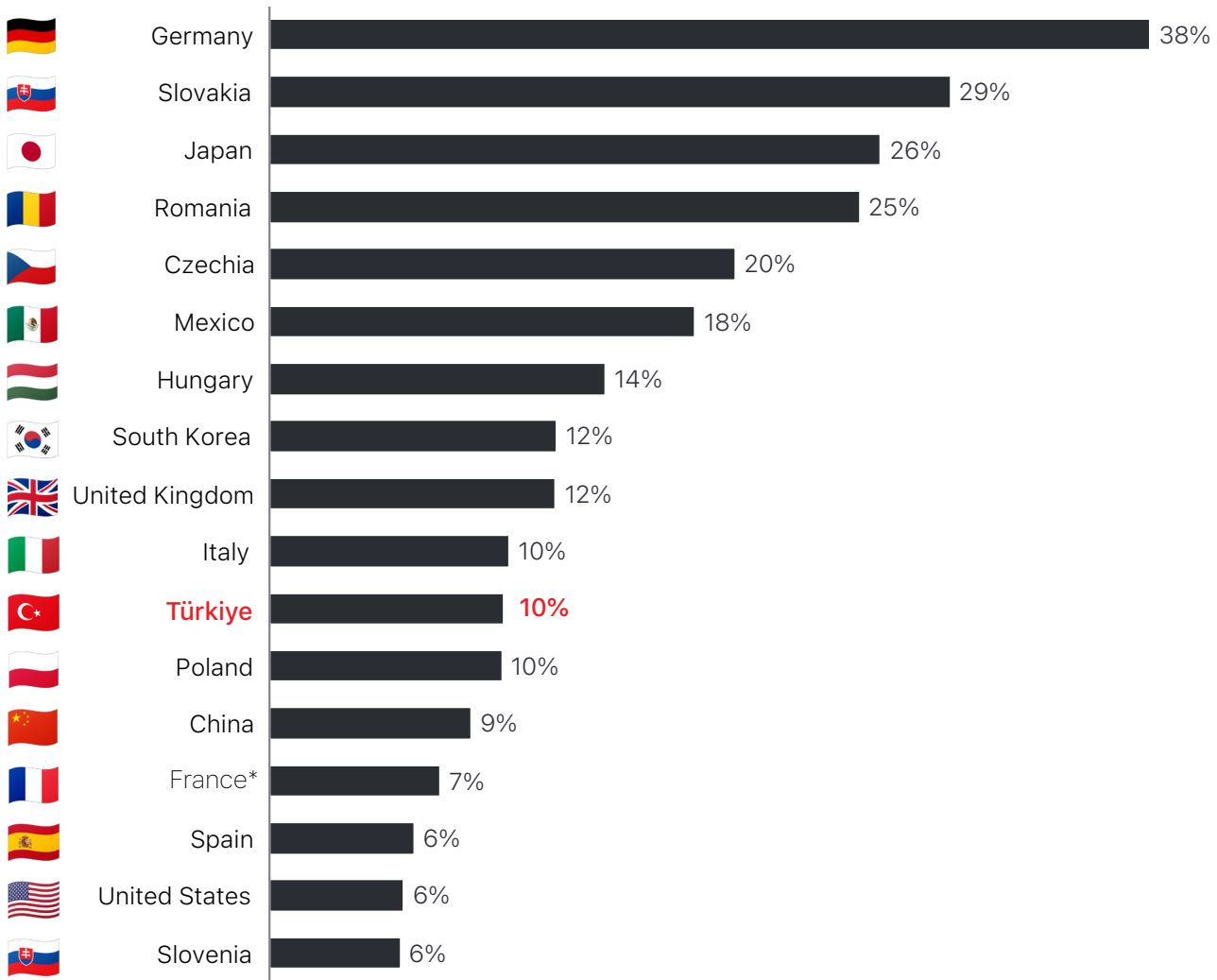
R&D EMPLOYMENT IN AUTOMOTIVE INDUSTRY* (2020)¹

Title	Male	Female
Researcher	5,238	1,156
Technician	1,795	139
Other	554	152
Total	7,587 (84%)	1,447 (16%)
= 9,034		

* Data consists of all companies in the motor vehicle manufacturing, i.e. NACE 29: Manufacture of motor vehicles, trailers, and semi-trailers

Source: (1) TURKSTAT; (2) Ministry of Industry and Technology

SHARE OF R&D SPENDING IN AUTOMOTIVE INDUSTRY IN THEIR TOTAL R&D SPENDING BY SELECTED COUNTRIES (2018)



The investments of OEMs in Türkiye in the field of R&D, which have been going on for years, turn into important success stories. For example, the eActros, the first electric heavy-duty truck of Mercedes-Benz Truck, which was put into mass production as of 2021, has the signature of Turkish R&D. Mercedes-Benz Türk Truck R&D teams were entirely responsible for systems such as the starting battery and cables and low voltage power distribution units. At the same time, Acoustic Vehicle Alert System (AVAS), In-Cabin Emergency Driver Warning System and High and Low Voltage Power Systems in eActros were also developed by Mercedes-Benz Türk Truck R&D teams ⁷.

* 2017

Source: Business Enterprise R&D Expenditure by Industry, OECD



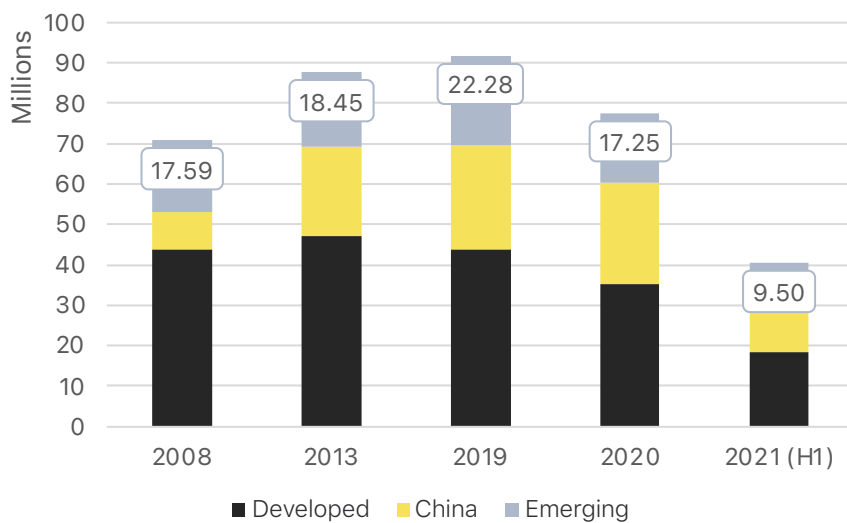
GLOBAL MOBILITY INDUSTRY

PRODUCTION AND SALES

The automotive industry restructured its production capacity and worldwide network in accordance with the changes in supply and demand profiles of world markets since the beginning of the 2000s. While vehicle production increased from 71 million units in 2008 to 92 million units in 2019, it dropped to 77 million units in 2020 due to the

impact of the pandemic. However, the industry is gaining momentum once again reaching 40 million units in total in the first half of 2021. Meanwhile, the production network of the global manufacturers has diversified.

VEHICLE PRODUCTION BY ECONOMIC ZONES



- While the share of the developed world in production has been decreased from 62% in 2008 to 45% in 2020, China's share has increased from 13% to 32% in the same period.

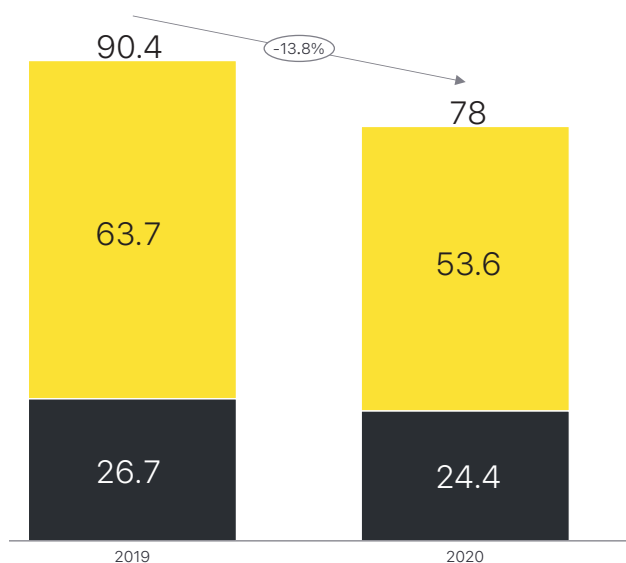
- Also, remaining emerging markets have come to the front as strong production hubs at the beginning of the 2000s and protected their shares around 22% to 25% with fluctuations on different years in the same period.

Source: International Organization of Motor Vehicle Manufacturers

*Developed Countries: The EU (15), NAFTA, Australia, Japan, South Korea

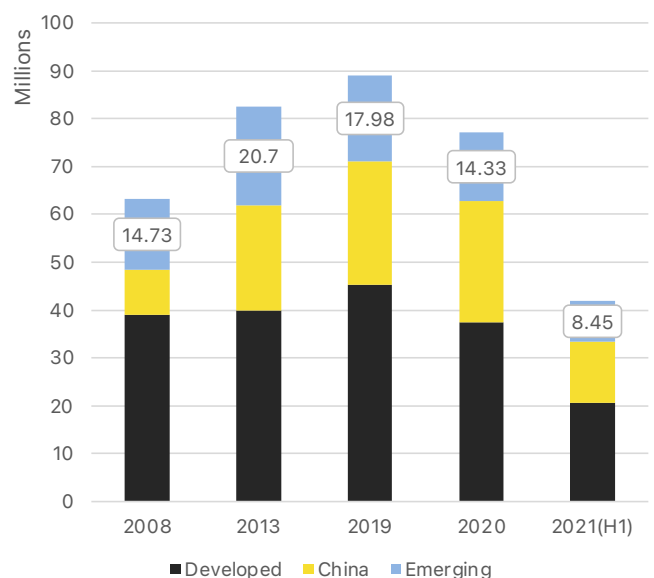
** Emerging Countries: All others except for China

GLOBAL REGISTRATIONS OR SALES OF NEW VEHICLES (2019-2020, UNITS)



Passenger Cars
Commercial Vehicles

VEHICLE SALES BY ECONOMIC ZONES



Source: Marklines

*Developed Countries: The EU (15), NAFTA, Australia, Japan, South Korea

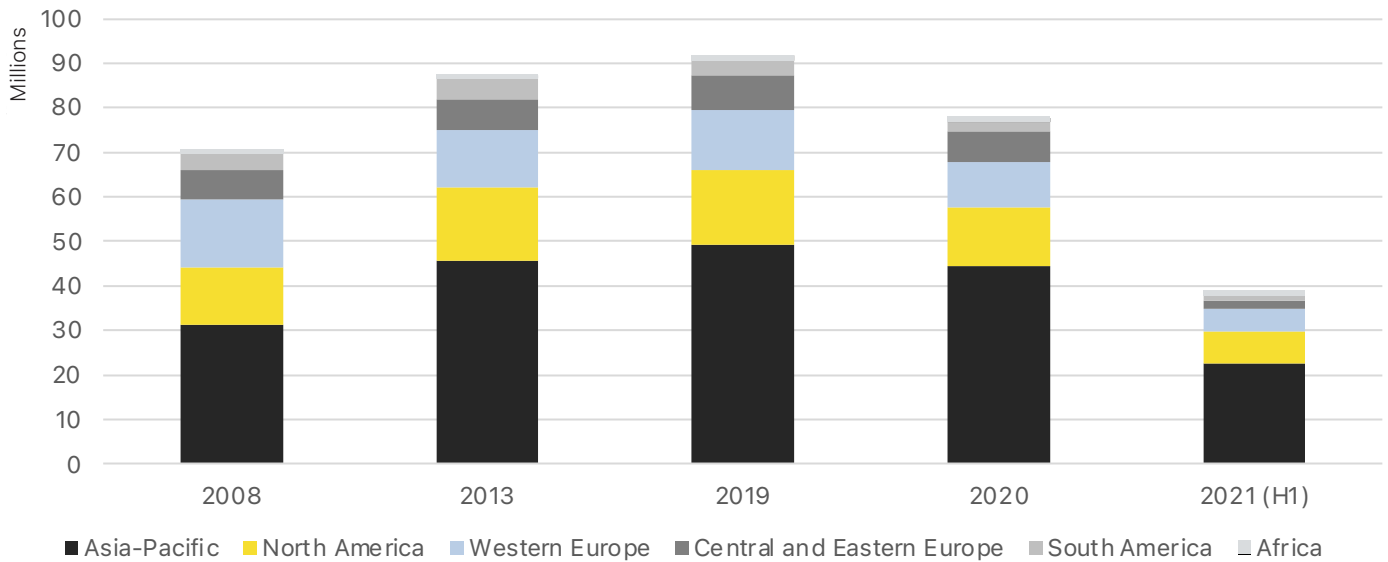
** Emerging Countries: All others except for China

- Vehicle sales continued to increase in the world until when the pandemic had a hard impact on production and sales in 2020. Then, sales dropped to 77 million units.
- While sales in developed countries constitute a majority of total sales, China's share continues to increase, even during the pandemic.

- In 2020, the share of developed countries is nearly 49% while China's share is 33% and emerging countries' 19%.

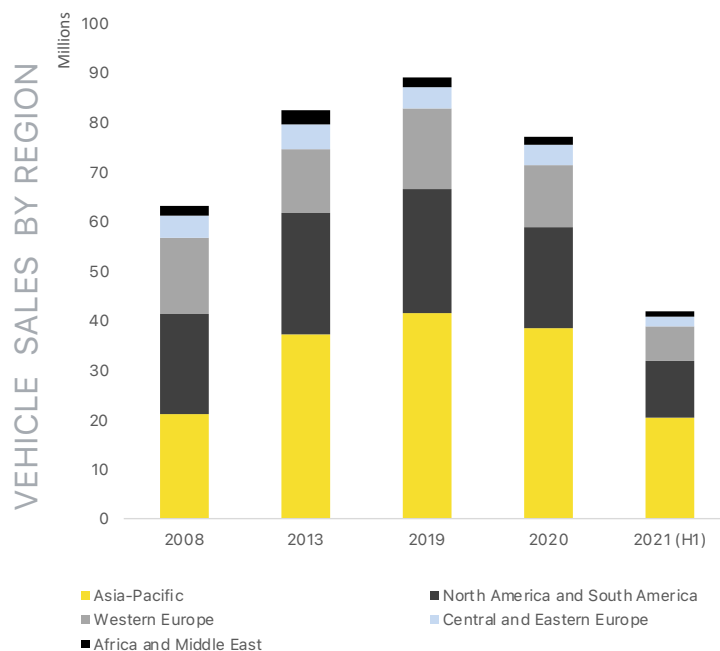
In the same period, North America and Western Europe have lost their dominance as production locations while developing countries emerged as new alternatives. In addition to China, various other regions have gained a place in the production network of global companies.

VEHICLE PRODUCTION BY REGION



Source: International Organization of Motor Vehicle Manufacturers

- The share of North America and Western Europe combined has decreased from 31% in 2008 to 22% in 2020 and to 18% in the first half of 2021.
- On the other hand, Asia Pacific's share increased from 44% in 2008 to 57% in 2020 and 59% in the first half of 2021.
- In the same period, Eastern Europe has been able to protect its place in the production network with its share of 9%.

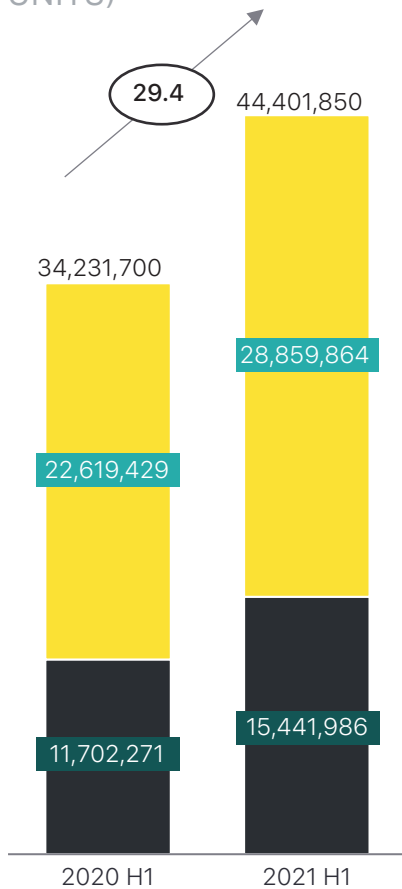


Source: Marklines

- According to the regional breakdown of vehicle sales, all five regions saw a drop in 2020 in vehicle sales.

