Agora Verkehrswende

Advantage for pioneers

How market developments and electrification strategies affect car manufacturers' profit prospects

STUDY

Imprint

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Preface

Dear Readers,

Words and deeds tend to diverge when it comes to climate protection. Although the international community agreed at the Earth Summit in Rio de Janeiro three decades ago to prevent „dangerous anthropogenic interference with the climate system" and this goal was made more specific at the UN Climate Summit in Paris in 2015, global emissions of climate-damaging carbon dioxide are rising, all but unaffected by the agreements under international law. This trend was only briefly interrupted because the coronavirus pandemic put the brakes on trade and production.

In Germany, too, progress on climate protection is barely visible. The climate protection targets for 2022 were exceeded by about 10 million tonnes across all sectors, mainly due to special effects resulting from Russia's invasion of Ukraine and the ensuing energy crisis. This led to reduced emissions especially in the industrial sector. In the transport sector, emissions increased for the second year in a row by about 1.7 million tonnes to approximately 148 million tonnes of CO_2. This means that the climate protection target for the transport sector for 2022 was missed by about 9 million tonnes of CO_2.

Particularly in the transport sector, there are, among other things, technical possibilities to reduce emissions quickly and significantly: battery electric vehicles (BEVs) are powered by electricity from renewable energy sources wherever possible. Millions of cars worldwide are already electric, so there is no need to reinvent the wheel. The governments of many countries have decided that conventional combustion engine vehicles will no longer be allowed to be newly registered in a few years. As things stand, the future of road transport is largely electric.

Nevertheless, the transformation to climate-neutral mobility remains a task and a challenge. First of all for the automotive industry, which is already facing new competitors and material bottlenecks, high energy prices, rapid digitalisation, rising interest rates and geopolitical uncertainties. But the situation is also challenging politically especially in Germany, where car manufacturing is of such great importance for overall economic development. The comparative novelty of BEVs therefore gives rise to some concerns: will hundreds of thousands of jobs be lost? And can Germany maintain its leading position in car manufacturing?

Together with the Boston Consulting Group (BCG), Agora Verkehrswende already addressed the first question in 2021. The result: although the number of jobs in the automotive world of work is hardly shrinking, the nature of employment is changing fundamentally, which is why politics is called upon to shape and support the change in a socially acceptable way.

The focus of this study is the financial impact the switch to electromobility will have on car manufacturers. The answer depends on how the political framework conditions develop and on what speed of electrification the car manufacturers decide on. The bottom line, however, is that our analyses suggest that they need not fear a drop in profits – not even if the structural change is accelerated. On the contrary: if they are quick and if politicians support them, they can even realise an increase in profits, in addition to the social benefit of climate protection.

All this may come as a surprise to some. This makes it all the more important to make the derivation of the results transparent and to peek into the analysts' engine room. That is at the core of this study.

We wish you a stimulating read.

Christian Hochfeld
Executive Director of Agora Verkehrswende
on behalf of the Agora Verkehrswende Team
Berlin, July 2023

Results and recommendations

1 **From combustion engine to electromobility: the automotive industry is facing a fundamental transformation.** The only question is how fast the structural change will be. In 2040, according to the vehicle manufacturers' current market forecast, around three-quarters of all newly sold passenger cars worldwide will be equipped with battery electric drive. In 2021, the figure was not even 7 percent, with around 4.7 million electric vehicles. This technological change in drive systems, which will vary from region to region, is part of a comprehensive structural change in the automotive industry that poses major challenges for manufacturers. Politics is helping to shape the pace of change and can support car manufacturers in a successful transformation.

2 **Even with today's market forecasts and under the current framework conditions, vehicle manufacturers cannot significantly increase their profits by 2040 unless they focus on transformation to electromobility today.** European premium manufacturers can increase their profits this way by about 15 percent, and volume manufacturers by about 5 percent. If they do not succeed in converting to electromobility by 2030, they will have to reckon with losses of around 10 percent compared to the current market forecasts.

3 **If the worldwide ramp-up of electromobility is accelerated by political decisions, car manufacturers can significantly increase their profits. European premium manufacturers particularly stand to gain.** They can increase their profits by around 30 percent by 2040 compared to the current forecast for the base scenario. If, on the other hand, the already agreed targets for the ramp-up of electromobility are missed, losses would occur for most manufacturers. Only Asian manufacturers, who are still at the beginning of the transformation path, will then have the chance to increase their profits by about 5 percent.

4 **A slow market ramp-up of electromobility will cause losses for European premium manufacturers - regardless of the strategy they have pursued so far.** European premium manufacturers must expect losses of about 10 percent compared to the current market forecast in the event of a slow ramp-up of electromobility. European and US volume manufacturers also have to expect losses, as do traditional Chinese manufacturers. Asian volume manufacturers can slightly increase their profits in this scenario if they now focus more on the production of BEVs.

5 **Ambitious policies set the framework conditions in such a way that the challenges of the transformation pay off for the automotive industry in the long term through higher profit expectations and greater competitiveness.** For climate protection and also for the economic success of the automotive industry, it is of enormous importance that the politically set electrification targets are achieved. Currently, the production costs of electric vehicles are relatively high, and supply bottlenecks in particular have made BEVs more expensive. It is therefore all the more important to base the taxes and levies on vehicles and fuels on CO_2 emissions - so that climate-friendly mobility is worthwhile for end customers.

Content

List of abbreviations

BEV	Battery electric vehicle
Destatis	Statistisches Bundesamt (German Federal Statistical Office)
EU	European Union
FCEV	Fuel cell electric vehicle
HEV	Hybrid electric vehicle
ICEV	Internal combustion engine vehicle
ICCT	International Council on Clean Transportation
IEA	International Energy Agency
KfW	Kreditanstalt für Wiederaufbau (Credit Institute for Reconstruction)
PHEV	Plug-in hybrid electric vehicle
UN	United Nations
US	United States of America

1 | Climate protection: almost always a gain

Pressure to act on climate protection is growing. With the Paris Climate Agreement, the international community agreed back in 2015 to limit global warming to well below 2 degrees Celsius, if possible to 1.5 degrees Celsius, compared to the pre-industrial era – but global CO_2 emissions continue to rise steadily. The fact that global average per capita emissions remain close to the 2009 level[1] is not enough to confront the climate crisis – they must fall significantly in absolute terms. In a few decades, according to the Paris Agreement, there must be a „balance between anthropogenic emissions of greenhouse gases by sources and removals of such gases by sinks" in order to keeping the world habitable.

Politicians have already set ambitious targets: in total, more than 40 countries want to achieve climate neutrality[2] by 2050 – these countries are responsible for around three-quarters of global CO_2 emissions.[3] Many of the largest industrialised countries and regions – the European Union (EU), China, the US, Japan and South Korea – have also set climate neutrality targets, planning to achieve net zero emissions by 2060 at the latest. With the Climate Protection Act amended in the summer of 2021, Germany has committed to being climate neutral as early as 2045.

The pressure to act is particularly great in the transport sector. Emissions have been increasing there for years. After a brief decline in the wake of the coronavirus pandemic, this ominous trend has continued. Worldwide, the transport sector is responsible for more than a fifth of energy-related CO_2 emissions.[4] Success must now be achieved quickly. This requires the electrification of the vehicle fleet – hand in hand with the rapid expansion of renewable power generation. According to the International Energy Agency (IEA), no new combustion vehicles may be registered worldwide after 2035 at the latest if the Paris Climate Agreement is to be adhered to.[5] Accordingly, the EU is discussing phasing out the internal combustion engine vehicles (ICEVs) by 2035. Although the German government is not yet planning to follow suit, the governing parties have set themselves the goal in their coalition agreement of having at least 15 million fully electrified passenger cars registered by 2030.

These political goals must now be buttressed by adequate measures. What happens in Germany is of particular importance: new registrations in the country account for 25 percent of all European new registrations.[6] If Germany fails to meet its targets, it is highly likely that the EU targets will not be met either.