- **Meanwhile, vehicle sales in Türkiye continued to increase in 2020 despite the pandemic from 479.060 units to 772.788 with an increase of 62%.**

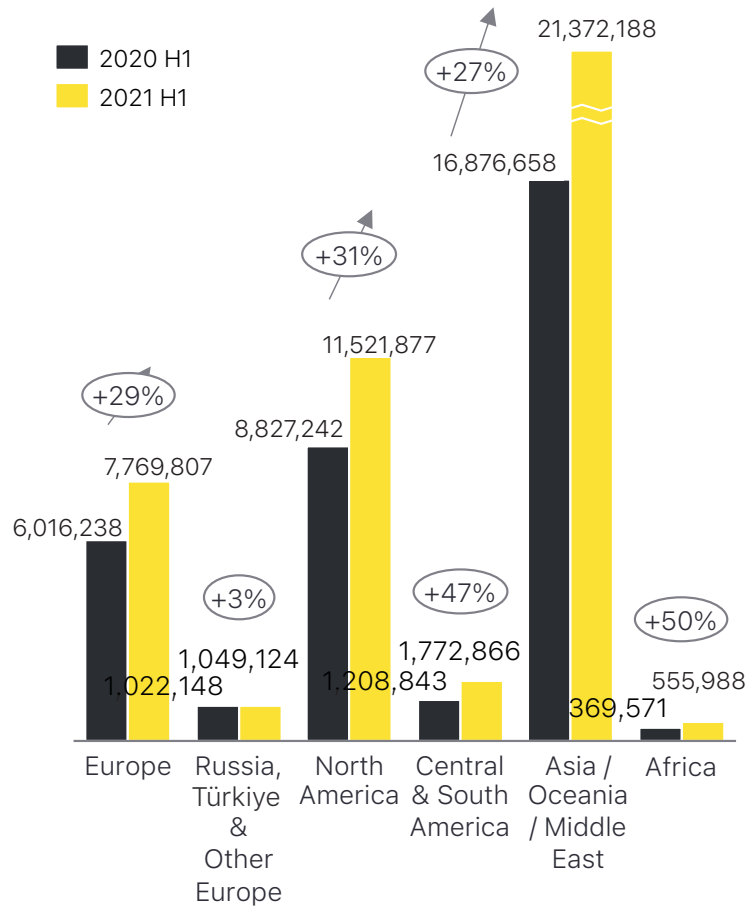
GLOBAL REGISTRATIONS OR SALES OF NEW VEHICLES (2019-2020, UNITS)



■ Passenger Cars
■ Commercial Vehicles

Source: OICA

GLOBAL REGISTRATIONS OR SALES OF NEW VEHICLES (2020H1 & 2021 H1, UNITS)



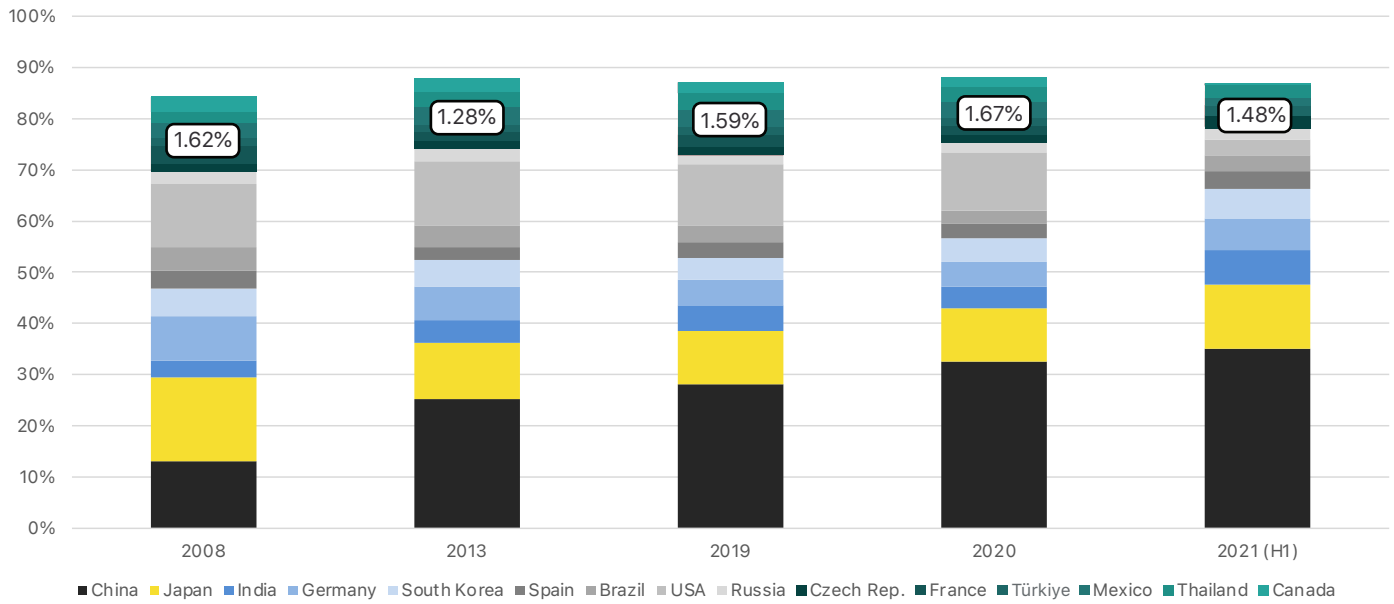
• In the first half of 2021, global sales of passenger cars and commercial vehicles increased by 29.4% compared to the same period of the previous year.

• Considering the regional breakdown, the highest vehicle sales were realized in Asia / Oceania / Middle East with 21.4 million. Based on the percentile change, the highest increase occurred in Africa with an increase of 50%. Vehicle sales in Europe increased by 29% compared to the same period of the previous year. The rate of change in Russia, Türkiye & Other Europe was 3%.

EVOLVING POSITION OF TÜRKİYE IN THE GLOBAL MOBILITY INDUSTRY

The list of top manufacturers is dominated by the brand owner countries. Yet, the countries positioned as production hubs in the value chain continue to gain more ground.

TOP 15 VEHICLE MANUFACTURER COUNTRIES

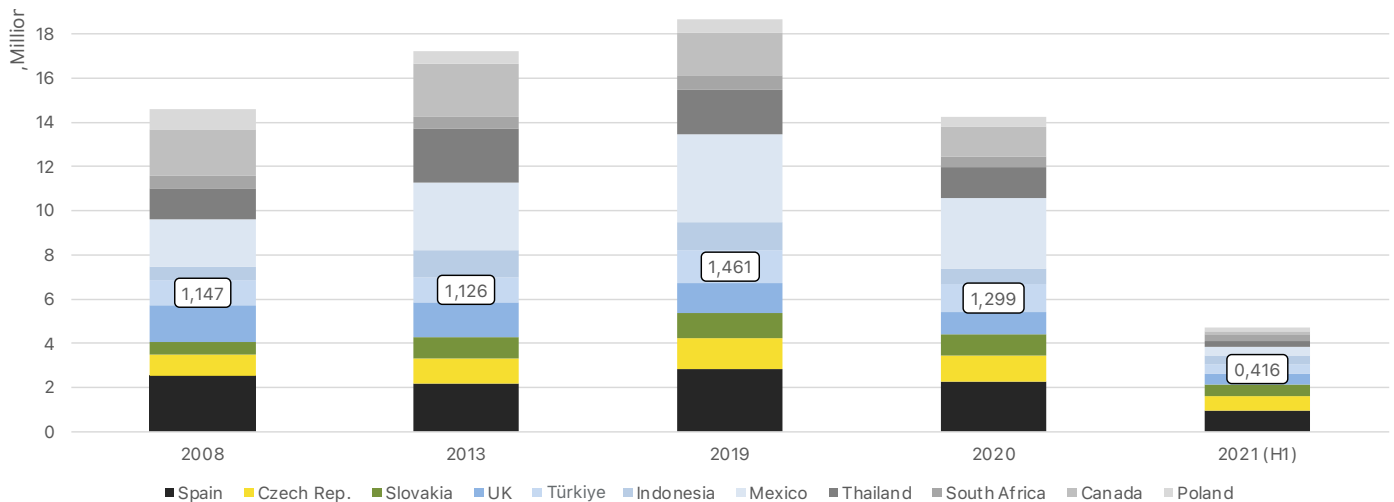


Source: International Organization of Motor Vehicle Manufacturers

- Thanks to its local dynamics, China has enjoyed a continuously increasing investment in the automotive sector from international firms.
- As one of the top 15 manufacturers, Türkiye was able to increase its share in vehicle production up to 1.67% in 2020 and the rate has been realized at 1.48% in the first half of 2021, which made **Türkiye the 12th largest manufacturer** in the same period.

A production hub can be defined as a country which do not have its own vehicle brand but is preferred by other countries' vehicle manufacturers due to various reasons. Dynamics like proximity to target markets, cost optimization needs, and skilled labor force have led to the formation of new production hubs overseas rather than in brand owner countries.

TOP VEHICLE PRODUCTION HUBS

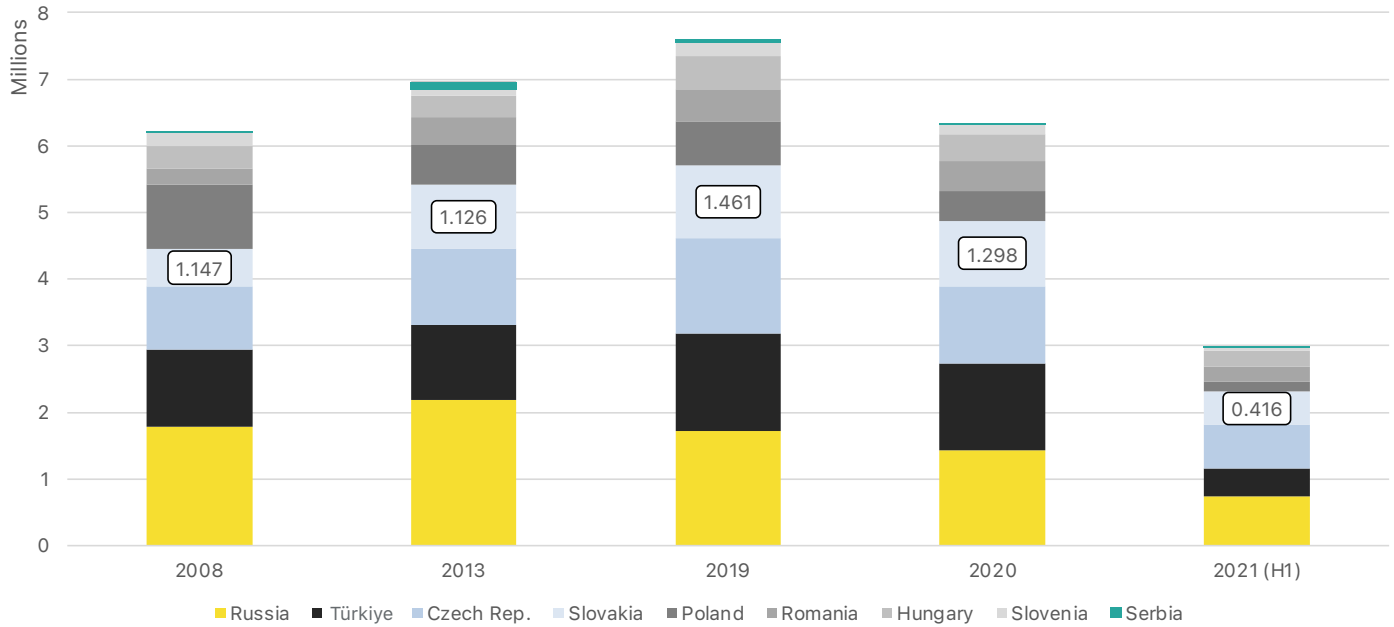


Source: International Organization of Motor Vehicle Manufacturers

- As of 2020, Spain and Canada are still protecting their position as important production hubs while the UK is losing its place.
- As of 2020, Mexico is leading the list of the largest production hubs and followed by Spain, Thailand, Canada, and Türkiye, respectively.
- Since 2000, global OEMs invested over USD 15 billion in their operations in Türkiye making the country one of the strongest production hubs in the world.

Central and Eastern Europe have become a strong partner for global automotive manufactures. Although the production has been decreasing in Western Europe, CEE has been able to increase its production continuously and saw a peak in 2019 with a production of 7,587,642 units. However, this number decreased to 6,338,439 units due to the impact of the pandemic in parallel with global manufacturing rates.

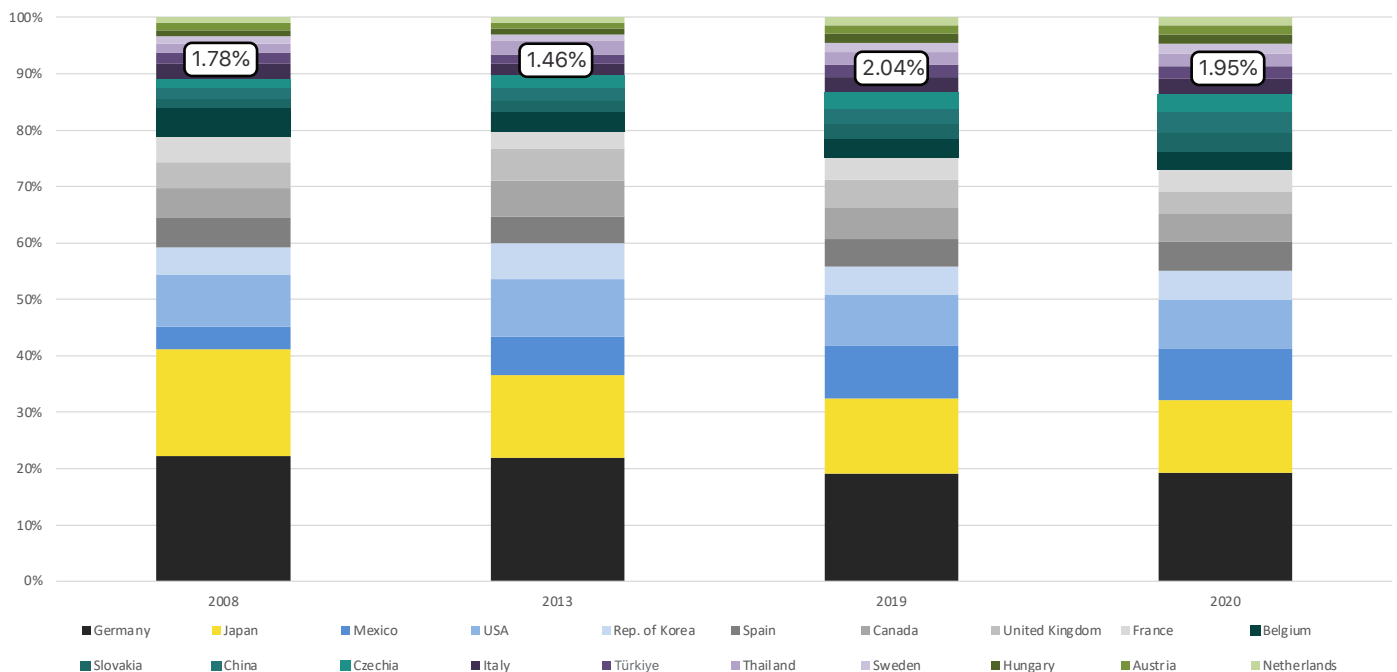
VEHICLE PRODUCTION IN CEE



Source: International Organization of Motor Vehicle Manufacturers

- In terms of production volume Russia, Türkiye, and Czech Republic are the leading countries in the region.
- With their market potential, Russia and Türkiye play another role compared to other countries in the region.
- With a vehicle production of 1.46 million and 1.29 million vehicles in 2019 and 2020 respectively, **Türkiye was the second largest vehicle manufacturer after Russia.**

TOP 20 COUNTRIES BY AUTOMOTIVE EXPORTS RATES

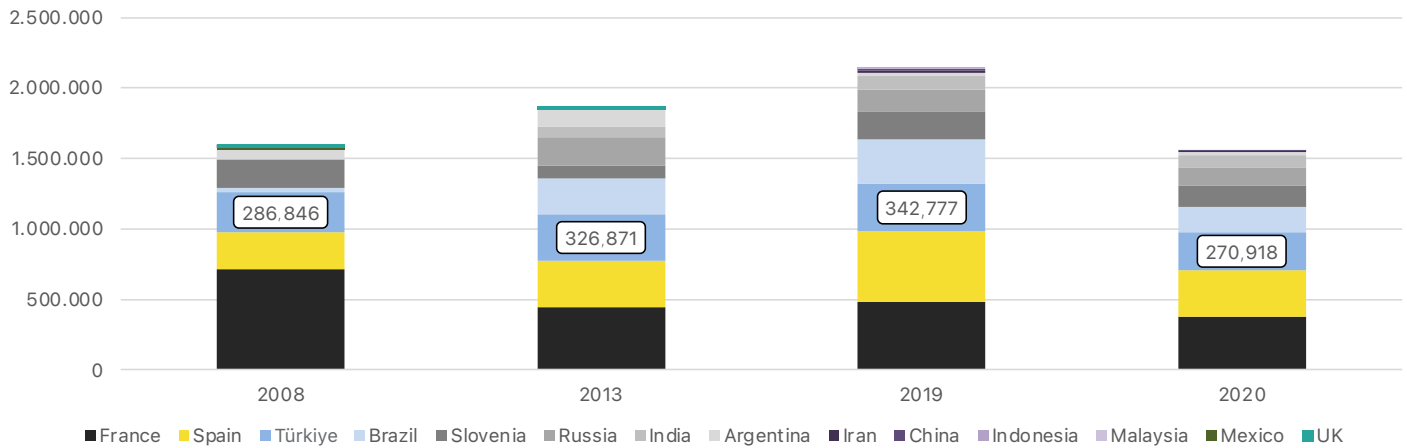


Source: Comtrade

While Germany, Japan, Mexico, and the US top the list of automotive export rates, **Türkiye has been able to find a place for itself in the list as well and protect its position as the 16th strongest country in terms of automotive exports rates despite the pandemic.**

It can be observed from the tables and graphics below that global vehicle manufacturers use Türkiye as a regional production hub in addition to its growing domestic market. They export most of their vehicles produced in Türkiye to other countries after allocating a certain share for the domestic market.

RENAULT WORLDWIDE PRODUCTION NETWORK

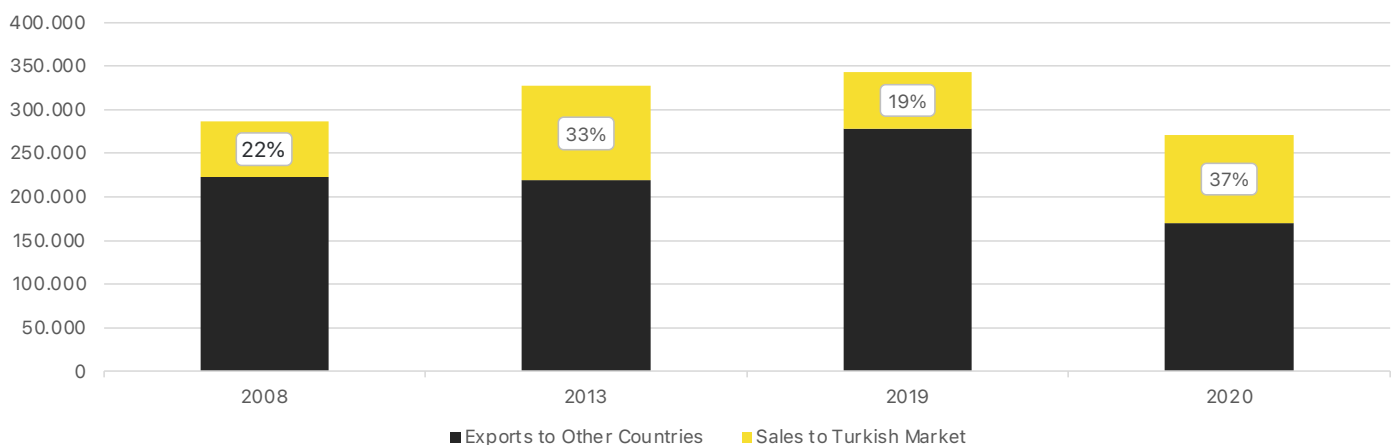


Source: Marklines

Each year 17-18% of Renault vehicles are produced in Türkiye, which makes the country the 3rd largest producer of Renault in the world after France and Spain.

Depending on the year, two-third or three-third of the produced Renault vehicles are exported to other countries.