However, the political will has so far been lacking.[7] Although the purchase of electric vehicles has been promoted, the subsidies are now being phased out and fossil mobility still does not get charged with the external cost caused. Vehicle and company car taxation, for example, are still not aligned with the requirements of climate protection. Even car manufacturers are showing a willingness to fully electrify their products. Mercedes-Benz, for example, wants to fully electrify its vehicle portfolio by 2030, „wherever market conditions permit".[8]

So why are policymakers hesitant? There are two essential reasons. First, electrification will lead to job losses for the German automotive industry. Second, it will cause financial losses for manufacturers and suppliers.

In 2021, Agora Verkehrswende, together with the Boston Consulting Group (BCG), published research results on the employment effects of the change in drive systems.[9] The current study focuses on the financial effects the switch to electromobility will have on car manufacturers.

To anticipate our conclusion: the fear of profit losses is largely unfounded. On the contrary: manufacturers who completely electrify their vehicle range at an early stage can expect growing profits – especially if politics accelerates the transformation, which is inevitable anyway. Nearly 80 percent of Germany's current exports of diesel and petrol cars go to countries where, as things stand, no new ICEVs will be registered after 2040 at the latest.[10]

1 European Commission (2022), p. 9
2 For the different definitions of "climate neutrality" see dena (2020)
3 IEA (2021)
4 IEA (2022a) and IEA (2022b)
5 IEA (2021), p. 138
6 ICCT (2021)
7 Agora Verkehrswende (2022a)
8 Mercedes-Benz (2021)
9 Agora Verkehrswende (2021a)
10 Agora Verkehrswende (2022b)

Manufacturers who cannot offer well-developed electric vehicles will then be among the losers – even if they are still earning good money today.

There is no disputing that the sales markets for combustion engines are shrinking, while those for electric vehicles are growing. Those who recognise this sign of the times are on the winning side, be they manufacturers or political decision-makers.

2 | What influences the business outlook

The objective of the present study is to gauge the cumulative profits of car manufacturers until 2040 depending on the electrification strategy they choose to pursue. For this purpose, similar manufacturers are grouped into six categories („archetypes"). Profit projection is based on three scenarios for the development of the passenger car market. These describe how the market shares of the drive technologies develop in different regions of the world. Profit calculation is based on assumptions for the development of vehicle prices, vehicle sales and production costs until 2040. Finally, the electrification strategies that car manufacturers can choose from are described. This way, a matrix can be developed that provides information on plausible profitability in the different scenarios.

2.1 Archetypes of car manufacturers

The world's car manufacturers are categorised into six groups for the analysis (Figure 1). Manufacturers are assigned to one category when similar effects of the scenarios and electrification strategies on their profits are to be expected. This can be assumed if they are similar in these five aspects:

- the price segment they cover with their vehicles
- their global sales volume
- their biggest markets
- the vehicle classes they primarily offer
- their current electrification strategy

European premium manufacturers – such as Audi, BMW or Mercedes – already have a comparatively high share of BEVs in their passenger car sales, averaging 9 percent, and at 60 percent they also have the highest electrification target for 2030. European volume manufacturers, such as Volkswagen, Skoda or Peugeot, are similarly advanced. They started in 2022 with an 8 percent share of BEVs, which they plan to increase to 50 percent by 2030.

The share of BEV sales of US volume manufacturers, such as Ford or General Motors, is currently significantly lower than that of their European competitors – it is less than 3 percent. Accordingly, their electrification target for 2030 is lower on average: they are aiming for a share of 40 percent. Asian volume manufacturers that already focus on electromobility, for example Hyundai or Nissan, are in the middle of the pack with a share of BEVs of around 5 percent. However, they have set comparatively low – 35 percent - electrification targets for their sales in 2030. At 1 percent, Asian volume manufacturers without a focus on e-mobility, such as Mazda or Toyota, have the lowest share of BEVs and therefore the lowest targets. They want to achieve a BEV share of around 20 percent in 2030. Traditional Chinese car manufacturers, for example Geely or Changan, today claim just as high share of BEVs in their sales as European premium manufacturers. Their electrification target, however, is much lower, at around 40 percent. Figure 2 shows how the vehicle classes are differentiated in the context of this study.

The six archetypes of analysed manufacturers

Figure 1

Manufacturer archetypes	Price segment	Respective volume [1,2]	Primary vehicle classes [1]	Primary sales markets	BEV starting point
European premium manufacturer	€ € €	~ 2 million vehicles (~ 2.5% market share)	C, D, E	Europe, China	9% → 60%
European volume manufacturer	€ €	~ 4 million vehicles (~ 5% market share)	B, C, D	Europe, China	8% → 50%
US volume manufacturer	€ €	~ 4 million vehicles (~ 5% market share)	B, C, D	North America	3% → 40%
Asian volume manufacturer **with** BEV focus	€	~ 3.5 million vehicles (~ 4.5% market share)	B, C, D	North America, Europe	5% → 35%
Asian volume manufacturer **without** BEV focus	€	~ 7 million vehicles (~ 9% market share)	B, C, D	North America, China	1% → 20%
Traditional Chinese manufacturer	€	~ 1 million vehicles (~ 1% market share)	C, D	China	9% → 40%

2022 2030

1. Vehicles sold in 2022; 2. Volume per archetypical manufacturers

€ Low price segment €€ Mid-price segment €€€ Premium price segment

BEV ICEV and PHEV

Agora Verkehrswende (2023) | Source: IHS production data for 2022

Overview of different vehicle classes as part of the market model

Figure 2

Vehicle class	Example	Price level [1]	Market share [2]
A	Peugeot 107, Citroën C1, Toyota Aygo X, etc.	~ 13 k € – ~ 16 k €	8%
B	Volkswagen Polo, Suzuki Swift, Kia Soul, etc.	~ 17 k € – ~ 20 k €	19%
C	Audi A3, BMW X1, Hyundai i30, etc.	~ 24 k € – ~ 35 k €	34%
D	Ford S-Max, Mercedes C-Klasse, Škoda Superb, etc.	~ 37 k € – ~ 46 k €	28%
E	BMW X5, Audi A6, Volvo V90, etc.	~ 60 k € – ~ 70 k €	10%
F	Bentley Continental, Ferrari 458, Rolls-Royce Phantom, etc.	~ 150 k € – ~ 250 k €	< 0,5%

1. Average price level (base model) in Germany (as of 09/2022), 2. Global market share of vehicles produced in 2022

Agora Verkehrswende (2023) | Source: IHS production data for 2022, BCG

2.2 Vehicle sales

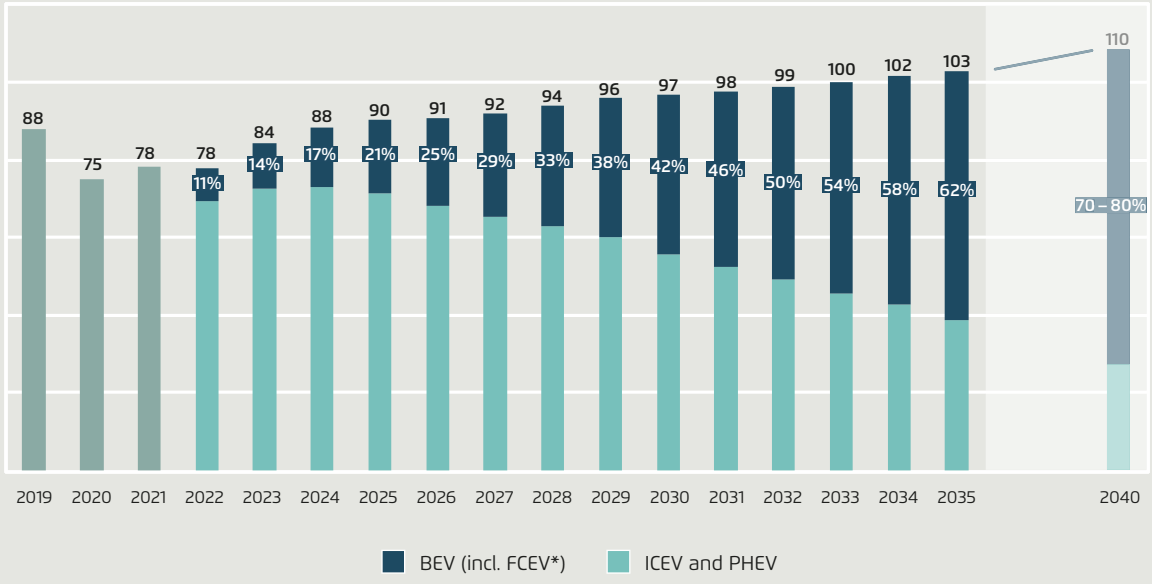
The manufacturers' turnover depends on the realised sales prices and the number of vehicles they sell. To determine this figure, global sales of passenger cars are first forecast, then the shares of the six manufacturer archetypes are determined – depending on their electrification strategy (Chapter 2.5). In order to model the sales of electric vehicles by 2040, three scenarios are used: a base scenario according to the manufacturers' forecasts and one scenario each for a slowed-down and an accelerated electrification. Global passenger car sales are differentiated according to key sales markets: Africa, Europe, China, Japan/Korea, Middle East, North America, South America, South Asia.

The annual volume of passenger cars sold worldwide is identical in the three scenarios. The number of passenger cars sold worldwide is not expected to return to pre-coronavirus levels until 2024, when it is projected to reach 88.3 million, after which date it will rise slightly by 1.4 percent annually until 2040 (Figure 3). However, this global trend masks opposing developments: while in some regions, Europe or North America, the markets are already largely saturated, in other regions passenger car sales will still grow significantly (Figure 4). For example, the number of passenger cars sold in South Asia will double from 9 million in 2022 to 22 million in 2040, while in Europe, passenger car sales will increase by only 4 million in the same period.

The question is how passenger car sales will be divided among the various drive technologies. The market forecasts of the manufacturers and the currently adopted electrification targets of politicians serve as the basic scenario. Data from IHS Markit and the Boston Consulting Group's own research are used for this. In the baseline scenario, the share of BEVs in new registrations worldwide grows to around 70 to 80 percent by 2040. Developments in the world's largest sales markets – North America, Europe and China – play the most important role: here, BEV shares of between 70 and 95 percent can be assumed in 2040.

Forecast of global passenger car sales sold by 2030 in millions, differentiated by drive type

Figure 3

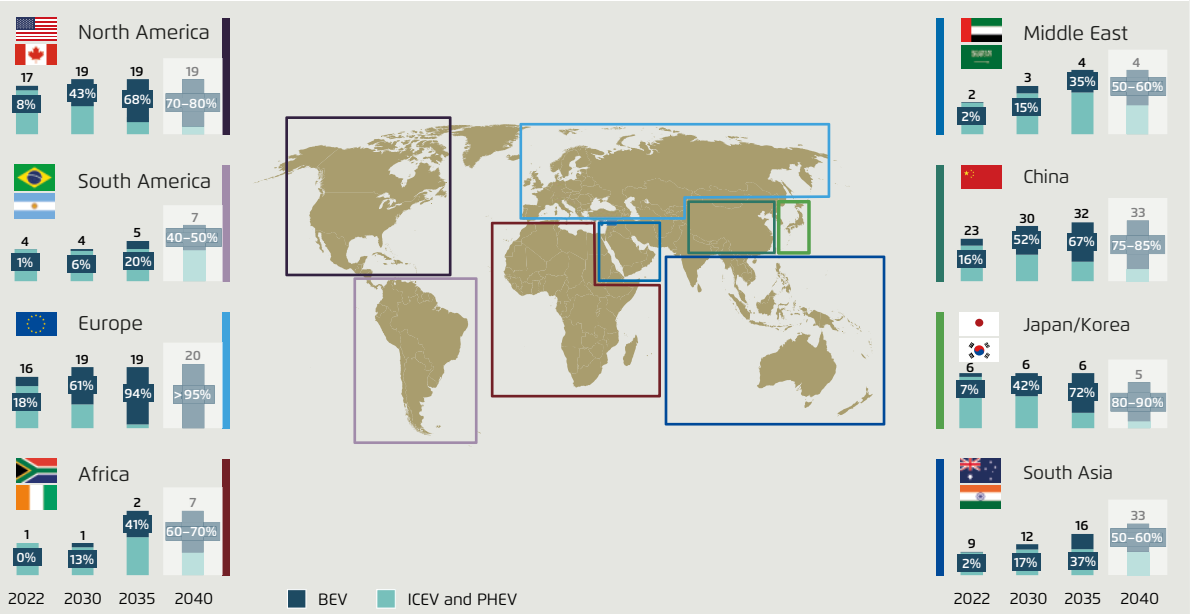


* < 1% FCEV share by 2040 and thus only marginal effect on market model

Agora Verkehrswende (2023) | Source: BCG

Forecast of passenger car sales in various world regions until 2040, differentiated by drive type

Figure 4



Agora Verkehrswende (2023) | Data: detailed forecast until 2035. Source: BCG

For the accelerated and decelerated scenarios, first the factors that significantly influence the ramp-up of electromobility are identified (Figure 5). The legal framework in the respective regions is particularly relevant. For example, it is important whether combustion vehicles may no longer be newly registered from a certain point in time or whether registration taxes for combustion vehicles are levied or increased. Also decisive for the demand for electric vehicles is whether subsidies are granted for their purchase and how the expansion of the charging infrastructure is progressing in the various sales markets. Furthermore, the availability of raw materials is also important. Only if raw materials, such as rare earths for battery production, are available in adequate quantity can the demand for electric vehicles be met. Finally, the level of energy prices is relevant for the demand for electric vehicles: the cheaper charging electricity is compared to fossil fuel, the greater the effect on the demand for electric vehicles.

The question is how likely a positive or negative manifestation of these factors is in the regions under consideration. For example, can it be presumed that the expansion of the charging infrastructure in Europe will progress faster than planned? Or that raw materials will be scarcer for US car producers than assumed in the baseline scenario? In the accelerated scenario, the effects of all positive developments that are sufficiently probable on the sales of BEVs are estimated; in the decelerated scenario, the effects of the negative developments are estimated. This is based on interviews with experts. In the accelerated scenario, the share of BEVs in global passenger car sales can be increased by 15 million in 2040; in the decelerated scenario, only 10 million fewer electric cars can be assumed (Figure 6). However, different market developments can be expected for Europe, China and North America in the different scenarios (Figure 7).

2.2.1 Europe

European sales of BEVs differ only minimally between the various scenarios and, with a share of 95 to 100 percent of new registrations, are very high compared to all other regions. The basis for the high BEV sales is primarily the ambitious political goals that the EU is currently discussing with regard to electromobility: from 2035