RENAULT IN TÜRKİYE

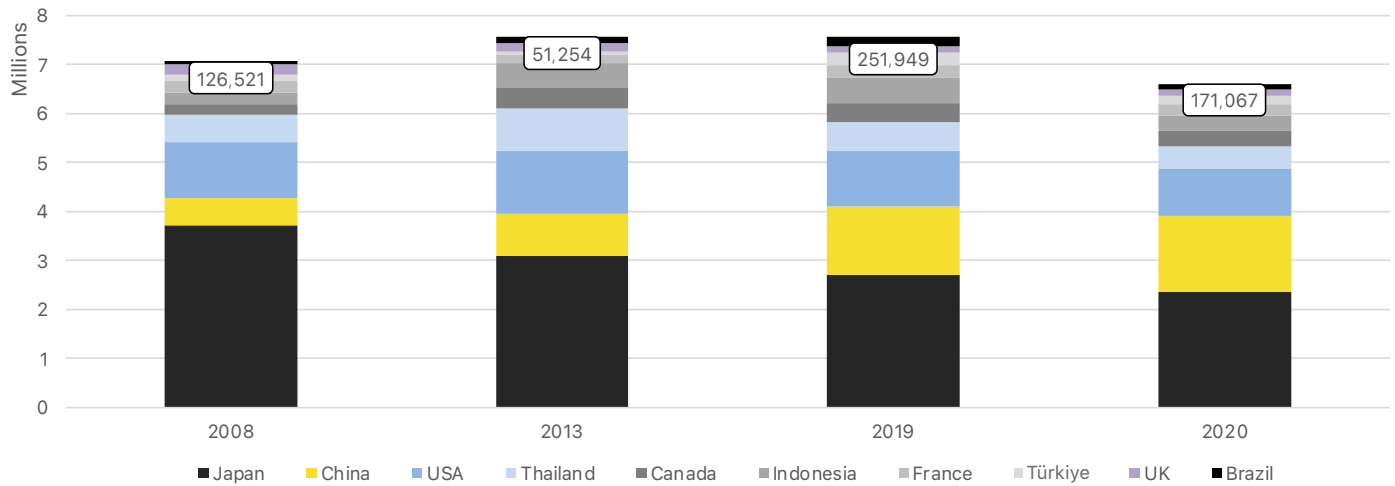


Source: Marklines

Depending on the year, two-third or more of the produced Renault vehicles are exported to other countries.

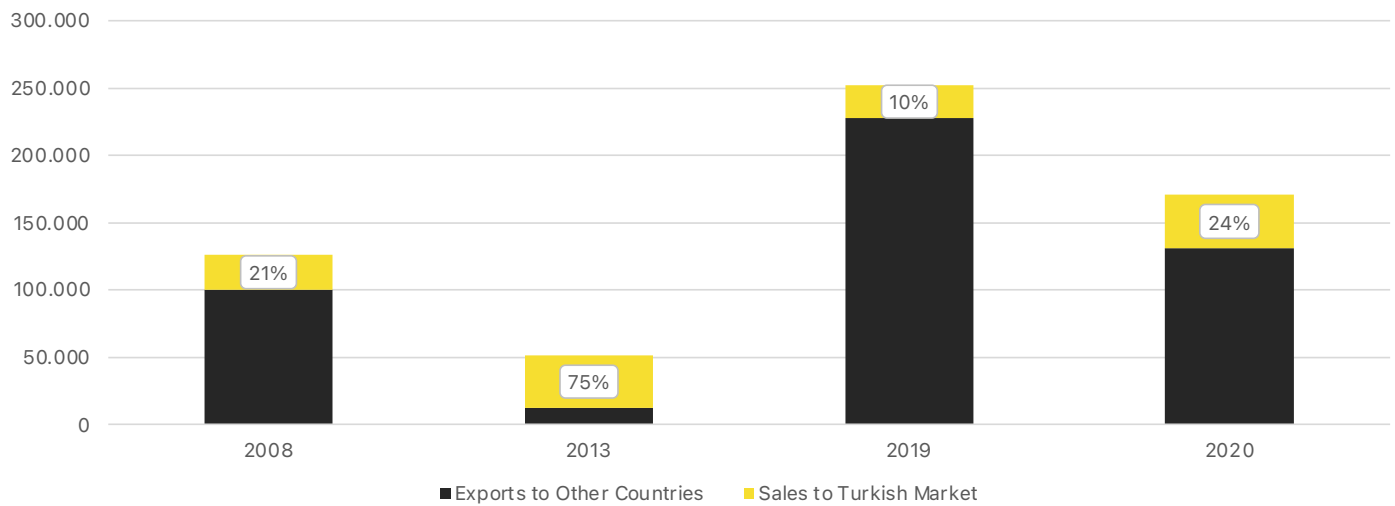
Allocating an important place to Türkiye in its strategic plan within the scope of the "Renaulution", Groupe Renault continues its investments in order to diversify its activities in Türkiye. Operating in Türkiye since 1968, the group has established a new company in Türkiye, "Renault Group Automotive A.Ş.", a 100% subsidiary of Groupe Renault, as of December 1, 2021. In this context, Groupe Renault aims to strengthen its presence in production and industry in Türkiye, to contribute to the development of the electric vehicle ecosystem in the country, and to create a stronger synergy in the projects to be developed with all other local and global business partners⁸.

TOYOTA WORLDWIDE PRODUCTION NETWORK



Source: Marklines

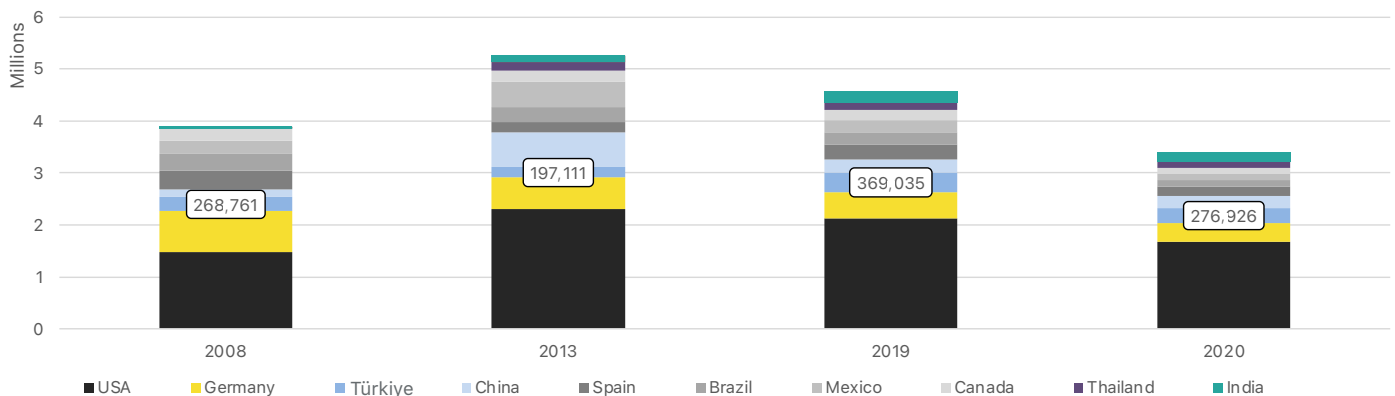
TOYOTA IN TÜRKİYE



Source: Marklines

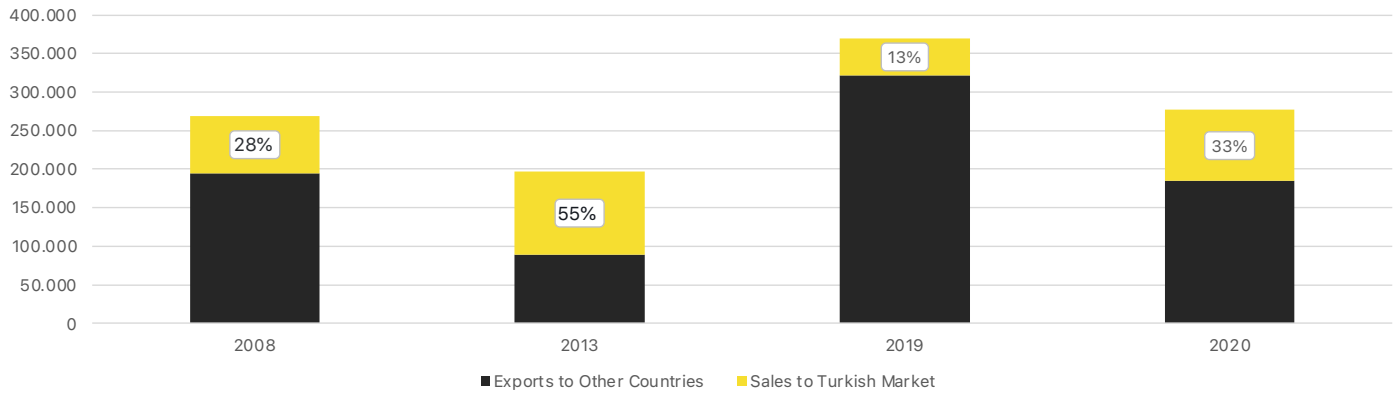
Türkiye is a significant production hub for Toyota especially for its exports to the European market. In most years, two-third or more of the produced Toyota vehicles are exported to other countries.

FORD WORLDWIDE PRODUCTION NETWORK



Source: Marklines

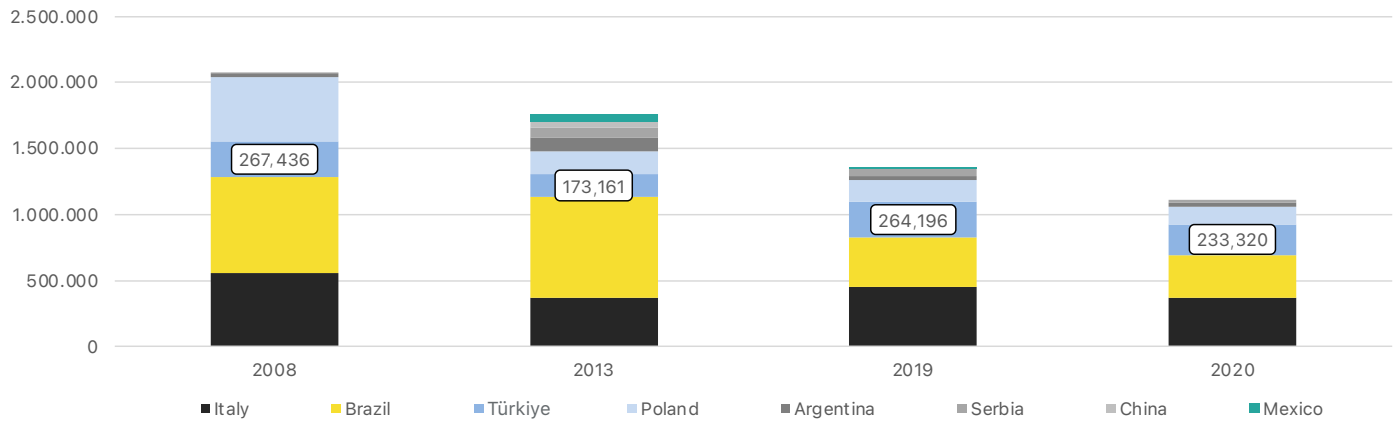
FORD IN TÜRKİYE



Source: Marklines

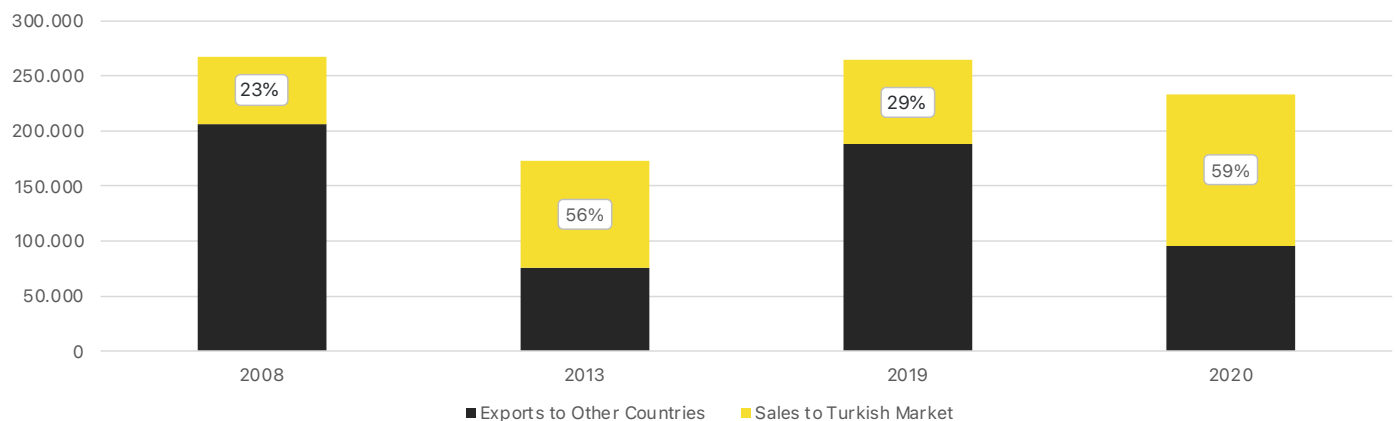
Türkiye is the third biggest production hub of Ford after the US and Germany. In most years, two-third or more of the produced Ford vehicles are exported to other countries.

FIAT WORLDWIDE PRODUCTION NETWORK



Source: Marklines

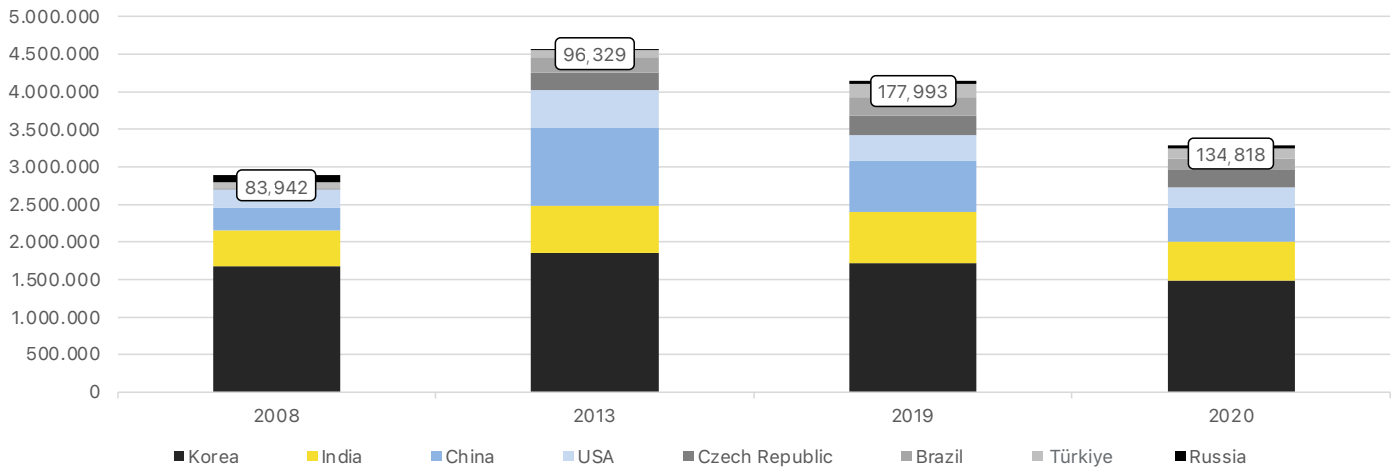
FIAT IN TÜRKİYE



Source: Marklines

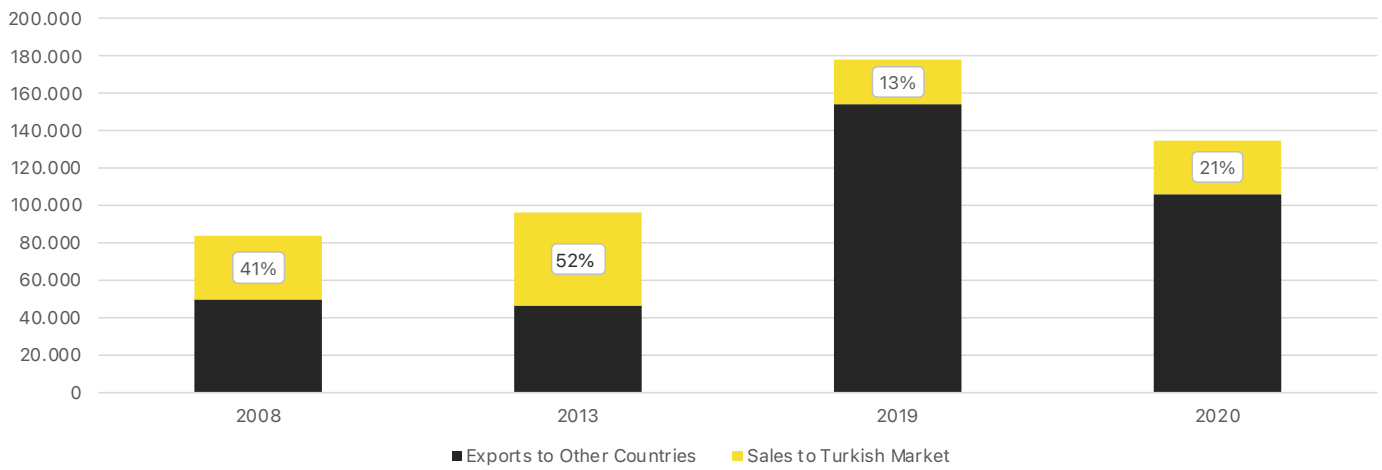
Türkiye holds an important place in Fiat's worldwide production network. Similar to Ford, it is the third biggest production hub of Fiat after Italy and Brazil. In most years, two-third or more of the produced Ford vehicles are exported to other countries.

HYUNDAI WORLDWIDE PRODUCTION NETWORK



Source: Marklines

HYUNDAI IN TÜRKİYE

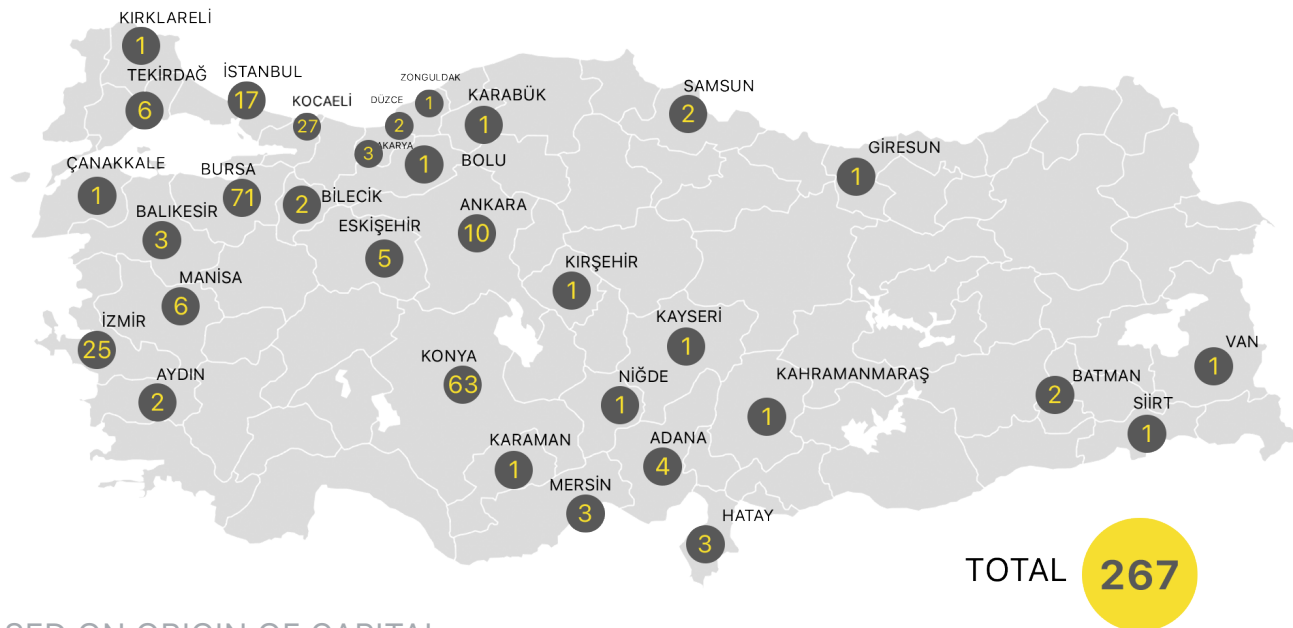


Source: Marklines

The number of the produced Hyundai vehicles is relatively low compared to the global production of the brand; however, Türkiye plays a key role in Hyundai's sales in the European market since one-fourth of the produced Hyundai vehicles are for the domestic market and the rest is exported to other countries.

INVESTMENTS AND INCENTIVES IN MOBILITY INDUSTRY IN TÜRKİYE

BASED ON INVESTMENT LOCATION



BASED ON ORIGIN OF CAPITAL

Type of Capital	# of Investment Projects
Local	248
Foreign	19
Total	267

INVESTMENT AMOUNT BASED ON ORIGIN OF CAPITAL

Type of Capital	Total Investment (TRY)
Local	2,526,133,017
Foreign	6,128,402,347
Total	8,654,535,364

EMPLOYMENT BASED ON ORIGIN OF CAPITAL

Type of Capital	Employment (person)
Foreign Investment	2,237
Local Investment	4,658
Total	6,895

INVESTMENT TYPES

Investment Type	# of Investment Projects
New	61
Expansion	193
Modernization	13
Total	267

TOTAL INVESTMENT AMOUNT BASED ON INVESTMENT TYPE

Investment Type	Total Investment (TRY)
New	3,225,167,730
Expansion	4,977,777,998
Modernization	451,589,636
Total	8,654,535,364

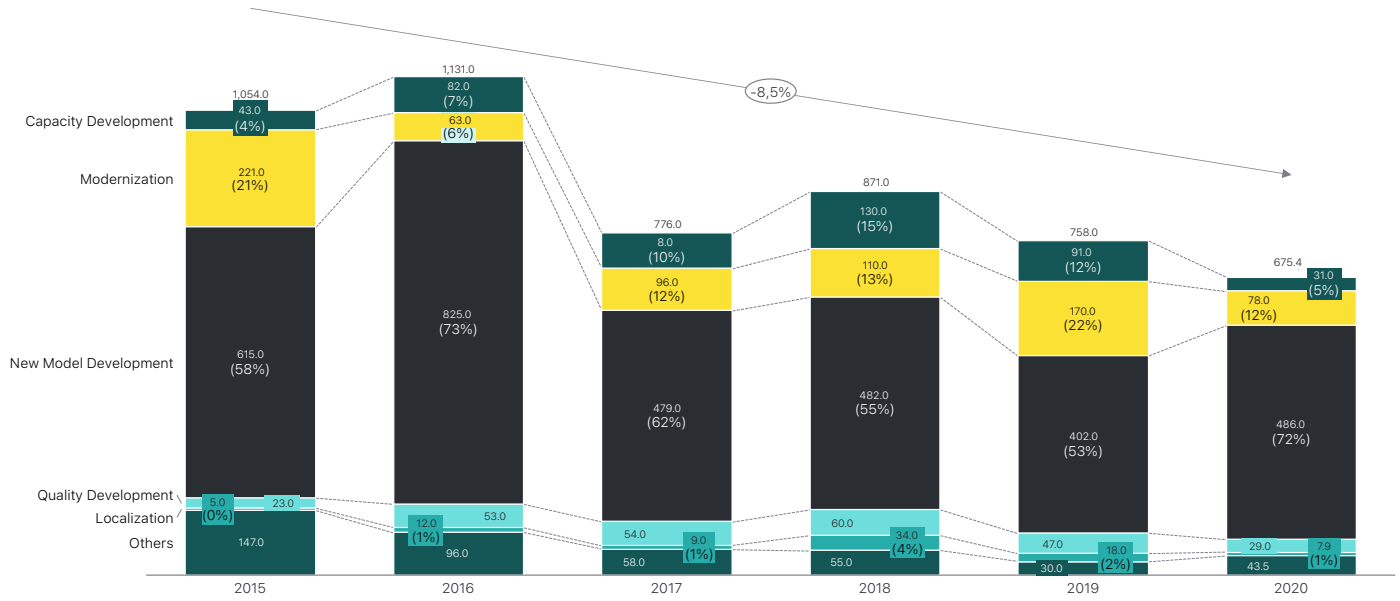
Source: Ministry of Industry and Technology (as of August 2021)

TOP 10 AUTOMOTIVE INVESTMENTS (AS OF AUGUST 2021)

	Company	Investment Location	Investment Type	Fixed Investment Amount (TRY)	Estimated New Employment
1	Atik Metal Sanayi ve Ticaret A.Ş.	Izmir	New	872,073,618	120
2	A.Döksan Döküm Sanayi ve Ticaret Ltd. Şirketi	Istanbul	Expansion	486,934,608	300
3	Ak-Pres Metal Yedek Parça Makine Sanayi ve Ticaret A.Ş.	Bursa	Expansion	363,428,946	405
4	Happiness Tech Otomotiv Sanayi ve Ticaret A.Ş.	Kocaeli	New	351,411,918	75
5	Beyçelik Gestamp Otomotiv Sanayi A.Ş.	Bursa	Expansion	333,633,600	243
6	Varroc Lighting Systems Türkiye Endüstriyel Ürünler İmalat ve Ticaret A.Ş.	Kocaeli	New	328,243,314	125
7	Ak-Pres Metal Yedek Parça Makine Sanayi ve Ticaret A.Ş.	Sakarya	Expansion	320,672,493	40
8	Beyçelik Gestamp Şasi Otomotiv Sanayi A.Ş.	Kocaeli	New	270,960,996	827
9	Beyçelik Gestamp Otomotiv Sanayi A.Ş.	Kocaeli	New	209,533,201	430
10	Sanel Sanayi Elektroniği İmalat ve Ticaret A.Ş.	Istanbul	Expansion	192,205,376	10

Automotive Companies Supported by Turquality Programme 18 companies (as of December 2021)	Authorized Economic Operators (AEO)	Automotive Companies Supported by Turquality Brand Support Programme 18 companies (as of December 2021)
Airtech	Autoliv	Ak-Pres
ArmaTrac	Aisin	AYD OE Excellence!
Assan Hanil	BMC	Birinci
Beyçelik Gestamp	Bosch	Cavo
BMC	Bridgestone	Doğu Pres
CMS	CMS	Farplas
Hema	Denso	FOMPAK Automotive Plastics and Interiors
İnci Akü	Fiat	Jantsa
Karsan	Ford	KAT
Kirpart	Goodyear	Katmerciler
Lassa	Hema TRW	KI Kale Oto Radyatör
Mutlu	Honda	MARTUR Automotive Seating Systems
Otokar	Hyundai	Norm
Petlas	Isuzu	Orau
Sampa	Karsan	Platin Battery
Standard Profil	Magneti Marelli	Tirsan
Teklas	Mercedes-Benz	Toksan
Temsa	Norm Civata	Vaden Original
	ORS	
	Otokar	
	Pirelli	
	Renault	
	Standard Profil	
	Temsa	
	Tirsan	
	Toyota	
	Yazaki	
	Yiğit Akü	
	ZF	

TOTAL INVESTMENT AMOUNT BASED ON INVESTMENT TYPE



Source: The Automotive Manufacturers Association of Türkiye

Automotive sector investments of OEMs are still ongoing. The increase in value-added investments compared to previous years can be seen with the increasing rate of new model development investments in total sector investments. While the share of capacity development and modernization investments in the total investment was 25% in 2015, this ratio decreased to 17% in 2020, while “new model development” investments increased from 58% to 72%. Taking all these points into consideration, it can be concluded that Türkiye maintains its position as an attractive market for OEMs.



MOBILITY INDUSTRY RESEARCH

FORD OTOSAN



HAYDAR YENİGÜN

GENERAL MANAGER, FORD OTOSAN

1- What do you see as the most favorable opportunities in Türkiye's automotive sector and companies working on new mobility solutions? What makes the country's automotive industry stand out compared to other locations?

In the last 25 years, the Turkish automotive industry has managed to increase its production capacity 3 times, its production 5 times, and its exports 35 times. Türkiye has considerable competitive advantages for new automotive investments due to its competent and experienced workforce, strong R&D infrastructure, strong supply industry, high potential local market, and strategic location advantages. Automotive industry companies have continued to invest without interruption and reached 14th place in world production rank, becoming one of the most important trading partners of the EU in the process. Türkiye has also become a very competitive and strong supply base in the last 20 years. Turkish suppliers export almost one-third of total automotive exports. The recent global crisis proved that a reliable and professional supply base is a sine qua non for OEMs. Turkish automotive suppliers make Türkiye more attractive investment location for global OEMs.

Furthermore, Türkiye has considerable knowledge and experience in the automotive industry and has reached the position of exporting automotive engineering to the world beyond product development and production. Flexibility, quality, and drive to succeed will be the critical factors. Recently announced new investments support that Türkiye will continue to be an important automotive player in the future. OEMs are investing to introduce new generation products and new technologies. There are also important investment incentives in place to support mobility related developments.

In addition, as a result of a high ratio of young population, innovative mobility solutions are spreading very quickly. Also, we anticipate that the interest of the society in different mobility solutions will increase due to the high vehicle ownership costs in Türkiye. In this sense, we predict that trend, which started with micro-mobility solutions, will also be enriched with light mobility, vehicle subscription & sharing, and mobility as service solutions.

2- How do you evaluate Türkiye's position is for electrification and modernization of the automotive industry? What is behind the decision to expand your operations and make a new investment in 2020?

With the impact of the pandemic and the sustainability perspective gaining prominence, together with the resolutions and incentives imposed by the governments in Europe, we are observing significant changes in customer preferences in recent years. The emission restrictions (green zones) imposed by the EU countries in city centers are also an important factor. In line with these developments, commercial van customers will continue to prefer electric vehicles for distribution, delivery, and transportation in city centers. With this level of demand and technological developments as well as advancements in battery technology, electric vehicles will most likely be sold at the same price ranges as petrol and diesel versions in 10 years. In addition, the lower after-sales maintenance and fuel costs of electric vehicles already provide a significant advantage in terms of the total cost of ownership, especially for vehicles in commercial use. Looking at the figures, we see that the demand for electric vehicles is increasing, globally.

Accordingly, as the leading commercial vehicle manufacturer in Europe, we announced the 2 billion € investment plan until 2026, for the next-generation electric and connected commercial vehicle projects in our Kocaeli plant with our vision of becoming the leading company

in the electrical transformation of the Turkish automotive industry. Within the scope of the biggest investment of the Turkish automotive industry, commercial vehicle production capacity at Kocaeli plant, targeting mostly for export markets, will increase tremendously and as well as turning Ford Otosan to Ford's global hub for the production of EVs and Kocaeli plant will be Türkiye's first and only EV integrated manufacturing plant.

We see this investment, as a strategic move forward. Türkiye's role in the production of EVs is expected to grow and we will have the opportunity to work on advanced technologies that will contribute to the national economy and bring a global competitive advantage for higher value-added exports. Ford Otosan engineers will build upon their skills with critical design, development, and software competencies for electric vehicles and batteries. In the long-term, we will also contribute to the local supplier ecosystem and improve the standards and efficiency of our suppliers through the transfer of knowledge and by stepping up their integration into the production processes and finally reach a position where they will be able to serve many global brands.

3- How do you evaluate the supply of skilled labor in Türkiye? What was your experience while finding employees for your IT operations?

One of the strongest aspects of the Turkish automotive industry is its highly qualified and young workforce. Our workforce stands out as an important criterion in attracting new investments to our country, thanks to its high education and competence level, and its corporate business style that sets an example for the global business world. It is of great importance for our industry, which has a high level of education and young employment, to preserve the knowledge and experience. Currently, the average seniority in the main industry is over 9 years. Within the framework of the positive developments in the Turkish automotive industry, the additional employment needed in the coming period will play a key role in the development of our industry and in increasing our competitiveness. In this context, it is critical to recruit employees who are open to innovation, who can offer creative and original ideas, who are interested in automotive, and who constantly improve themselves.

As the future of the automotive industry is transformed by technology, it is very important that young people take part in this process. At Ford Otosan, we always support new graduates and young people both in our corporate social responsibility projects and in our recruitment processes and we continue to give priority to them. For this purpose, as Ford Otosan, we carry out many projects for students studying at vocational high schools, from establishing automotive laboratories, donating vehicles, increasing educational opportunities, providing mentorship support, and gender equality. We donate all the vehicles used in the testing stages of the projects to the vocational high schools to develop their motor and technical departments.

In order for the young and the best talents to join our company, we also introduce our company to the students studying in the 3rd and 4th grades of the engineering

departments of universities. At the same time, we have the opportunity to get to know the young talents we consider as potential. At the end of the program, students who

want to work at Ford Otosan are included in our selection and placement process, and candidates who successfully complete the process start working in our organization.

4- What do you think about Türkiye's endeavors to achieve the shift to electric vehicles and high-tech operations in the automotive sector? What is needed to accelerate this transition?

Demand for electric vehicles in Türkiye is growing noticeably every year. The number of all-electric vehicles sold in the first 6 months of 2021 has reached more than the whole of 2020 numbers. Especially with the pandemic, while "green transformation" is accelerating in many areas, we are observing the tendency to alternative fuels in Türkiye as well as all over the world.

Although current numbers are not strong, according to Deloitte 2021 Global Automotive Consumer Study, Turkish consumers' interest in electric vehicles is rapidly increasing and they consider their next vehicle will be electric. There are still roadblocks in the market such as taxation, incentives, and charging infrastructure to overcome.

In 2021 autumn, Türkiye ratified the Paris Agreement, established new institutional structures to tackle climate change, and prepared to adopt a Climate Law. Soon we will see Türkiye's CO₂ reduction targets and financial schemes to support this transformation. We strongly believe that, in the mid-term, Türkiye will be one of the most important manufacturing centers and an attractive market for electric vehicles. Green transformation comes at a cost. Many countries allocate a significant portion of their budget to support the required infrastructure, public charging points, green fleet renewals, and green transformation of production facilities. We are confident that similar support schemes will be also available in Türkiye in the near future such as affordable loans and credits, scraps schemes.

5-How has Türkiye's automotive industry been impacted by the pandemic?

The automotive industry in Türkiye, with an installed annual production capacity of over 2 million units/year, has managed to cope with the coronavirus pandemic, very well from the beginning. As of January 2020, it started to develop scenarios to tackle the crisis and gradually put into effect the plans to protect the health of its employees and ensure the continuity of production. With the increasing impact of the coronavirus pandemic, namely interruptions in the market and the supply chain and the measures taken to cope with the pandemic, OEMs inevitably started to stop their production as of March.

While the average monthly downtime of the industry was 6 days in March 2020, it reached 18 days in April. As of May 11, the sector resumed its production, with the introduction of appropriate measures to ensure workforce health. Due to both the social distance requirement and the gradual recovery of demand, the plants at first started operating at low volumes, resulting in low-capacity usage. Therefore, it was necessary to maintain production with higher costs and low efficiency for a while. However, the pace of production has increased since the second half of the last year.

Despite the challenging conditions of the pandemic, the automotive industry produced 1.3 million units, representing a decline of 11% compared to 2019. In comparison to automotive production globally and in Europe, which contracted by 16% and by 25% respectively, the Turkish automotive industry managed to perform better and increased its share in global production from 1.53% to 1.66%. Tractor production increased by 59% compared to the previous year as a result of delayed demand and rapid recovery in the domestic market.

As elsewhere, supply chain problems, essentially related to the pandemic, are impacting the automotive industry in Türkiye. The semiconductor supply shortages result in an interruption in production. When we look at the production downtimes globally and here in Türkiye, it may be possible to say that Turkish OEMs are relatively less affected by the semiconductor issue.

6- How do you evaluate the competitive environment in e-mobility from investments perspective?

The traditional automobile industry is in constant change. The future of the automotive transforms according to the expectations of customers and the new understanding of e-mobility. The transformation, which were expected to take place over the years, happened within months with the effect of the pandemic and the digital transformation. Today, customers demand access to their smart devices from anywhere, get their work done quickly, and have solution-oriented secure connectivity. As a new e-mobility ecosystem rises, it paves the way for massive innovation and investments.

Automotive is a sector that is very open to developing new business models and initiatives in the fields of “transportation” and “logistics” in a commercial sense. Therefore, it is inevitable that governments and big technology companies make large investments in this direction. Since 2009, USD 260.6 billion has been invested in startups in the field of 'smart mobility' alone, adding another USD 41.1 billion in 2020. The race of technology companies to enter the automotive industry is accelerating the transformation in the automotive industry.

It is obvious that this rapid transformation has affected the current structure of the industry, business models, customer demands, and most importantly the competitive environment. Although this process seems to be a threat for automotive manufacturers, we see it as an opportunity. Because staying out of this process and failing to meet customer expectations means missing out on this new world of opportunities. We know that to be successful in this new mobility and smart production environment, companies must make changes at an unprecedented pace and adopt new business models and practices. While the 'entrepreneurship ecosystem' for smart mobility is growing rapidly all over the world, we are taking the necessary steps to develop cooperation with start-ups and entrepreneurs in the automotive world of the future.

These days, it is necessary not only to keep up with the changing customer expectations and technology but also to be ahead of the trends. This is the only way to ensure the sustainability of companies. Accordingly, we have taken steps to create a structure that will follow the venture ecosystem both in Türkiye and in the world, understand opportunities and new technologies, implement new business models and possible business partnerships, and we have implemented our corporate venture capital company “Driventure”, focusing on electrification, connectivity, autonomous driving, smart mobility solutions, and smart production. With Driventure, we aim to create a strategic competitive advantage and gain insights from the market. Furthermore, we know that every day new trends are emerging, such as e-scooters, e-bikes, as well as micro-mobility OEMs. The competitive environment in this area is also very open to development. As Ford Otosan, influenced by the needs of customers for the rapidly rising e-commerce and mobility trend today, we established Rakun Mobilite Company to provide services with different business models for all users who are looking for innovative and light mobility solutions with our know-how in electric vehicle and commercial vehicle production.