The three market scenarios used in the analysis — Figure 5

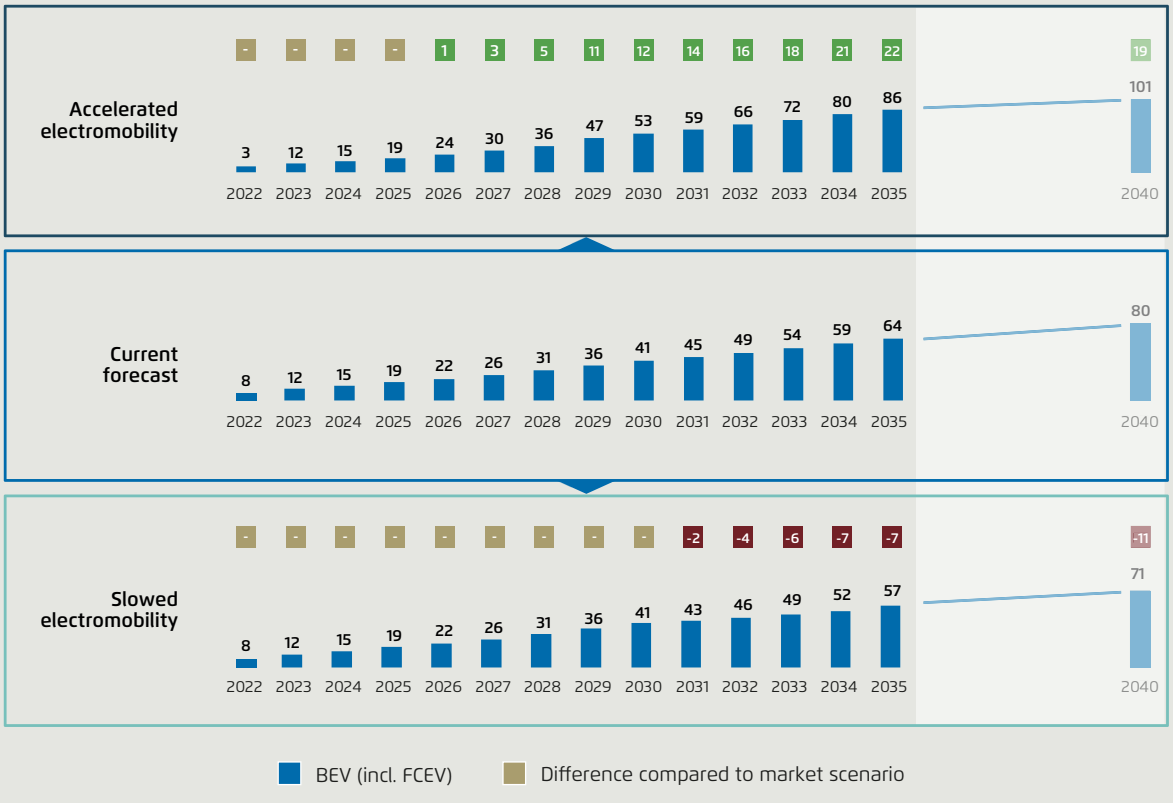
Slowed electromobility	Electromobility ramp-up slower than forecast
Baseline scenario: **current forecast**	Electromobility ramp-up as forecast
Accelerated electromobility	Electromobility ramp-up faster than forecast

External factors that can slow down or accelerate the ramp-up of electromobility

- § Legislation
- Subsidies
- Charging infrastructure
- Energy prices
- Raw material availability

Agora Verkehrswende (2023)

Forecast of BEV sales in millions, depending on market scenario — Figure 6



Agora Verkehrswende (2023) | Source: IHS production data for 2022, BCG

onwards, no new ICEVs are to be registered in the EU. The already relatively high share of BEVs offers a good basis for achieving the ambitious goals. In addition, the purchase of electric vehicles is subsidised in many European countries, which also speaks in favour of a rapid BEV ramp-up by 2040. If, however, the expansion of the charging infrastructure cannot be realised as planned, electricity prices remain at a high level and a sufficient supply of raw materials is not ensured, European BEV sales will be lower. However, according to the experts surveyed, the share of BEVs in new registrations will fall by only 3 percentage points. According to them, faster market ramp-up of electromobility in Europe can be expected especially if electricity prices fall. In this case, some EU member states could significantly accelerate the BEV market ramp-up from 2030 onwards.

2.2.2 China

The Chinese passenger car market is also expected to witness a significant increase in BEV sales by 2040. However, there is a big difference between the baseline scenario and the accelerated scenario compared to Europe: although China has not yet officially decided to phase out the combustion engine, the country's president has announced that China is to become climate neutral by 2060. To achieve this goal, a large part of the car fleet would have to be electrified. As things stand, it seems plausible that Chinese policy makers could also phase out ICEVs in the very short term. If it is possible to synchronise the expansion of the charging infrastructure with a short-term phase-out of the internal combustion engine, the complete electrification of new car registrations in China could be realised by 2040. However, even without an official ban on ICEVs, a high BEV share of 80 percent would probably be achieved by 2040. The main reasons for this are the comparatively high subsidies for electric vehicles and the rapid expansion of charging infrastructure. A somewhat slower ramp-up of electromobility could occur if energy prices remain high and access to certain raw materials required for car production cannot be secured. For example, China imports large quantities of cobalt, lithium and nickel from Australia, Canada, Chile and the Democratic Republic of Congo for the production of batteries for electric vehicles. In addition, there is a dependence on the US for certain speciality chemicals and advanced materials, such as electrolyte salts, used in the production of electric vehicles. Supply shortfalls and possibly even supply restrictions are potential risks here, leading to a less optimistic forecast in the slowdown scenario. However, the BEV share would then still be around 70 percent in 2040.