We believe that these entities, which have emerged with the combination of Ford Otosan's know-how in the field of investment and technology, will add great value to the entrepreneurial ecosystem, the economy of our country and improve the competitive environment. As always, we will continue our investments to design the future of the automotive industry as a prime mover in Türkiye with the innovative technologies we offer in commercial vehicles and be a global player in the field of mobility.

FARPLAS



AHU BÜYÜKKUŞOĞLU SERTER

PRESIDENT, FARK LABS

1- How do you evaluate the collaboration among Fark Labs, the automotive industry, and academic institutions to develop new solutions?

Fark Labs was founded on this exact premise to develop new mobility solutions in partnership with industry and academia. As we leave behind the 50th anniversary of Fark Holding and our main business, Farplas Automotive, Türkiye's largest plastic injection company in the automotive sector, we started to plan the future strategy of our business and how it would intersect with the future of mobility. As part of that strategy, we opened Fark Labs in 2019. It is not only one of Farplas' 4 R&D centers, but also an incubator, accelerator, co-working space, and innovation hub for mobility startups.

One area of major disruption in mobility is the rise of electric vehicles. We conduct deep research, both in the technology and investment spectrum, in this area that we share with OEMs and suppliers in Türkiye. As such, Fark Labs is becoming a transformation center for OEMs, suppliers, and other corporations that want to get ready for the electric vehicle revolution.

We also have received European Union Horizon Framework funds for 7 projects, which we work on with academic institutions in Türkiye, Germany, and Spain (for example, Fraunhofer Institute in Germany). In addition, Fark Labs and Farplas work together as the official lead of the European Institute of Innovation & Technology (EIT) Urban Mobility RIS HUB Türkiye, in partnership with Sabancı University and PwC Türkiye.

For every R&D project at Fark Labs and Farplas, we strive to incorporate a university-industry collaboration with our ecosystem partners. By doing so, we aim to integrate different perspectives into our work. Some of our key Turkish academic partners are Sabancı University, Istanbul Technical University, Okan University, and Middle East Technical University. One of our current projects is called REVOLUTION, funded by EU Horizon 2020 and for which Farplas is the consortium coordinator. As part of our circular economy strategy, REVOLUTION's objective is to maximize EV range and end-of-life vehicle recovery by optimizing recycled plastics and advanced light materials.

2- What can be done to improve the ecosystem to accelerate the development of new mobility solutions?

Today, due to the rise of EVs and micromobility, we are facing new ways of moving things and people. There is a lack of standards with EVs but this also creates new opportunities for companies to develop new products, processes, and business models. Some of these new business models include Mobility as a Service (MaaS) and Infrastructure as a Service (IaaS). Thus, we need common infrastructure and standards, and joint R&D projects to accelerate the development of new mobility solutions.

This is what we are trying to achieve at Fark Labs and Farplas. For example, we recently spun off our first startup

investment, DUCKT, which has created the world's first universal micromobility charging station. It now has stations in 20 countries and is quickly becoming a global micromobility charging standard.

We also look at how successful solutions in certain places (such as the minibus concept or company shuttles in Türkiye) can be replicated elsewhere, incubate these ideas, and grow them into stand-alone startup businesses. There isn't always a need to find something "new." Old solutions here can become new solutions elsewhere.

3- How do you evaluate Türkiye's talent pool in the automotive sector? Is there room for more training, development, and collaboration with academic institutions to develop the required workforce for the future of the industry?

Türkiye has a very skilled talent pool in the automotive industry, thanks to our strong engineering universities (known as technical universities in Türkiye), our solid position as a regional automotive hub, and our young population. However, the automotive industry is quickly changing to a new world of mobility, so the talent needs further training to keep up and we are doing our part to support this.

At Fark Holding, we have gone through a dual transformation, based on the principles in the book of the same name, which I was very inspired by. That's why we created an ambitious strategy at our 50th anniversary to strengthen our plastic injection business with international collaborations, joint R&D, and a global footprint, while

also creating Fark Labs to be in the middle of the mobility industry disruption. In order to align our employees' mindset and skillset with our strategy, we regularly hold strategy meetings and a variety of training.

In order to further develop the Turkish talent pool, our senior leadership regularly teach at the top engineering universities as adjunct professors and also via webinars and seminars. We also have an annual internship program where we offer a rotational program for new graduates so that they are given exposure to various departments and then are offered a full-time position upon successful completion of the program.

4- What sort of international collaborations do you carry out to make Türkiye a manufacturing hub?

At Farplas Automotive, we have built a strong manufacturing base in Türkiye, which we have leveraged to expand our operations abroad. We are currently operating production facilities in Thailand, Romania, and Croatia with local JV partners. In addition, we have offices in both Paris and Seoul, and soon to be in Shanghai and Detroit, where we engage in both Farplas business and Fark Labs startup activities and investment. The information, knowledge, and resource exchange through our global network helps

strengthen our manufacturing presence in Türkiye and our working relationships with our OEM clients who also produce nearby our facilities, and as a result, we are able to generate more exports from our sites within Türkiye. At the same time, it creates attractive and competitive solutions for our international production facilities and brings new export and investment opportunities to us.

5- What are the challenges you have encountered during the development of the services and models you offer in the mobility ecosystem?

When we started our Fark Labs journey, many people - both within and outside of Fark Holding - thought that this was not worth our time and money. However, we knew that we needed to act, to design a better future together, not only for our own company and people, but also for our ecosystem.

Many OEMs aim to realize their EV plans by 2030, and at the same time, the role of big data is becoming an increasingly important factor in the industry. Thus, we persevered and continued to tell our story of why Fark Labs needed to be an integral part of Fark Holding's transformation. After having opened our Istanbul headquarters and our Ankara hub,

investing over €10 million in Turkish and foreign startups, creating partnerships with Korean and US accelerators and VCs, spinning off our first internally incubated startup, and acquiring our first corporate customer, many of those skeptics have come on board. However, the path is still long and we continue to improve and develop our services and startups, and share the success story of how a Turkish automotive company has transformed into a mobility innovation hub.

ELECTRA IC



ATEŞ BERNA

GENERAL MANAGER & MANAGING PARTNER, ELECTRA IC

1- Could you briefly outline Electra IC's operations in Türkiye? In which areas do you see the greatest potential?

Electra IC is mainly active in the aerospace and defense sectors providing training and engineering services for electronic hardware development especially for avionic hardware development and radar systems. Electra IC's main focus is digital IC (Integrated Circuit) design and verification. IC Design is either done using an ASIC approach where the microchips are produced from scratch or FPGA (Field Programmable Gate Array) devices are used and the functionality of the chip is designed by a design house like Electra IC.

The power of designing a microchip brings crucial power to a country as the new technologies can be developed

for any sector that uses microchips. We see microchips in almost every part of our daily lives like at home, in offices, in hospitals, in our pockets (mobile phones) -. Electra IC has been one of the few microchip design houses in Türkiye since 2014.

Having worked with Aselsan since its foundation, we're awarded as their strategic partner in 2020. We have exported our engineering services related to ASIC/FPGA design to Europe. What makes Electra IC different from other design houses in the world is its Functional Safety know-how. And the greatest potential here is for automotive, avionics, and railways are mobility for people.

2- Do you believe chip design is a strategic potential for Türkiye for the mobility industry? And Why?

Türkiye is a developing country in the field of aerospace and defense with its strong defense contractors. However, chip design remains an area that they failed to throw their full weight into given the fact the number of chips used in aerospace and defense is not as high as consumer electronics (like mobile phones and laptops). Turkish computer brands, mobile phone brands, among other electronic devices do not require new chip designs.

We touched base with existing players in the Turkish market to explore if their new products' developments might need new chip designs, but the demand, willingness or possibly budget for new chip design were lacking. This is the main bottleneck for companies like Electra IC to tap into new microchip design projects. There are almost no microchip

design projects in Türkiye other than some limited ones in the aerospace and defense sector.

If Türkiye can produce high-tech products in high volume, the economic power will surely increase. But in the end, production is not enough. The key question is, "Is there a mass market for the production output?". Microchips are produced for the global mass market. In that sense, if Turkish microchip design houses can get involved in global projects and also own the IP rights of what they design, they can make sales and grow. Looking at the trends in avionics, automotive, and railways, we can say that chip design has a strategic potential for Türkiye.

3- Do you believe chip manufacturing for mobility may become a strong capability for Türkiye? How and why?

Microchips are being used not only in mobility but almost in every sector. There is a very limited chip manufacturing capability in Türkiye today. Only TÜBİTAK YİTAL can manufacture chips using 0,25µm 5 metal CMOS and 0,25µm 5 metal SiGe technologies. This technology can be used for some low frequency and low volume needs. One thing that might improve local chip design and productions in Türkiye is to bring IC Design Houses together with YİTAL in some high-volume projects. For advanced technologies like 20nm,

10nm, 5nm CMOS technologies, a chip manufacturing fab needs to be subsidized by the government and cannot be positioned as a lucrative investment. It is like building a submarine. You do not build a submarine to sell it in the first place, you build it to become stronger. A microchip fab makes a country stronger as this fab serves to develop the technology. However, the capital required to build a microchip fab is huge.

4- How do you evaluate Türkiye's talent pool for your operations? What can be done for further improvement and skilling up the younger generation, particularly in STEM subjects?

Türkiye has a very high potential mainly thanks to its young population. Also, there is a considerable interest in technology from this young population. We are receiving large number of internship applications.

Because of the rather advanced defense sector in Türkiye, fresh graduates are also interested in electronic hardware and software design. We're working closely with some universities and we have built a unique [EIC Academy](#) Program for our recruitment process. R&D is the main focal point for STEM subjects.

What is mainly missing in companies in Türkiye and also abroad is the R part in R&D. Companies rather prefer fast development instead of spending long months/years in research. But innovation comes from research and research can be done by academicians who are strong in STEM subjects. With research, we can find the unknown that creates value for the masses and research is an area for people who have advanced knowledge in STEM subjects.

I do not think that it is the job of engineers in the private sector. An engineer is a person who knows the related processes and flows in a specific area and repeats those processes for new product development. However, research aims to find an answer to a question and the result of research becomes more valuable if the answer is something new, not known to others, and facilitates the life of others. In my opinion, an engineer's first role in a corporate is not

research. Having more than 25 years of experience in this sector and having acted as an engineer in microchip design projects in various global semiconductor corporates, I can say that IC Design Engineers' initial role in a corporation is development.

Research institutes like TÜBİTAK can develop the prototypes of new technology, but this needs to be transferred to SMEs (technology transfer) such that the know-how is shared and grows and new SMEs can spawn. I believe the interest and upskilling of the younger generation should start from the kindergarten. And this requires a mind shift in our education system.

Look at the most-in-demand university degrees, are they STEM subjects? No! Engineering, medical doctor, and business administration eventually win the day. Subsequently, they lead to the most highly ranked professions, mainly because the pay scale is skewed towards these areas. Development is rather faster than research. Research is time-consuming and might not reach a satisfying result. But if satisfying results are obtained; the value of the product, once developed, will be more highly prized.

5- What do you provide for mobility players and what sort of opportunities do you see in the electrification and digitalization of the mobility industry?

When it comes to avionics, automotive, and railways, there are functional safety standards like DO-254, ISO 26262, EN 50129 for electronic hardware development. Electra IC is involved in electronics hardware development projects with [functional safety](#) compliancy and is capable of delivering design and verification services compliant with those standards. Microchip design is already a very niche and unique area and microchip design with functional safety know-how makes Electra IC even more unique in its market. Each day, electrical vehicles are entering into our lives more and more. eVTOL (Electric powered Vertical Take-Off and Landing) aircraft (a.k.a. air car, air taxi), electric cars, electric locomotives are the new trends for mobility.

For example, there are more than 550 eVTOL aircraft listed on [World eVTOL Aircraft Directory](#) and investors are behind those companies investing in the future of mobility. Similarly, electric automobiles and electric locomotives will be entering our lives more and more in the coming years. Therefore, a company like Electra IC has a very high potential to get engaged in those projects and deliver unique solutions to its customers. Moreover, Electra IC does not only deliver engineering services but also [trainings](#) for high-tech subjects such as microchip design, embedded system design, and functional safety.

6- Is there a need for different technology experience/capabilities in Türkiye for chip design?

The image below is from our “Comprehensive VHDL” course and depicts a typical Digital IC Design Flow with simple explanations of each step. Each of those steps requires different tools from different EDA (Electronics Design Automation) vendors. A company involved in chip design is either acting in the Front End part, which is logic design, verification, and synthesis or can also master the Back End flow to turn the synthesized netlist to a manufacturable mask format ([GDSII](#)). Each of those steps in the IC (aka chip) Design Flow requires different tools and different know-how. So even for an IC Design Engineer, it is very hard to master each step in this flow

Chip design requires a team specialized in different steps of this flow. As each step requires different knowledge and requires different tools, an engineer creates more value as he/she can master more steps in this flow with different know-how of different EDA tools and different HDL languages (VHDL, Verilog, SystemVerilog). Bottom line, we need IC Design Engineers specialized in different steps of the below IC Design Flow. This is where Electra IC plays a very important role in Türkiye. Our trainings’ focus is ASIC&FPGA, embedded systems, and functional safety. Being one of the five Certified Training Partners of Doulos, a well-known worldwide training provider, we deliver over 200 different high-quality trainings in Türkiye.

FRONT END

DESIGN CAPTURE

Text editor, graphical entry, state machine entry...

SIMULATOR

Simulate testbench (non-synthesizable) and design (synthesizable) to verify functional correctness

SYNTHESIS TOOL

Translate synthesizable code into gate level netlist in chosen technology

BACK END

NETLIST MAPPING

(Re-)Map gate level netlist to technology primitive cells

PLACE AND ROUTE

Place cells on chip and route wiring

TIMING ANALYSIS

Analyze timing "Static Timing Analysis"

HARDWARE

Produce mask (ASIC), bitstream (FPGA)

7- How do you foresee the possibility of competitive chip designs and production opportunities in Türkiye?

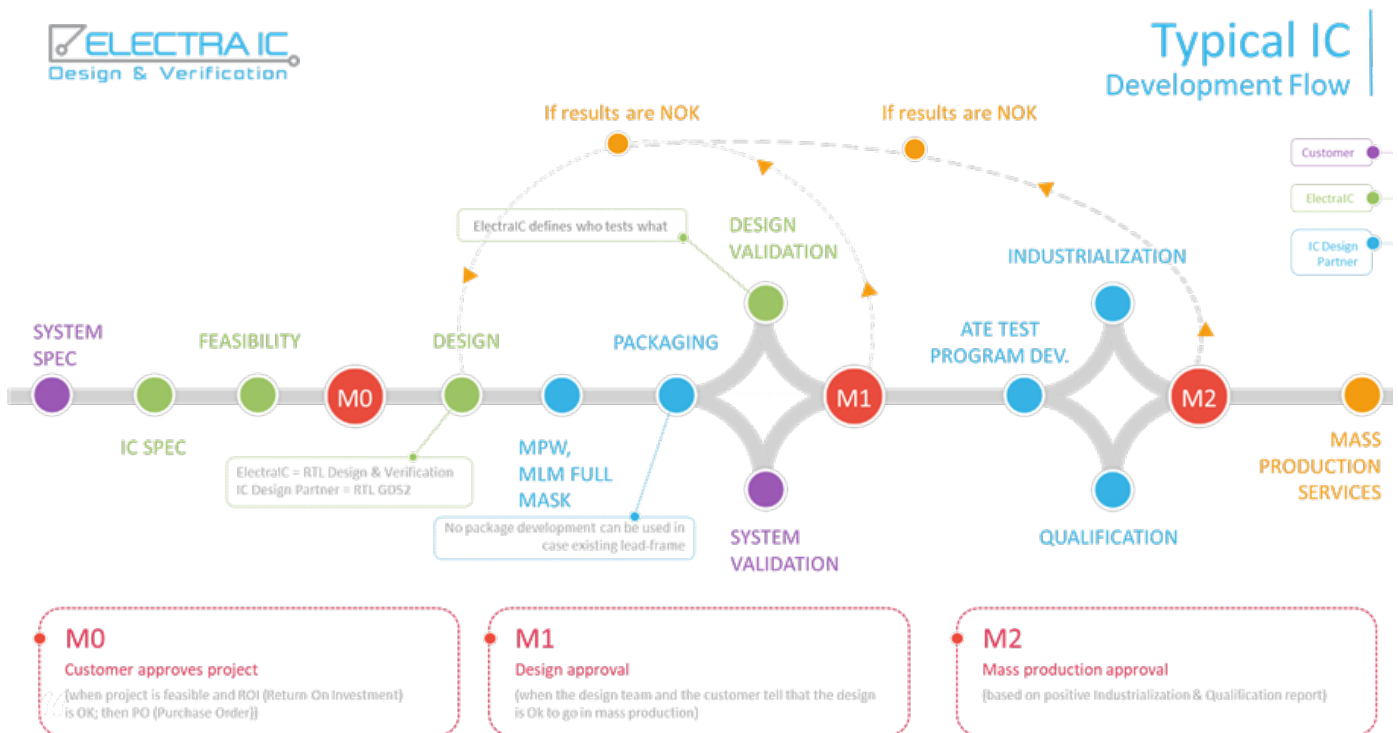
I believe that there needs to be a high-level “Microchip Design Vision” created from the governmental level. This vision needs to be supported and marketed with a well-known project or projects for Türkiye. It will be better if the selected and promoted project is a non-military one. The chip designs in that project can be shared between local chip design houses like Electra IC. The production can be executed out of Türkiye for the initial phase of that “Big Vision”. What is important in the first phase of this vision is to increase the IC Design Capability of Türkiye by creating more IC Design Houses. The more they advance in this

field, the more Türkiye will have high-tech development capability. The more capabilities we have, the more opportunities for Türkiye will pop up. But we need to get up and start walking slowly on a path (Big Vision of Chip Design) in the first place. Then, we will start running. Once there is a well-established chip design capability in Türkiye which is also well-known by other countries in the world, then we can have a production facility in Türkiye as well. I’m a strong believer in “Big Successes will only come out of Big Visions”.