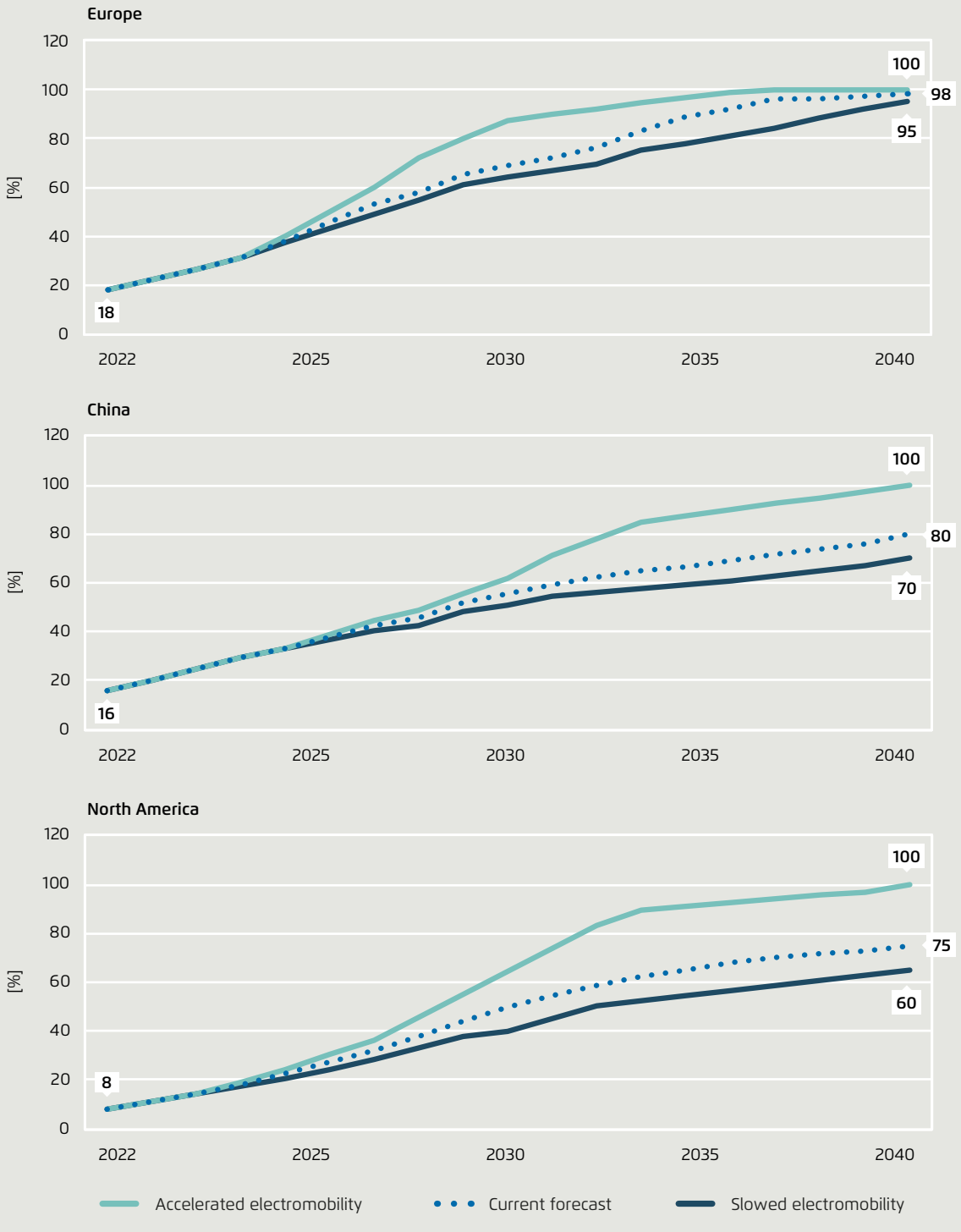
2.2.3 North America

In North America, the share of BEVs in new registrations will grow significantly by 2040, from 8 percent today to 75 percent in the baseline scenario. The reason for this growth is that many states are planning to stop allowing new ICEVs in the near future. It is possible that more states will join them, so that a BEV share of 100 percent could even be reached by 2040. However, for the phasing out of the internal combustion engine to work, sufficient charging infrastructure is needed. Currently, there are only about 6,500 public fast-charging stations[11] in the US; by 2030, about half a million are to be built.[12] If this goal is not achieved, it would have negative consequences for the share of BEVs in North America. If high energy prices and shortages of important raw materials continue, the ramp-up of electromobility will slow down and a BEV share of only 65 percent could be reached by 2040. The US is particularly dependent on China, Japan and South Korea for the procurement of batteries and battery components for electric vehicles. This dependence plays an important role in the production of electric vehicles in the United States.

11 US Department of Energy (2023)
12 Germany Trade & Invest (2022)

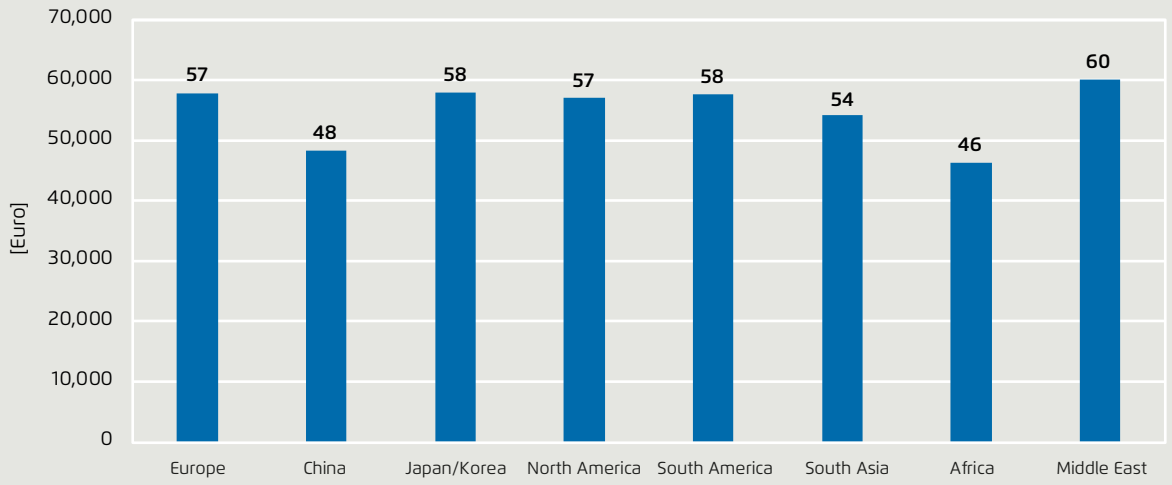
Projected BEV share of new registrations in Europe, China, North America until 2040, depending on market scenario

Figure 7



Agora Verkehrswende (2023) | Source: BCG

Average car price in the sales markets for the year 2022 Figure 8



Agora Verkehrswende (2023) | Data: Vehicle prices weighted by vehicle sales. Source: The Global Economy (2023), BCG

2.3 Vehicle prices

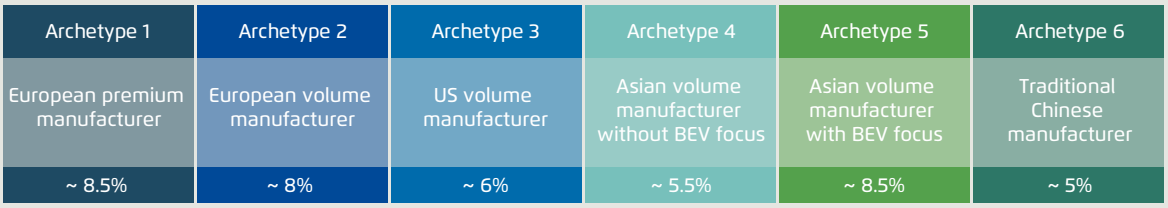
The decisive factor for manufacturers' turnover is the price at which they can sell their vehicles. For this study, vehicle prices are determined per vehicle class, drive technology and region. The average vehicle prices differ according to region. In China and Africa, passenger car prices are comparatively low (Figure 8). This is due in particular to the fact that smaller vehicle classes have higher market shares in these sales markets and there are suppliers that serve lower price segments.
Vehicle prices will develop differently from region to region, per vehicle class and per drive technology. However, since price forecasts over such a long period of time are not possible on a regional level and since the core conclusions of the study are hardly affected by this, a constant price increase corresponding to a global annual inflation rate of 2.2 percent over the next decade is assumed for simplification purposes in the present analysis.

2.4 Production costs

To determine the profits of car manufacturers, the costs of vehicle production must be subtracted from the sales revenue. The current manufacturing costs are taken from the companies' profit and loss accounts. Manufacturing costs differ according to the type of manufacturer: Figure 9 shows the average return, i.e., the ratio of profit to turnover as an average for the years 2019 to 2021, for the various manufacturer archetypes. The greater the return, the lower the share of costs in turnover.

The lower returns of US volume manufacturers and Asian volume manufacturers without a focus on electromobility as well as of traditional Chinese manufacturers are particularly striking. In principle, the returns of all manufacturer archetypes are at a similar level. However, the coronavirus pandemic forced different government interventions at the various production locations with corresponding consequences for the companies' profits in 2020 and 2021. European car manufacturers in particular were supported. Measures such as the temporary possibility of short-time work kept costs stable for the most part. At the same time, manufacturers were able to realise higher end-customer prices in some cases. Traditional Chinese car manufacturers also have higher costs, as many companies in this category are still relatively young, such as Changan or Dongfeng, and therefore currently still have high expenses for building up production capacities.

Average return on investment (2019-2021) of the different manufacturer archetypes Figure 9



Agora Verkehrswende (2023) | Source: S&P Capital IQ

Starting in 2022, the production costs for each scenario and the electrification strategy are extrapolated based on interviews with experts. The main components of the production costs are the material and production costs as well as the research and development-related expenses; the production costs are primarily determined by the energy and rental costs as well as the wages of the company employees.

The **costs for materials and components** develop differently depending on the market scenario. In general, the larger the market share of electric vehicles, the more the material costs for their production will fall. This is mainly because automotive suppliers realise volume discounts in material procurement with increasing production volumes and can pass on the fixed costs for production to a larger production volume. For the same reason, the material costs of combustion cars rise when fewer of them can be sold.

Production costs develop primarily depending on the respective electrification strategy. Again, the more electric vehicles car manufacturers produce, the faster their total production costs will fall. This is mainly because electric vehicles are less complex than comparable petrol and diesel cars; their production therefore requires fewer production steps and less labour and is correspondingly cheaper. In addition, if the vehicle range is electrified quickly, companies can convert their production facilities to purely electric plants sooner and benefit from cost savings by dispensing with mixed plants. The operation of mixed plants is fundamentally more expensive, as different production technologies and plants have to be kept available at the same time.