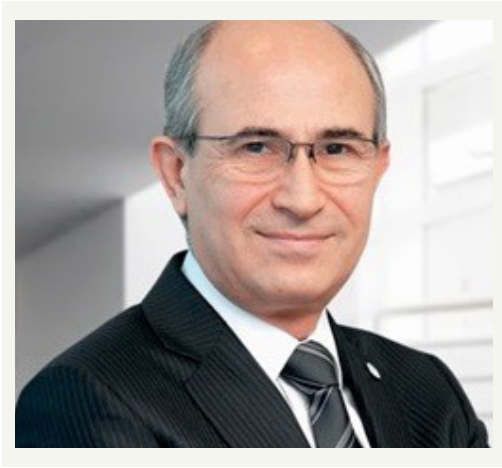
8- What is your capability for testing and/or what are the requirements for lab environment infrastructure to become more competitive in such area?

The below image is a typical IC design flow. Purple dots are where we work with our customers. Green dots are Electra IC’s responsibility and require EDA tool licenses and workstations which are usually very costly. For the blue dots, we need to work with an external company specialized in the related step. As mentioned, Türkiye needs to grow its IC Design capability in the first place before IC Production. And those capabilities are the purple and green dots in the

below image. In that case, computers with well-equipped EDA tools will be enough. For design validation, a company will need a lab as well, but this can be a shared lab that can be used by many companies to reduce the costs of lab equipment. The same sharing method can also be applied for EDA licenses and this will decrease the costs of EDA tools.



OTEP PERSPECTIVE - UNDERSTANDING THE FUTURE OF THE AUTOMOTIVE INDUSTRY



ERNUR MUTLU

PRESIDENT, AUTOMOTIVE TECHNOLOGY PLATFORM (OTEP)

The automotive industry is going through a major change, shortly described in the acronym “CASE,” standing for Connected-Autonomous-Shared-Electrified.

These 4 major topics cover a wide variety of existing and new technologies and business models, which makes the automotive segment a member of a wider new group of segments combined and defined as mobility.

As we all know, the industries involved in this mobility definition have already come a long way regarding some technologies. I will group these technologies into 3 categories.

Firstly, the so-called “Implementation Ready” technologies have already become a part of our daily lives. Various levels of connectivity, level 2 or 3 autonomous vehicles, hybrid and BEV are only a few of them.

Secondly, we also know that some technologies are not yet completely ready for implementation and still need further development as well as improvement of legal, security, and safety. And I am sure that these issues will be sorted out in the upcoming years/decades and these technologies will also become a part of our daily lives.

And thirdly; we do not know what we do not know yet! I personally do expect that there will be new technologies,

which we do not know of today, emerging in the upcoming years, with the pace of innovation we live through.

Implementation of these technologies on automotive products has gained a strong pace, led by the EU, China, and the US. While new product announcements follow one another, declarations are made by governments and authorities almost every day and incentives are given to lead buyers to new products, or measures are announced to stop carbon emissions as early as possible such as banning fossil-fueled vehicles from entering cities or stopping their registrations by certain dates.

Where does Türkiye stand among all those? I would like to review this from two perspectives.

The first is the automotive industry, in other words, vehicles produced in Türkiye. A remarkably high percentage of these vehicles are exported, predominantly to the EU, and this trend is believed to continue in the decades to come. For this, the industry will have to evolve and start producing the vehicles these countries want/plan to have. We have already started hearing examples of that. If/when it becomes a reality, half of the vehicles, if not more, produced in the 2030-2040 period will be electrified and equipped with new tech products. So, the industry has already been on a path to change, inevitably.

Second is the domestic market in Türkiye. While there are efforts to follow what the EU and others are planning to do, we still need to see actual announcements and measures by governments and local authorities for a speedier change. The necessity for high investments and the GNI per capita seems to be barriers for a fast change in front of updating the infrastructure and directing buyers' attention to new tech vehicles; however, there are advantages as well to deploy these changes. Local production of new tech vehicles at an increasing rate and development of fully-electrified home-grown vehicles equipped with the latest technology will provide products for the domestic market attracting the attention of new buyers. While the products will be available, hopefully at reasonable costs, we need to supplement those with widely available charging facilities and supporting infrastructure as well as regulative measures to encourage buyers to buy environment-friendly new products. A healthy and affordable investment plan is required to fulfill these purposes.

Let us briefly concentrate on C: Connectivity.

We are already quite connected as individuals with the internet, 4G-5G wireless communication, and apps that make a lot of things possible for us via our computers, tablets, and smartphones. We cannot do without them nowadays, can we? With these latest technology devices, we can do many activities while sitting at home from banking to shopping.

What about the automotive industry and the greater mobility segment? For safer, more secure, and more comfortable mobility, new technologies have already been or soon to be implemented on our personal and commercial/public vehicles. Vehicles will communicate with other vehicles, the infrastructure, and us via our devices and services to be able to accomplish the actions we want and expect from them. We all want our vehicles to be as smart as our computers and phones.

While there is already a huge list of "implementation ready" technologies that the industry is deploying on the vehicles produced, more investments are inevitable and needed to be carried out in our buildings, streets and cities so that new vehicles and services can offer these great features for a safer, more secure and comfortable life we all are longing for.

A few of them are still under development/deployment worth mentioning are as follows:

We need faster communication networks for speedy data flows, processing, and decision making; we know 4G is not good enough, so we need wider deployment of 5G, and continue to aim for faster speeds.

We need to resolve the pending cyber security issues to be able to process and use data in a more secure way with no hesitation of any kind!

We need to restructure the legal system to get rid of the current issues and questions regarding the ownership of data, privacy, and many others.

It is obvious that we need global implementation and availability of these new technologies through global investments, and we also need to make them work smoothly across borders.

Although there might be too much on our plate, there is nothing to stop us moving forward with the right planning. Let us start enjoying these new technology products along with a safer, more secure and cleaner environment. We do believe that future generations deserve a better world!

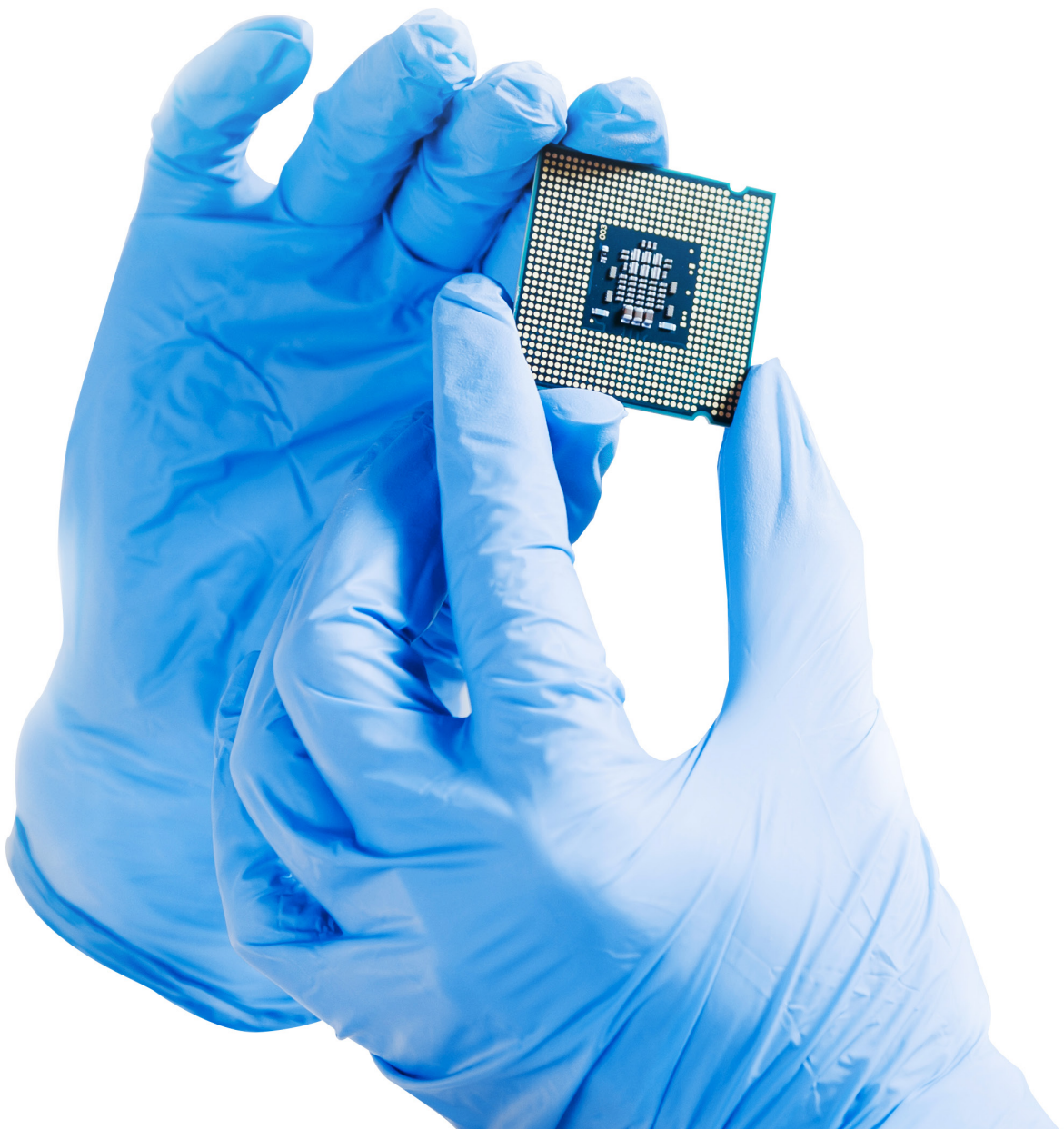


KEY TRENDS

PERSISTENT SEMICONDUCTOR SHORTAGE

The semiconductor shortage continues to affect the profitability of suppliers due to production disruptions impacting global vehicle production in 2021.

Automotive suppliers are gearing up to meet increased demand from the automotive industry by providing dedicated capacity for semiconductor manufacturing, working on longer contracts from the OEMs, and increasing the supply.



A. MAIN FACTORS OF SHORTAGE

The automotive industry is facing a semiconductor shortage due to multiple factors which are listed below.

1. THE AUTOMOTIVE SECTOR HAS LIMITED CONTRIBUTION TO SEMICONDUCTOR MANUFACTURERS' REVENUE

Consumer electronics orders make up a larger and more profitable segment of semiconductor manufacturers' business. The automotive sector contributed only 4% to TSMC, the largest semiconductor manufacturer, revenue in 2020 while smartphones and high-performance computing contributed 82% to the overall revenue.

2. JUST-IN-TIME MANUFACTURING PRINCIPLES

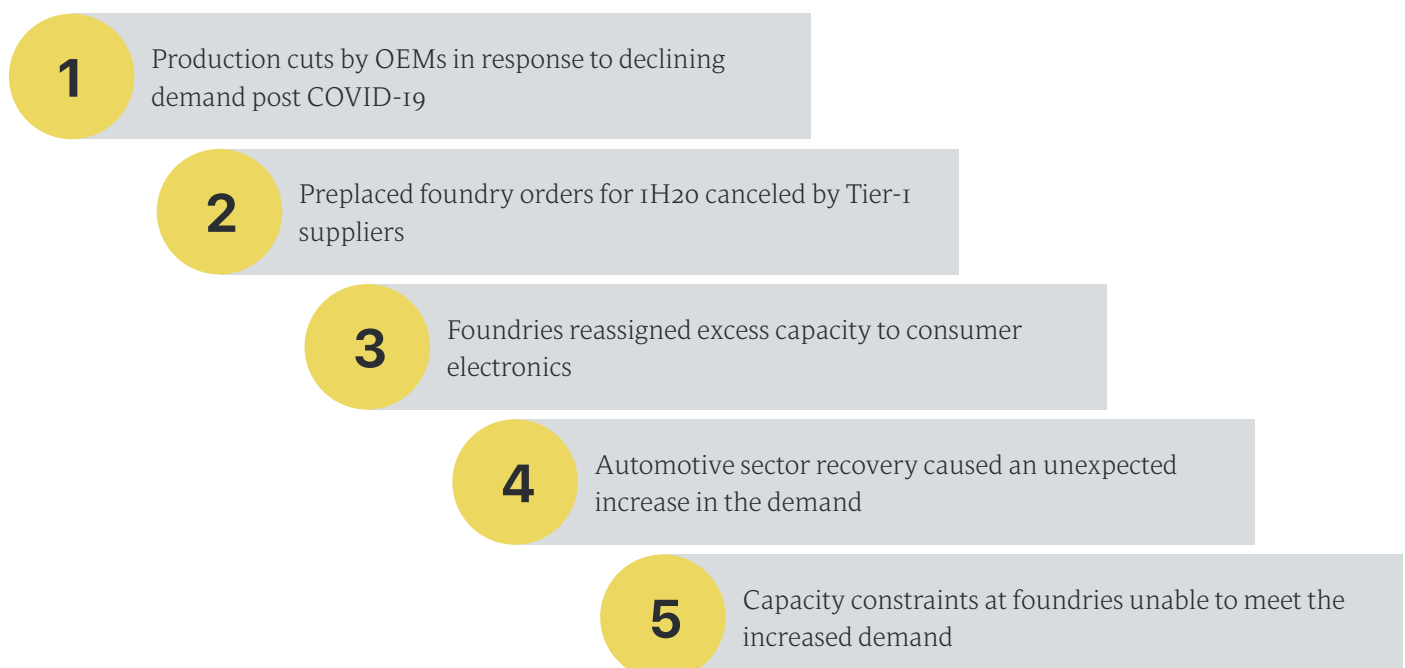
The automotive sector operates on a just-in-time inventory model ignoring the high lead time and resilience required in their semiconductor supply chain. On the other hand, semiconductor manufacturing is a time-consuming process with a lead time of 12-16 weeks. Tier-1 auto component suppliers canceled orders significantly due to a conservative outlook during the pandemic.

3. GEO-POLITICAL ISSUES IMPACTING SEMICONDUCTOR SUPPLY

The increasing geopolitical tension due to US-China trade war adversely impacted the semiconductor supply chain. In 2018, the US imposed export restrictions on China's largest chipmaker, Semiconductor Manufacturing International Corp (SMIC).

4. IMPACT OF COVID 19

COVID-19 triggered a shortage of semiconductors for the automotive industry.



B. IMPACTS OF SEMICONDUCTOR SHORTAGE FOR AUTOMOTIVE INDUSTRY

SHORT TERM

SEMICONDUCTOR SHORTAGE HAS LED TO SUPPLY CHAIN CONSTRAINTS INCLUDING PRODUCTION HALTS

Automakers globally have temporarily halted or slowed down vehicle production in lieu of a semiconductor shortage.

Semiconductor prices increased by 30% in December 2020 from the prior month's levels due to increased demand from the automotive sector.

Automakers look to penalize suppliers for delays in semiconductor supply.

Foundries are prioritizing automotive semiconductors by reallocating wafer capacity.

MEDIUM TERM

VALUE CHAIN PLAYERS ARE UNDERTAKING INITIATIVES TO COMBAT THE SUPPLY-DEMAND IMBALANCE

Foundries are expanding capacity through increased investment in existing or new production facilities to meet the future demand.

Government intervenes for additional foundry support as automakers are lobbying governments to subsidize the construction of more chip-making capacity.

Free trade agreements are being signed to prioritize the future supply.

The nature of contracts between OEMs and suppliers changes for long-term visibility and better capacity planning.

LONG TERM

MAJOR PLAYERS ARE CONSIDERING LOCALIZATION AND ALTERNATE SOURCING OF SEMICONDUCTORS

Semiconductor manufacturing is localizing as countries aim to lower their reliance on foreign providers.

Alternative sourcing for semiconductor requirements is sought as supply-demand imbalance and geopolitical situation cause concerns for major markets.

C. RESPONSE OF STAKEHOLDERS

SEMICONDUCTOR MANUFACTURERS

- TSMC plans to invest USD 100 billion over the next three years to increase capacity at its plants.
- Korean chip maker SK Hynix will invest USD 106 billion over 10 years.
- Samsung will invest USD 116 billion in chip production by 2030.

OEM & SUPPLIERS

- Volkswagen has started to invest in chips for its own cars.
- Bosch, one of the largest sub-industry suppliers of the German automotive industry, established a chip factory in Germany with an investment of € 1 billion.
- Hyundai explores long-term strategies to better diversify its supply chain by collaborating with South Korean chip companies.
- GM looks to sign longer-term supply contracts or partner with chip and wafer suppliers to mitigate the impact of semiconductor shortage in the future.

GOVERNMENTS & PUBLIC ADMINISTRATIONS

- The American Automotive Policy Council, the EU, Germany, and Japan appealed to the Taiwan government for assistance in stabilizing the chip supply in the automotive market
- The US semiconductor industry leaders urged the US and Taiwan to sign a free-trade agreement and enter the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)
- EU has created an Important Project of Common European Interest (IPCEI) which is expected to steer investments into the chip sector.
- European Commission approved €146 million (USD 173.6 million) in Austrian state aid to NXP and Infineon for microelectronics research, expected to unlock €530 million (USD 630.1 million) in private funding.
- The Japanese government announced a joint public-private sector concern to cooperate with TSMC for a semiconductor research project to develop cutting-edge chip technology in the country. Around 20 Japanese companies including Asahi Kasei and Shin-Etsu Chemical will work with TSMC on the project worth USD 337 million.
- The US Government plans to establish a new Supply Chain Disruptions Task Force to address the near-term supply chain challenges.

D. FUTURE ACTIONS



1) DIRECT PURCHASE FROM SEMICONDUCTOR MANUFACTURERS

Automotive OEMs will need to collaborate with foundries to better capacity visibility and avoid such in the future.

Volkswagen is reportedly looking at the direct purchase of certain semiconductor components from manufacturers reducing the role of suppliers.

2) SHIFT FROM JUST-IN-TIME INVENTORY MODEL TO ENABLE INVENTORY CORRECTION

Automotive OEMs will need to shift from just in time inventory model operate with higher inventory levels, at least over the intermediate-term.

Toyota's average quarterly inventory levels over the last five years have been one of the highest in the sector. It has up to a four-month stockpile of chips, expects no immediate impact on production due to semiconductor shortage. Toyota also had its own semiconductor plant until 2019 when it transferred it to Denso.

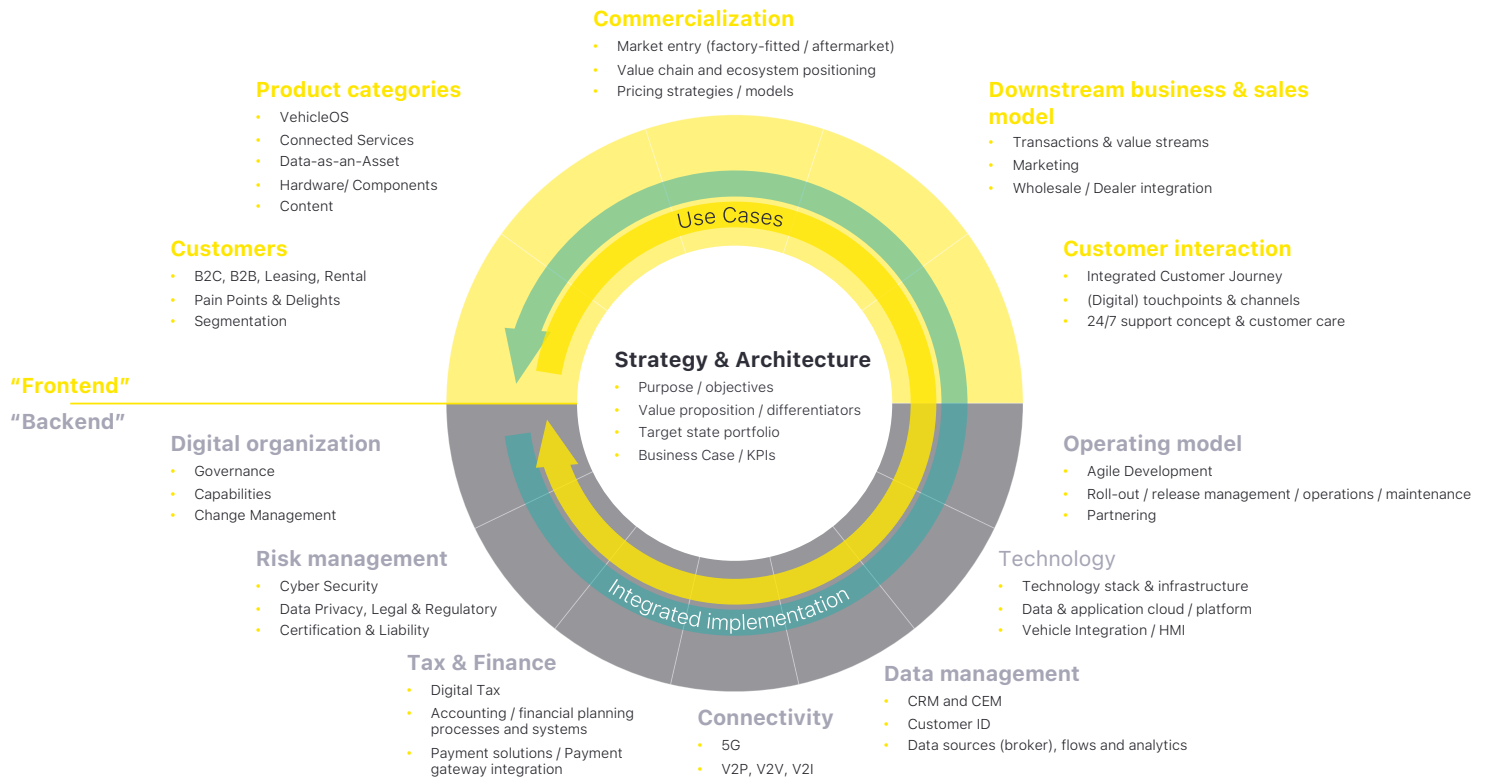
3) DEDICATED FOUNDRY CAPACITY FOR SEMICONDUCTOR MANUFACTURING

Regional foundries will need to be established to reduce dependence on one manufacturer.

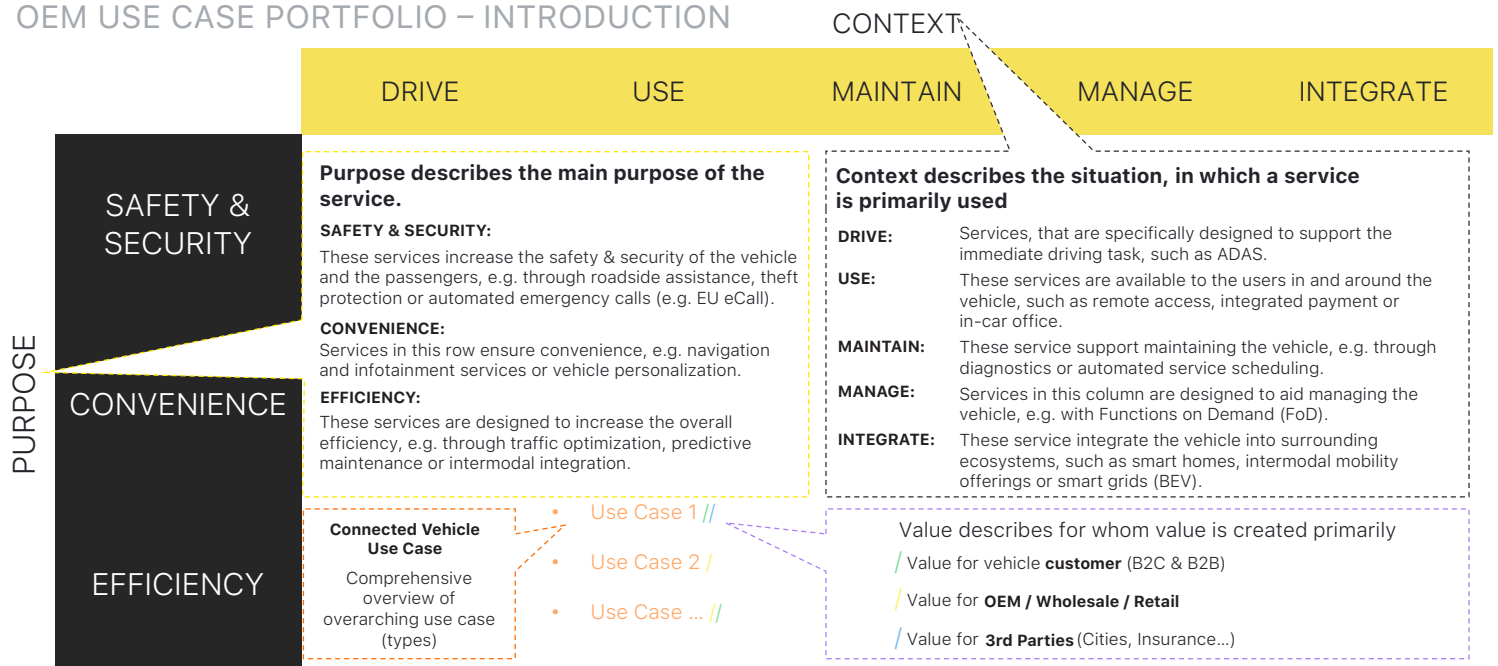
EU is targeting a 20% value share of advanced semiconductor manufacturing by 2030. It is discussing the growing importance of establishing a foundry to decrease dependence on foreign sources of supply.

KEY MOBILITY CONNECTED CAR FRAMEWORK

360° FRAMEWORK FOR CONNECTED CAR TRANSFORMATION



OEM USE CASE PORTFOLIO – INTRODUCTION

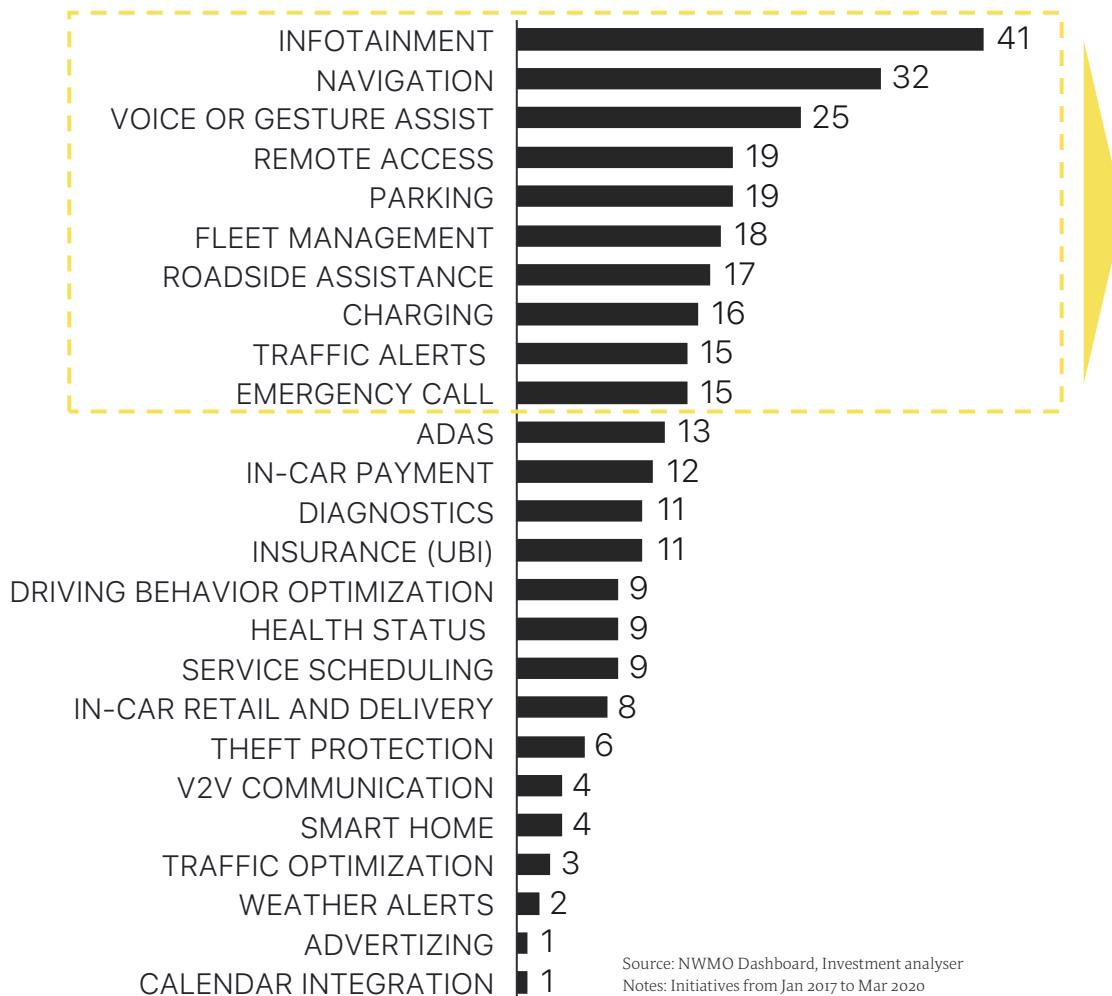


CLUSTERING OF SERVICES ALONG THE DIMENSIONS "CONTEXT" AND "PURPOSE"

		CONTEXT				
		DRIVE	USE	MAINTAIN	MANAGE	INTEGRATE
PURPOSE	SAFETY& SECURITY	<ul style="list-style-type: none"> • ADAS ● • Weather alerts ● • Traffic alerts ● • Safety alerts ● 	<ul style="list-style-type: none"> • (EU) e-call ● • Roadside Assistance ●●● 	<ul style="list-style-type: none"> • Health Status ●● 	<ul style="list-style-type: none"> • Theft protection ● • Biometric services ●● 	<ul style="list-style-type: none"> • City infrastructure ●●
	CONVENIENCE	<ul style="list-style-type: none"> • Navigation, incl. (multimodal) planning ●● • Voice or gesture assist ● 	<ul style="list-style-type: none"> • Infotainment ●● • Remote Access ● • In-car payment ●●● • Location based services ●●● • Keyless entry ● 	<ul style="list-style-type: none"> • Service Scheduling ●●● • Diagnostics ●●● • Vehicle registration & admin ●● 	<ul style="list-style-type: none"> • Vehicle personalization ● • Function-on-Demand ●●● • Vehicle Status ●● • Customer Care (CRM) ●● 	<ul style="list-style-type: none"> • Smart Home ●● • Calendar integration ●●● • Virtual assistant & concierge service ●● • eCommerce Access & Delivery ●●● • Community Access ●●
	EFFICIENCY	<ul style="list-style-type: none"> • Driving behavior optimization ●● • Traffic optimization ●● 	<ul style="list-style-type: none"> • In-Car Office ● • (Advertising) ●● • Charging ●● • Parking ●● 	<ul style="list-style-type: none"> • Predictive Maintenance ●●● • Remote Update (OTA) ●●● 	<ul style="list-style-type: none"> • Insurance (UBI, etc.) ●●● • Smart Contract Mgmt ● • Fleet Management ●● • Residual Value ●● 	<ul style="list-style-type: none"> • Vehicle-to-Grid ●● • Intermodal Mobility Services Integration ●●● • V2X Communication ●●●

● Value for vehicle customer (B2C) & (B2B) ● Value for OEM / Wholesale / Retail ● Value for 3rd parties (Cities, insurance...)

NUMBER OF INITIATIVES BY OEMS BY USE CASES KEY USE CASES AND FINDINGS









KEY USES AND KEY FINDINGS

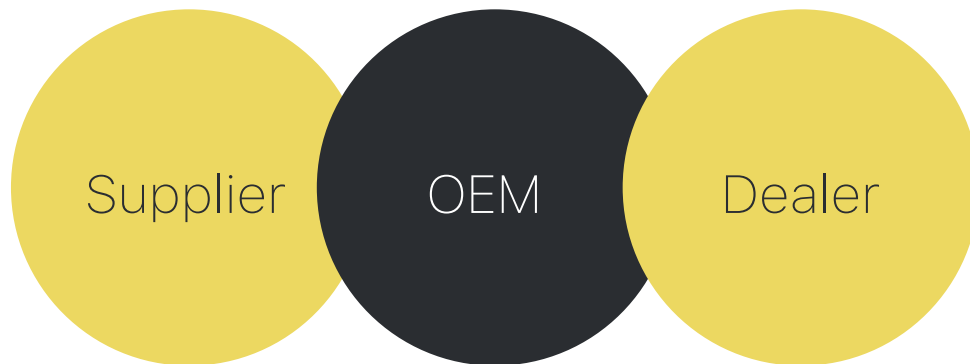
Use cases such as infotainment, navigation and parking are being offered in collaboration with 3rd party players, while others associated with safety and security are being developed in-house.

Infotainment In addition to introducing Android Auto and Apple Car play, OEMs such as Daimler, Tesla, Audi and Ford are developing in-house self-branded offerings	Navigation Partnership with players such as Google, Baidu etc. for in-dash navigation. Investment in start-ups e.g. HERE and TomTom for advanced mapping features
Voice or gesture assist While, Amazon Alexa and Google Assistant have captured voice recognition space, premium OEMs are embedding branding within proprietary tech e.g. "Mercedes me"	Remote access Features such as mobile app enabled remote access to the vehicle to perform tasks such as lock/unlock or turn on the AC are increasingly gaining customer interest. A few in-house offerings – Mercedes me, Audi app, Tesla app
Parking Ranging from parking spot location and navigation to cashless payment and automated valet parking, OEMs are improvising offerings. E.g. BMW ParkNow, VW WePark	Fleet management A few OEMs such as Toyota, FCA and Ford are offering fleet management and telematics to corporate fleet and ride-hailing companies in partnership with technology players
Roadside assistance With safety and security becoming necessary, OEMs are launching enhanced roadside assistance solutions e.g. – GM OnStar, Volvo Action, Audi Connect Care etc.	Charging With rising demand for EVs, OEMs such as GM, VW, Daimler and Tesla have added features and apps such as Health status check and alerts on battery and car, location and in-car payment at charging stations etc.
Traffic Alerts Automakers are including Traffic alert features in their vehicles along with the Navigation systems. Mostly, the feature is being offered through Function-on-demand mode	Emergency call Primarily driven by safety regulations, OEMs have embedded e-call system in vehicles and also tying up with Telecom players to establish reliable connection/network technology.

AUTOMAKERS ARE LOOKING INTO TAPPING THE CONNECTED VEHICLE REVENUE POOL THROUGH CROSS-SECTOR DATA SHARING

Exploring in-car advertising based on user profile and location	Data monetization opportunities with cross-sector data sharing
<p>Connected vehicles offer additional customer touchpoints and potential segmentation and targeting opportunities for digital advertising</p> <p>US\$30 annual revenue per vehicle could be generated by the pop-up car ads, which could be split between partners (Source: Telenav)</p> <p> GM's e-commerce app, an in-vehicle billboard and payment portal for partner companies - receives revenue based on impressions as well as transactions</p> <p> Thinknear by Telenav, a leading location-based mobile marketing company</p>	<p> Driver and vehicle data to motor insurance providers to offer usage-based insurance (UBI) Hyundai partnered Verisk to share customers' driving data in exchange for offering UBI</p> <p> Sharing data with e-commerce providers to roll out in-car deliveries GM rolling out in-car deliveries with Amazon</p> <p> Offering in-vehicle data plans in the form of bundled packages based on customer profile GM offering unlimited-data plans for OnStar, 4.21m GB in-vehicle customer data used in 2018</p> <p> Connected car data in the health domain Audi Fit Driver service connected car and associated wearable device data to monitor driver's wellbeing</p>

CONNECTED MOBILITY ECOSYSTEM PRESENTS A ROBUST WIN-WIN BUSINESS CASE NOT ONLY FOR OEMS BUT ALSO FOR CROSS-SECTOR STAKEHOLDERS...



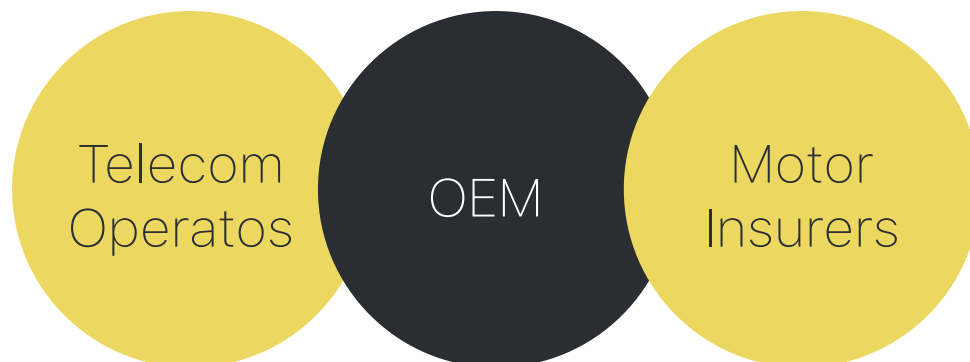
Automotive suppliers have a huge opportunity in connected vehicle technology and solutions development. By 2023 annual V2X hardware revenue could reach up to US\$1.2billion

Delphi, introduced dongle plug into the OBD port, to connect vehicle to the network to share data

HARMAN launched Aftermarket Connected Automotive Platform

For dealers the value of telematics is concentrated in after-sales market. By 2025, cloud CRM will evolve to integrate customer data across multiple retail channels

Tech Mahindra developed 'Aftermarket Connected Car Suite', where dealers can boost customer engagement through online vehicle maintenance calendar and mobile app



Carriers can offer flexible data plans (e.g. shared data plans or split billing services). The monthly revenue from car data plans could lie between US\$1 to US\$2 per vehicle

Carriers can either position as end-to-end customer services provider (e.g. subscription management)

E.g. GM and AT&T share 4G service revenue

Motor insurers can realize improvement in risk selection

by analysing information on individual driving. UBI which holds an opportunity of US\$25 - US\$40 per car per year is in the earliest stages of acceptance.