Research and development-related costs are also essentially dependent on the electrification strategy pursued by a car manufacturer. To electrify their product portfolio, manufacturers have to develop new e-vehicle models or adapt existing ones, and costs for research and development are incurred accordingly. Depending on when a manufacturer focuses on electromobility, these expenses shift over time (Figure 10). If a manufacturer electrifies at a relatively late stage, it must expect slightly higher overall costs for research and development. Comparatively greater efforts are necessary to catch up with the technological lead of the competition. Accordingly, manufacturers with a relatively low current share of BEVs that want to speed up their electrification must expect higher research and development-related expenditure.

2.5 Electrification strategies

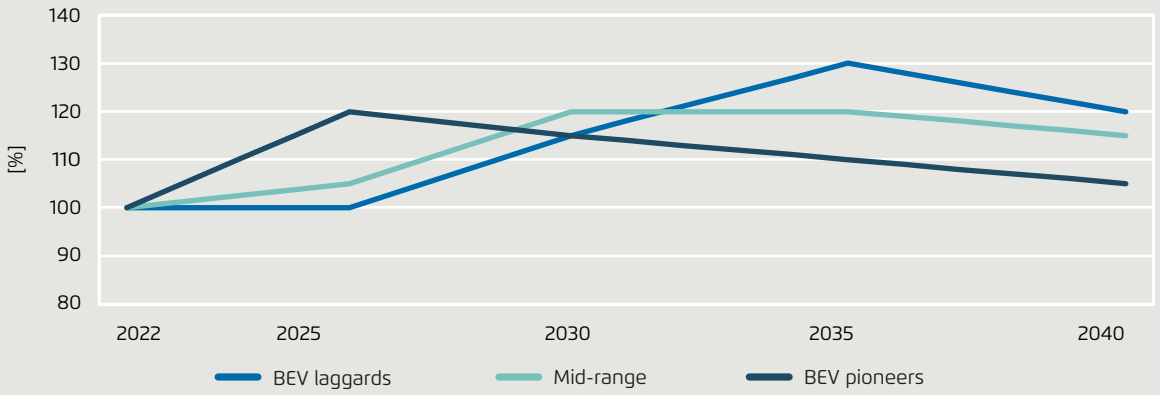
Depending on which electrification strategy a manufacturer pursues, it can – depending on the scenario – secure different shares of the global passenger car market. How the chosen electrification strategy affects the market shares of the respective manufacturer type is estimated based on interviews with experts. In addition, the chosen strategy has an impact on manufacturing costs (Chapter 2.4).

Car manufacturers can choose between three basic electrification strategies:

- **BEV laggards** initially focus on the production of ICEVs and siphon off the profits that can still be generated with the sale of diesel and petrol vehicles. However, this leads to a weaker market positioning in the electromobility sector and thus, in the medium

Research and development-related expenditures of a European premium manufacturer relative to the year 2022, depending on the electrification strategy

Figure 10



Agora Verkehrswende (2023) | Source: BCG

term – when the number of electric vehicles increases significantly worldwide - to corresponding losses in sales. Manufacturing costs are low for BEV laggards in the short term, as most investments in the production of ICEVs have already been written off.I In the medium term, however, manufacturing costs rise for BEV laggards. On the one hand, they have to catch up on investments in order not to lose market share in electric vehicles. On the other hand, BEV laggards have comparatively high production costs until 2040: since they are not expected to produce more electric cars than combustion cars until 2035, BEV laggards have to operate expensive blending plants for a correspondingly long time. As a result, their profits rise in the short term, but they lose market share as electromobility ramps up, so their profits then fall. These will only increase again when they have caught up with electromobility – if they succeed in doing so.

- Car manufacturers pursuing a **mid-range** strategy are already starting to reduce their capacities for the production of combustion vehicles and build up those of electric cars. Accordingly, they can still make profits with combustion cars, but also already with electric cars. The profits of manufacturers with a midfield strategy are therefore lower than those of the BEV laggards in the short term, but they also fall less sharply in the following years as electromobility ramps up. For car manufacturers in the midfield, manufacturing costs also rise due to catch-up investments in electromobility and comparatively high production costs. However, they reach the tipping point earlier than BEV laggards: from around 2030, the production of electric vehicles exceeds that of combustion vehicles, manufacturers can therefore switch to purely electric plants earlier and benefit from efficiency gains.
- **BEV pioneers** are already focusing on electromobility in the short term and are investing heavily in the electrification of their product portfolio. In the next few years, they will therefore only make comparatively low profits on the sale of petrol and diesel cars but can realise a market advantage over BEV laggards and car manufacturers with a midfield strategy in terms of electromobility. BEV pioneers can accordingly benefit from the rising revenues that can be generated in the medium to longer term through the sale of electric vehicles. The manufacturing costs for BEV pioneers are initially relatively high, especially since they have to invest a lot in the development of e-vehicle models and the conversion of their production capacities. However, from around 2025 onwards, they will produce more electric vehicles than combustion vehicles. Accordingly, BEV pioneers will be able to realise the cost advantages of converting to purely electric plants much earlier than their competitors.

3 | Results

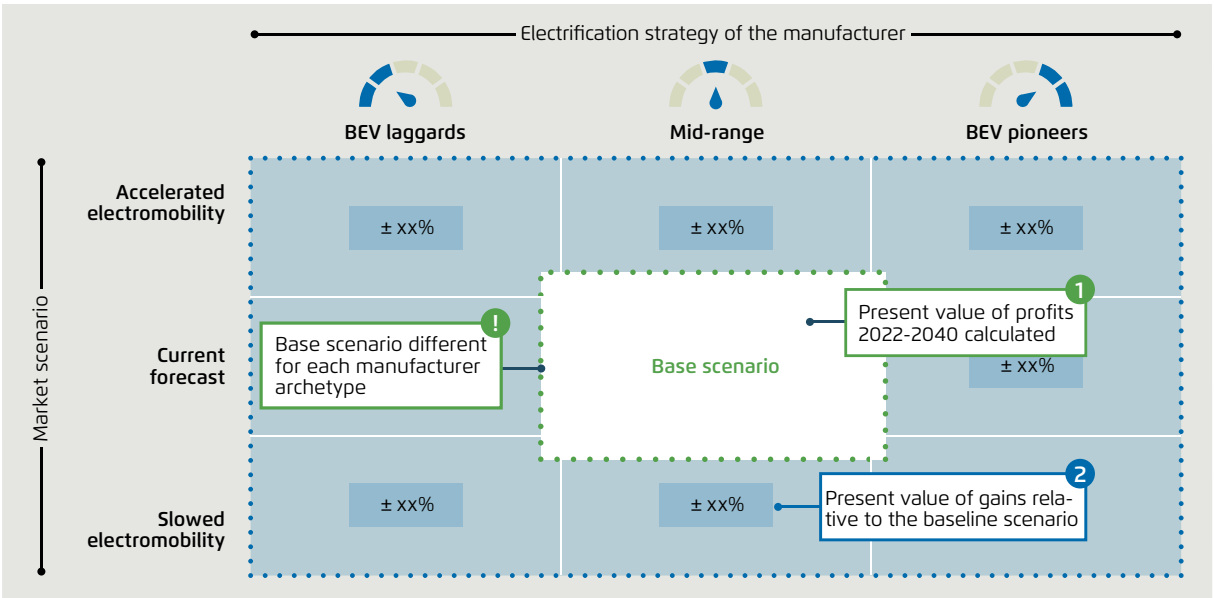
Against the background of the influencing factors presented, the future profits of the manufacturer archetypes vary with the market scenario and their electrification strategy. The latter is determined by the manufacturers themselves, while the market scenario is significantly influenced by political decisions (Chapter 2.2). This results in a matrix with nine fields that ideally covers every combination of electrification strategy and market scenario. Figure 11 illustrates the principle; Figure 12 shows the concrete results for all six manufacturer archetypes.