Verisk Analytics offering telematics data to insurance companies in the US

Octo Telematics analysed about 186b miles of connected car data to predict driver risk

VARIOUS THIRD-PARTY DATA MARKETPLACES ARE COMING UP IN THE CONNECTED MOBILITY SPACE

OEM OWNED MARKETPLACE



BMW's private data marketplace aiming to provide customers with customised third-party services in a transparent and privacy-compliant manner



Effectively crowdsources its data from all of its vehicles as well as their drivers, with internal as well as external sensors and send the data directly to the cloud



Based on BMW ConnectedDrive embedded connectivity platform and designed for customers driving up to 5,000 miles per year



Toyota invested US\$1 billion to develop Toyota Connected, automaker's automotive data-harvesting start-up

MULTI-PARTY DATA MARKETPLACE



Data aggregator approaching OEMs with a ready-made price list for data based on pre-sold use cases. It is backed by many OEMs including **Mercedes-Benz**



Vodafone acquired Cobra, which provides end-to-end services including UBI and vehicle emergency solution



Telogis' Mobile Resource Management platform to help companies make more informed business decisions based on driver & vehicle performance



Brings pop-up ads to infotainment screen - has been testing a "freemium" model borrowed from streaming music services to entice drivers to share their data



Launched Connected Vehicle Marketplace, with cloud-based service, allowing OEMs to share data and applications with third parties. Clients include **Scania**



A trio of strategic agreements with Valens, Rosenberger and Otonomo - introduced dongle plug into OBD port, connected to network to share data.



Hyundai partnered with data analytics company Verisk to share customers' driving data in exchange for offering UBI



Octo Telematics launched Next Generation Platform allowing integration of data to enable third-party services such as UBI, tolling and traffic management

INSURANCE SECTOR



Insurance providers are offering UBI plans based on telematics data. UBI holds an opportunity of US\$25 - US\$40 per car per year.



Reduced premiums for policyholders who are good drivers



To develop insurance plan with autopilot safety features



Offering UBI plans for Toyota Connected



Collaborations among insurance providers and fin-tech companies to strengthen insurance offerings and R&D programs



R&D collaboration for development of customized car telematics solutions



Octo Telematics acquired UBI assets from insurance provider Willis Towers Watson



Partnering with technology start-ups to develop telematics solutions to facilitate new insurance services

CLOUD TECHNOLOGY



For smartphone based cloud technology

TELEMATICS



To launch new telematics program

DRIVER ASSISTANCE



Mobileye's Advanced Collision Avoidance System

FLEET MANAGEMENT



GPS tracking and fleet management solution to boost adoption of UBI in Malaysia

TELECOM SECTOR

Telecom companies are trying to tap the connected vehicle revenue pool through partnerships with automakers / component suppliers. They are also launching their own services either alone or through collaboration with technology players

PARTNERSHIPS WITH AUTOPLAYERS



5G-Based connected car technology



To develop a secure connected vehicle system



Safety and diagnostics features for heavy-duty trucks



To jointly demonstrate 5G-Based remote driving technology



To offer Scania's embedded telematics units with global connectivity



TELCOS OFFERING TELEMATIC SERVICES ON THEIR OWN OR THROUGH ALLIANCES WITH TECH COMPANIES



Connected Vehicle Cloud to connect driver and vehicle and collect vehicle data to innovate and deploy new services.



Fleet telematics service remotely track and monitor vehicles' locations and condition



AT&T

AT&T fleet management solutions



Virtual networking solution that lets cars (and other devices) automatically connect to service providers in whichever country they are

WHILE THERE ALREADY EXIST OFFERINGS AROUND EV CHARGING INFRASTRUCTURE MAPPING, AVAILABILITY AND NAVIGATION

MAPPING SOLUTIONS PROVIDERS



Large mapping solution providers such as HERE Maps and TomTom are aggregating charging station and vehicle data to provide solutions around charging station location search, trip planning, navigation etc.

EV Focused mapping solution providers are tying up with Charging Station Operators (CSOs) to offer direct to customer applications or white-label solutions for OEMs and fleet operators.

EV CHARGING STATION OPERATORS



Many charging station operators are offering mobile apps allowing customers to locate stations, view information on charger type availability, navigate or plan route, monitor charging and in-app payment etc.

Most of these solutions are CSO specific. With increasing peer-to-peer roaming, other CSO data could also be integrated.

DATA AGGREGATORS AND CONNECTED SOLUTION PROVIDERS



Data aggregators (gathering connected vehicle data) and software solution providers are offering solutions and services around data integration, consent management, software integration etc.

Some of the companies such as Telenav and OCTO telematics also offer H/W (OBD) to embed into the vehicle for data capture; while others are following S/W integration approach

CASE STUDIES



GM has 12.7 million OnStar-connected vehicles in North America

In Q1 2018 about 4.2 million GB data used for in-vehicle HD video streaming, music, emails and web surfing

GM, through its Marketplace app, uses location and other vehicle data to help drivers find parking and schedule service appointments at nearby dealerships

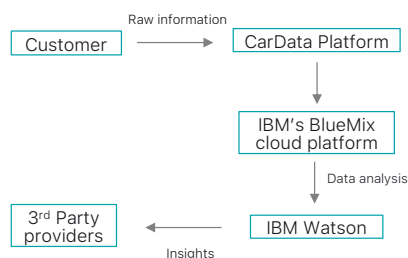
GM, plans to introduce vehicle fuel tank level detection system to offer coupons for nearby gas station

GM using connected car data to drive more informed insurance plans in partnership with Octo Telematics and IBM



BMW CarData providing customers with customised third-party services

In partnership with IBM, BMW has created a private data marketplace called BMW CarData allowing customers to share their cars' data with third parties, such as insurance providers. The data runs through BMW's servers first.

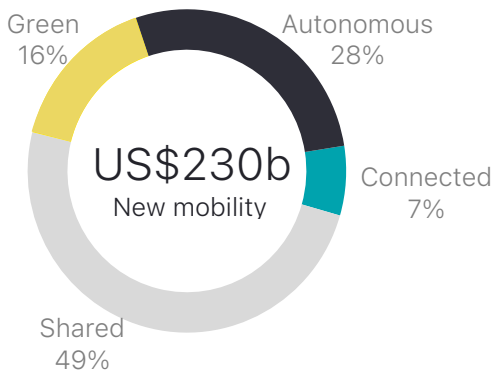


Data platform based on data collected from FordPass

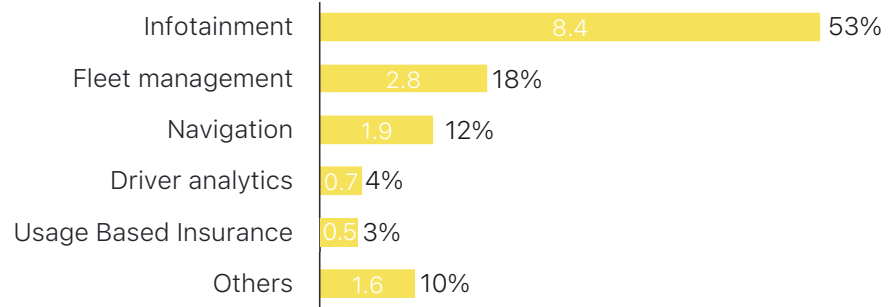
Ford invested in Pivotal, a software company to develop data platform based on FordPass. It is designed to aggregate data from vehicles and makes it available to third-party service providers.

Ford executives estimate that connected car data will add an additional US\$100 in annual revenue for each of their connected cars.

AUTOMAKERS CONTINUE TO STEP UP INVESTMENTS IN CONNECTED MOBILITY, WITH INFOTAINMENT AND FLEET MANAGEMENT GARNERING SIGNIFICANT INTEREST



KEY INVESTMENT AREAS (US\$ BILLION, %SHARE)

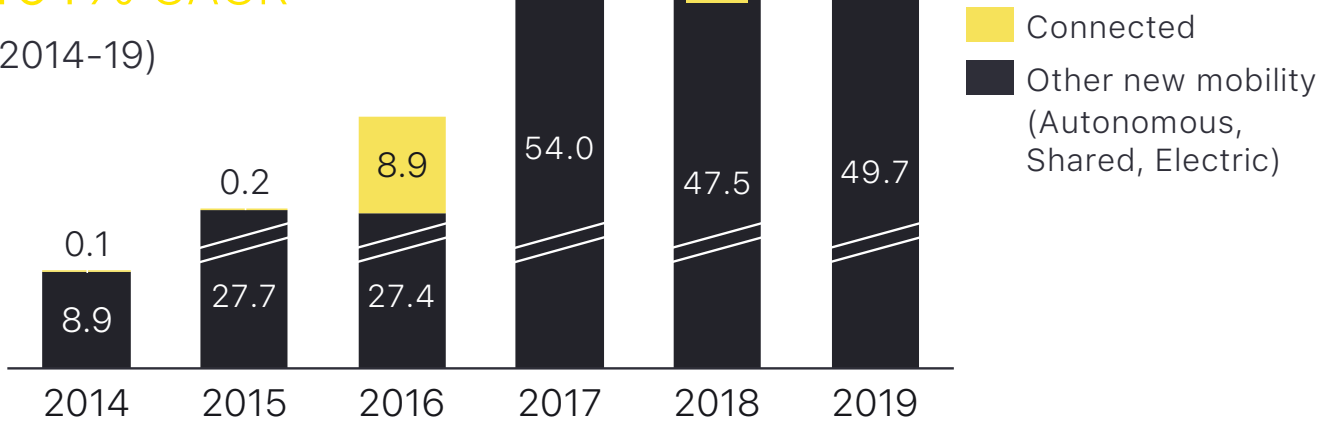


YEARLY INVESTMENT TREND (US\$ BILLION)

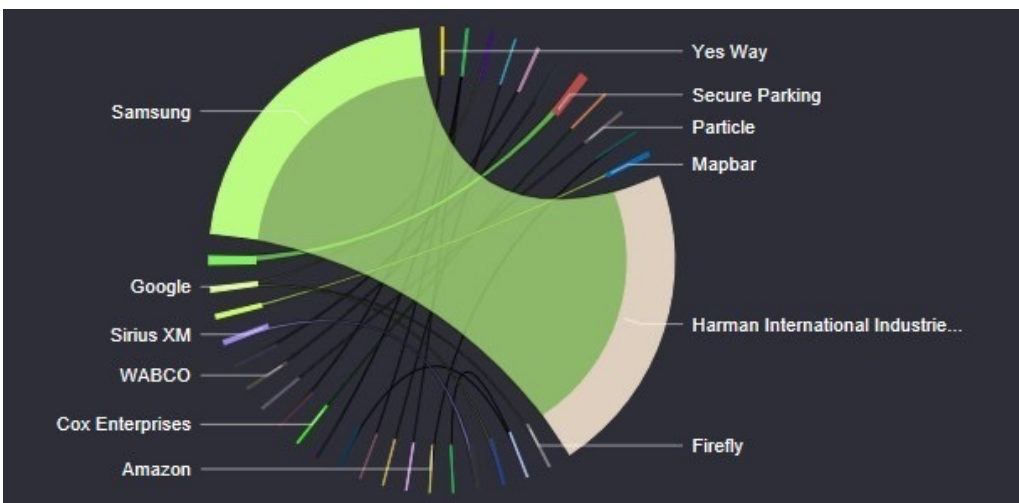
CONNECTED INVESTMENTS GROWING AT

101% CAGR

(2014-19)



US\$8.8B INVESTMENTS BY TECHNOLOGY PLAYERS (2014-19)



GOVERNMENT AND AUTOMAKERS ARE TAKING SMALL STEPS TO SUBSIDE DATA PRIVACY FEARS AND ENSURE CYBERSECURITY, HOWEVER, A LOT REMAINS TO BE DONE

REGULATORS' RECENT INITIATIVES TOWARDS DATA PRIVACY AND CYBERSECURITY HOWEVER, A LOT REMAINS TO BE DONE

National Highway Traffic Safety Administration (NHTSA)

issued proposed federal guidance to the automotive industry for improving motor vehicle cybersecurity

Alliance of Automobile Manufacturers

and Global Automakers have published a set of privacy protection 'principles'

AUTO-ISAC

was established by automakers as a clearinghouse for companies to share information about cyber security threats and countermeasures

General Data Protection Regulation (GDPR)

OEMs can only process customer data post customer's consent. Also, drivers' data has to be transferred across other OEMs, making it easier to change brands

Privacy and Electronic Communications Regulation

The OEMs to be forbidden from selling "connected cars" if the cars do not comply with the EU's data sharing standards (also applicable to V2V and V2I)

Conference of the German Federal and State Data Protection Authorities has adopted "**Data Protection in the Car**" regulation, limiting data processing without the presence of contractual agreement or explicit consent

AUTOMAKERS RAMPING UP CYBERSECURITY RESOURCES

- 1 Cybersecurity-embedded cars 60% of connected cars are expected to have built-in security solutions by 2025
- 2 Certified ethical hackers forming a core part of the connected car security ecosystem teams
- 3 Bug bounty programs offering incentives to ethical hackers detecting issues with Company's systems
- 4 Collaboration with technology players to develop new technology to address cybersecurity threats

THERE IS A GROWING NEED FOR STANDARDIZATION OF CONNECTED MOBILITY TECHNOLOGY TO SCALE UP THE CONNECTED OFFERINGS AND ENABLE CROSS-INDUSTRY COLLABORATION

In 2018, European Commission mandated all cars sold in Europe to be equipped with eCall system based on embedded technology

European Automotive and Telecoms Alliance (EATA) launched its manifesto to accelerate the deployment of Connected and automated mobility (CAM) in Europe including technology standards at the European level

CAR2CAR consortium in cooperation with international standardisation organisations concentrates on creating standards for wireless V2V communication to ensure interoperability of systems

ITU in collaboration with United Nations Economic Commission for Europe (UNECE) developed an international standard for secure over-the-air software updates to connected vehicles

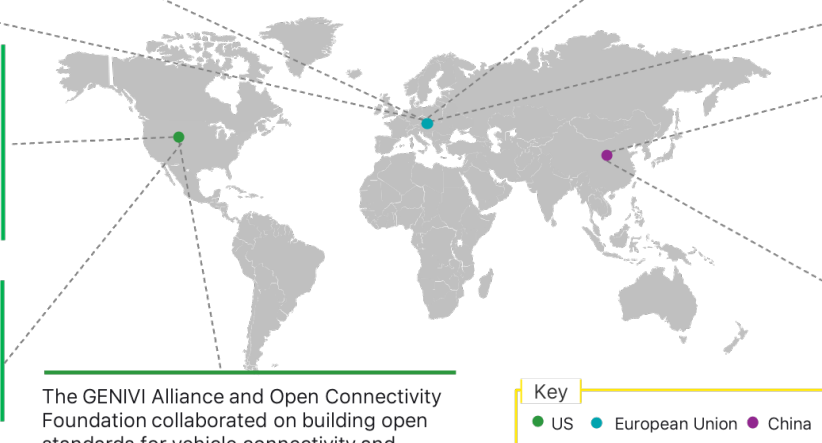
NHTSA proposed to mandate V2V communication on PVs to ensure safety. Initiative requires devices to communicate through standardized messaging. Also working on V2I communication framework

USDOT and ITS Joint Program Office developing a plan to guide Intelligent Transportation Systems standards-related efforts and to support deployment of connected vehicle technologies

The GENIVI Alliance and Open Connectivity Foundation collaborated on building open standards for vehicle connectivity and vehicle data exchange

ERA-GLONASS, an Accident Emergency Response System requires cars to be equipped with emergency response system based on the European eCall standard

The Ministry of Industry and Information Technology (MIIT), China and the Standardization Administration of China jointly issued the National Guidelines for Developing the Standards System of the Telematics Industry



REFERENCES

[1] TRT Haber. 2021. Elektrikli araç şarj istasyonlarının detayları belli oldu. [online] Available at: <<https://www.trthaber.com/haber/ekonomi/elektrikli-arac-sarj-istasyonlarinin-detaylari-belli-oldu-629695.html>> [Accessed 27 December 2021].

[2] Gökkoçun, S., 2021. Bakan Varank: TOGG ile dünya devi FARASİS, 20 GWh'lik pil yatırımına yakın zamanda Gemlik'te başlayacak. [online] Anadolu Agency. Available at: <<https://www.aa.com.tr/tr/ekonomi/bakan-varank-togg-ile-dunya-devi-farasis-20-gwhlik-pil-yatirimina-yakin-zamanda-gemlikte-baslayacak/2410502>> [Accessed 27 December 2021].

[3] Ford Otosan. 2021. Ford Otosan, Türkiye'nin ilk 'Batarya Montaj Fabrikası'nı kurmak için çalışmalara başladı. [online] Available at: <<https://www.fordotosan.com.tr/tr/medya/basin-kitleri/ford-otosan-turkiyenin-ilk-batarya-montaj-fabrikasini-kurmak-icin-calismalara-basladi>> [Accessed 27 December 2021].

[4] Gökkoçun, S., 2021. Bakan Varank: TOGG ile dünya devi FARASİS, 20 GWh'lik pil yatırımına yakın zamanda Gemlik'te başlayacak. [online] Anadolu Agency. Available at: <<https://www.aa.com.tr/tr/ekonomi/bakan-varank-togg-ile-dunya-devi-farasis-20-gwhlik-pil-yatirimina-yakin-zamanda-gemlikte-baslayacak/2410502>> [Accessed 27 December 2021].

[5] TRT Haber. 2021. Elektrikli araç şarj istasyonlarının detayları belli oldu. [online] Available at: <<https://www.trthaber.com/haber/ekonomi/elektrikli-arac-sarj-istasyonlarinin-detaylari-belli-oldu-629695.html>> [Accessed 27 December 2021].

[6] The Society of Motor Manufacturers and Traders (SMMT), 2021. UK Automotive Trade Report 2021. [online] London: The Society of Motor Manufacturers and Traders Limited. Available at: <<https://www.smm.co.uk/wp-content/uploads/sites/2/SMMT-Trade-report-2021.pdf>> [Accessed 27 December 2021].

[7] Milliyet. 2021. eActros'ta Türk Ar-Ge'si. [online] Available at: <<https://www.milliyet.com.tr/ekonomi/eactrosta-turk-ar-gesi-6660162>> [Accessed 27 December 2021].

[8] Hürriyet Daily News. 2021. Renault establishes new firm to enhance investments in Turkey - Latest News. [online] Available at: <<https://www.hurriyetdailynews.com/renault-establishes-new-firm-to-enhance-investments-in-turkey-169818>> [Accessed 27 December 2021].

INVEST IN  TÜRKİYE

TÜRKİYE YOUR
RESILIENT
PARTNER