Future profits up to 2040 are shown at their present value. For this purpose, they are discounted to their value in 2022 using an assumed interest rate of 8.3 percent. The accumulated profits are shown in each case in relation to the profits that could be realised in the base scenario with a midfield strategy. This means that the profits made by a car manufacturer correspond to 100 percent if the passenger car market develops as currently forecast by manufacturers and a company pursues an average pace of electrification. A negative sign does not mean an absolute loss, but a cash value that is lower by a certain percentage.

In the **current forecast**, it is worthwhile for every type of manufacturer to electrify its product portfolio faster than its competitors. Especially European premium manufacturers can benefit as pioneers. In this way, they can increase their profits by around 15 percent compared to the base case. For European volume manufacturers, the discounted profit increase is lower at around 5 percent, partly because they cannot pass on higher short-term costs to their customers in the same proportion as European premium manufacturers.

However, all manufacturers must expect losses if they invest less in electromobility than the current market forecast suggests. Both European premium and volume manufacturers would lose about 10 percent of their profits in this case. Asian volume manufacturers without a previous focus on electromobility as well as traditional Chinese carmakers will have to reckon with the biggest profit losses. Their cumulative profits are likely to be 20 percent and 15 percent lower, respectively, by 2040 than in the baseline scenario if they electrify their vehicle sales more slowly than their competitors. In the case of Asian manufacturers, this is because they are already unable to keep up with the rising demand for electric cars

Matrix of cumulative profits, depending on the electrification strategy of the manufacturer archetypes and market scenario (principle representation) Figure 11



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and are losing market share. Their profit losses are much greater than those of other manufacturers if they even reduce their investments in electromobility compared to a pioneering strategy. Traditional Chinese manufacturers, on the other hand, are particularly dependent on their home market, where a relatively ambitious target of a 40 percent share of BEVs in new registrations is to be achieved as early as 2030 – a laggard strategy therefore leads to sales losses.

The greatest profit increases are possible in the **accelerated market scenario**. However, this presupposes a pioneering strategy in electromobility. European premium manufacturers will then be able to increase their profits the most, because they have already invested a lot in electromobility and are targeting a particularly affluent clientele with their product range. With a pioneering strategy, they can realise extra profits that are around 30 percent higher than if they were just „swimming along" in the midfield. While all other types of manufacturers can increase their profits by at least 15 percent in this scenario, the profit prospects of European volume manufacturers are comparatively low, with an increase of 10 percent. This is mainly because in Europe the sales figures of electric vehicles differ comparatively little between the market scenarios. In addition, volume manufacturers start BEV sales from a lower level and can generate less profit from the low sales growth than premium manufacturers.

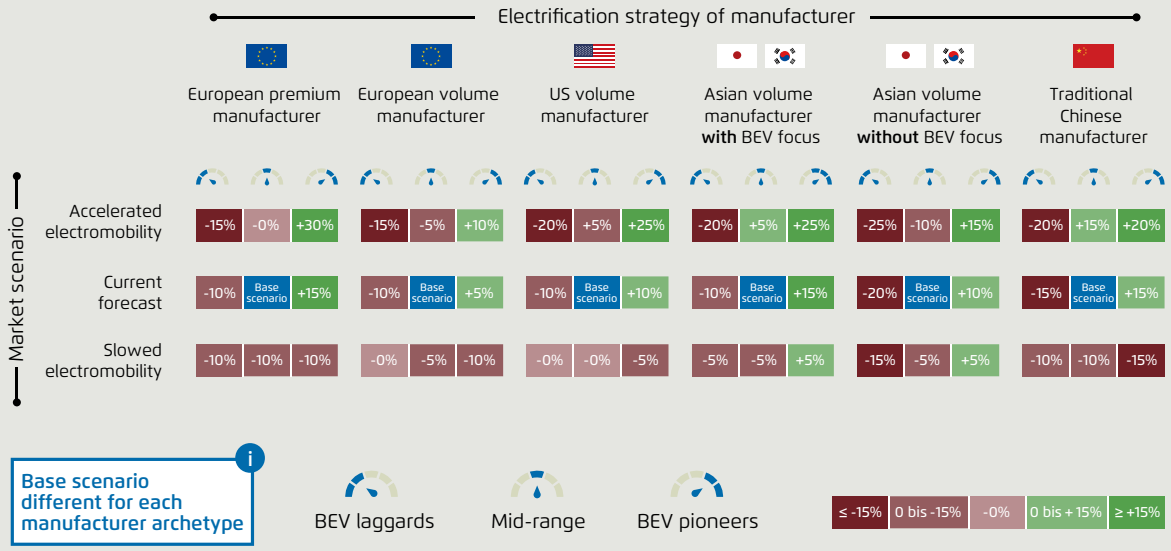
Nevertheless, the accelerated market penetration of electric vehicles offers all manufacturers the opportunity for the highest profit increases – if they become pioneers. However, if they are among the laggards, they will face the greatest disadvantages compared to all other scenarios. European premium and volume manufacturers then expect profit losses of 15 percent compared to the base case. With 20 percent lower profits, Asian volume manufacturers that have not yet focused on electromobility face the greatest losses in this scenario.

In the **slowed market scenario**, almost no car manufacturer can increase its profits until 2040. Instead, they have to expect profit losses of up to 10 percent compared to the base case. Especially for the profits of European premium manufacturers and traditional Chinese manufacturers, a slowdown of the market ramp-up would have negative consequences: they have to expect profit losses of at least 10 percent compared to the base case, regardless of which strategy they pursue. Only Asian volume manufacturers can achieve slight profit increases of 5 percent, but only if they electrify their product portfolio faster than their competitors. The reason for this is that Asian volume manufacturers with and without a previous focus on electromobility are lagging behind the market for electric passenger cars – Asian manufacturers can only catch up if the ramp-up progresses more slowly than expected today and if they significantly accelerate the electrification of their vehicle range at the same time.

Basically, in this scenario, the electrification strategy a car manufacturer pursues has relatively little impact on its profit opportunities. A pioneer strategy even leads to slightly higher profit losses for European and US volume manufacturers as well as for traditional Chinese manufacturers than other strategies.

Profits of manufacturer archetypes until 2040, depending on market scenario and electrification strategy

Figure 12



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4 | Recommended actions

All in all, the scenarios make two things clear: a rapid market ramp-up is not only economically possible for car manufacturers, it is even worthwhile. And it is precisely European premium manufacturers that benefit from an accelerated ramp-up of electromobility; these include first and foremost the German car manufacturers, such as BMW, Audi and Mercedes-Benz.

This realisation has led to a need for political action: more electromobility is needed quickly, not only for reasons of climate protection, but also to secure Germany as an automotive location. In other words, it is a matter of political and economic common sense to remove obstacles that slow down the ramp-up of electromobility.

Although the number of newly registered electric cars has increased significantly in recent years, it has not increased fast enough to reach the target set by the German government for 2030: at least 15 million purely battery electric vehicles in the passenger car fleet. To increase the demand for electric vehicles, the most important thing is to quickly ensure a sufficient expansion of customer-friendly charging infrastructure. In addition, the existing architecture of fiscal instruments must be reformed in such a way that fossil mobility becomes noticeably more expensive than climate-friendly mobility. Survey results show that the vehicle tax, which is already partly based on CO_2 emissions, is hardly taken into account when buying a car because it has to be paid over many years and is set at a low level; the company car tax even encourages companies and their employees to purchase large and powerful vehicles.[13] The tax rules should therefore be adjusted with the aim of setting a clear price signal for the purchase of electric passenger cars. A vehicle taxation scheme that is particularly applied to the first registration and geared to CO_2 emissions increases the visibility of the tax burden and will thus increase the demand for electric vehicles.

However, politics faces a further challenge: it must create appropriate framework conditions for the automobile companies – with the aim of increasing the production of electric vehicles in such a way that growing demand meets corresponding supply. Of particular importance in this context are the currently very high energy prices. In fact, the production of electric cars is more energy-intensive than that of combustion engine cars, mainly because of the high energy demand in the production of the traction batteries. This leads to a dilemma: if the manufacturers are unable to push through high energy costs in the form of higher retail prices on the market, their profitability suffers. If, however, they succeed in realising higher retail prices, the competitiveness of electric cars suffers in comparison to internal combustion engines. The acceleration of the energy transition offers a way out of this dilemma. With the expansion of renewable energies, Germany's dependence on gas and oil imports is decreasing and average energy prices are falling due to the marginal costs of renewable energies, which are tending towards zero.

But that's not all: to increase the production of electric vehicles, a sufficient supply of raw materials is necessary, which have to be imported to Germany due to the lack of its own mineral resources. This mainly concerns raw materials for battery production. Trade agreements are necessary to secure supply – this is a task for German policy in the European context. It also makes sense to strategically align international cooperation in the raw materials sector, one component of which should be the strengthening of international cooperation on sustainable mining.[14]

Finally, there is also need for political action with regard to the financing of investments that are necessary for the transformation of automotive companies. To be at the forefront of the global trend towards electric mobility, automotive companies need a lot of capital for the development of e-vehicle models and for the conversion of their production capacities. However, the increasing need for capital is offset by dwindling revenues from the sale of petrol and diesel cars. German car manufacturers generally have the necessary capital reserves. However, a large part of the German automotive industry consists of small and medium-sized supplier companies. These companies need additional political support, especially because they were particularly hard hit by the economic side effects of the coronavirus pandemic and by supply bottlenecks and have often exhausted their reserves. Possible political instruments could be special promotional loans from the KfW or investment funds, as are

13 Agora Verkehrswende (2022c)

14 Agora Verkehrswende (2017)

currently being planned. Rapid implementation should be on the political agenda.

Whatever instruments are used and in whatever doses: creating favourable framework conditions for the ramp-up of electromobility is a challenge that will not only benefit climate protection and car manufacturers. Because of the great importance of the automotive industry in the German economic structure, it is a matter of Germany as a business location. Due to its size and its interconnectedness, the automotive industry in Germany has considerable significance for the country's overall economic development. With a share of 4.35 percent of gross value added in 2019, it is one of Germany's most important economic sectors.[15] However, this strength is at risk should Germany lose out on the global trend towards electromobility. Germany will only remain a relevant production location for the automotive industry if the framework conditions are set in such a way that local companies become pioneers of electromobility.

This message of the present study is also important for the automotive companies themselves. Because no matter how the markets develop: as latecomers to electromobility, they will be among the losers. They can only win as pioneers. Only then will they be able to maintain the importance they have acquired over decades as innovation leaders.

15 destatis (2022): Share of gross value added of 4.35 percent results from a value for the automotive industry (industry sector 29) in 2019 of 136.219 billion euros and for Germany of 3,130.661 billion euros.

5 | Bibliography

Agora Verkehrswende (2017): *Strategien für die nachhaltige Rohstoffversorgung der Elektromobilität. Synthesepapier zum Rohstoffbedarf für Batterien und Brennstoffzellen.* URL: https://www.agora-verkehrswende.de/veroeffentlichungen/strategien-fuer-die-nachhaltige- rohstoffversorgung-der-elektromobilitaet/. Last accessed on 19.01.2023

Agora Verkehrswende (2021): *Autojobs unter Strom. Wie Elektrifizierung und weitere Trends die automobile Arbeitswelt bis 2030 verändern werden und was das für die Politik bedeutet.* Studie. URL: https://www.agora-verkehrswende.de/fileadmin/Projekte/2021/BCG-Jobstudie/64_Jobeffekte.pdf. Last accessed on 16.01.2023

Agora Verkehrswende (2022a): *Vom rasenden Stillstand zum versprochenen Fortschritt? Zwischenbilanz der Klimapolitik im Verkehr nach einem Jahr Ampelkoalition mit Empfehlungen für einen Kurs auf Klimaneutralität, Wirtschaftlichkeit und soziale Gerechtigkeit.* Politikpapier. URL: https://www.agora-verkehrswende.de/fileadmin/Projekte/2022/Ampel-Zwischenbilanz-1-Jahr/88_Ampel-Zwischenbilanz_A4quer.pdf.
Last accessed on 16.01.2023

Agora Verkehrswende (2022b): *Pkw-Export in Länder mit angestrebtem Verbrennerausstieg. Länder mit angestrebtem Verbrennerausstieg und deren Anteil am Export deutscher Pkw-Hersteller.*
URL: https://www.agora-verkehrswende.de/veroeffentlichungen/pkw-export-in-laender-mit-angestrebtem-verbrennerausstieg/. Last accessed on 16.01.2023

Agora Verkehrswende (2022c): *Steuersignale zur Transformation der Pkw-Flotte. Reformoptionen für eine faire und klimagerechte Kfz- und Dienstwagenbesteuerung.* Kompaktbericht. URL: https://www.agora-verkehrswende.de/fileadmin/Projekte/2022/Kfz-u-Dienstwagen/79_Kfz-u-Dienstwagen_Studie_Kompaktbericht-v2.pdf. Last accessed on 16.01.2023

Dena (2020): *dena-Analyse: Klimaneutralität – ein Konzept mit weitreichenden Implikationen.*
URL: https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2020/dena_BR_Analyse-Klimaneutralita__t_WEB.pdf. Last accessed on 16.01.2023

Destatis (2022): *Volkswirtschaftliche Gesamtrechnungen. Inlandsproduktberechnung. Detaillierte Jahresergebnisse. 2021.* URL: https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen-Inlandsprodukt/Publikationen/Downloads-Inlandsprodukt/inlandsprodukt-vorlaeufig-pdf-2180140.pdf?__blob=publicationFile. Last accessed on 16.01.2023

European Commission (2022): *CO_2 emissions of all world countries.* URL: https://edgar.jrc.ec.europa.eu/report_2022. Last accessed on 16.01.2023

Germany Trade & Invest (2022): *Der Ausbau der Ladeinfrastruktur schreitet voran.* URL: https://www.gtai.de/de/trade/usa/branchen/der-ausbau-der-ladeinfrastruktur-schreitet-voran-936950#:~:text=Bis%20zur%20Erreichung%20von%20US,also%20noch%20ein%20weiter%20Weg. Last accessed on 02.02.2023

ICCT (2021): *A statistical portrait of passenger cars, light-commercial, and heavy-duty vehicle fleets in the European Union from 2001 to 2020.* URL: https://eupocketbook. org/. Last accessed on 16.01.2023

IEA (2021): *Net Zero by 2050. A Roadmap for the Global Energy Sector.* URL: https://www.iea.org/reports/netzero-by-2050. Last accessed on 16.01.2023

IEA (2022a): *Global CO_2 emissions rebounded to their highest level in history in 2021.* Pressemitteilung.
URL: https://www.iea.org/news/global-co2-emissions-rebounded-to-their-highest-level-in-history-in-2021.
Last accessed on 16.01.2023

IEA (2022b): *Transport. Sectoral Overview.*
URL: https://www.iea.org/reports/transport. Last accessed on 16.01.2023

Mercedes-Benz (2021): *Mercedes-Benz Strategy Update: electric drive.* URL: https://group.mercedes-benz.com/unternehmen/strategie/mercedes-benz-strategy-update-electric-drive.html. Last accessed on 16.01.2023

The Global Economy (2023): *Vehicle prices – Country rankings.* URL: https://www.theglobaleconomy.com/rankings/vehicle_prices_wb/.
Last accessed on 03.03.2023

Universität Hamburg (2023): *Hamburg Climate Futures Outlook. The plausibility of a 1,5° C limit to global warming – Social drivers and physical processes.* URL: https://attachment.rrz.uni-hamburg.de/8c8af471/CLICCS-Hamburg-Climate-Futures-Outlook-2023.pdf. Last accessed on 06.02.2023

US Department of Energy (2023): *Electric Vehicle Charging Station Locations. Alternative Fuels Data Center.* URL: https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC&ev_levels=dc_fast&country=US. Last accessed on 16.01.2023

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