Center for Strategy and Scenario Planning

HHL

FUTURE SCENARIOS
for the German Automotive Electromobility Market

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1 Foreword

"Trying to predict the future is like trying to drive down a country road at night with no lights while looking out the back window." Peter Drucker

Rarely has the outlook for the German market for EVs been as bleak and uncertain as it is today. What are the implications of the growing need for decarbonization and new technologies? How can automakers deal with supply chain disruptions? Can they emerge stronger? In this study, we seek to answer these questions and provide food for thought, not only for German automotive executives.

Today's business environment is increasingly complex, volatile, and uncertain. Change comes faster than ever, and many developments are impossible to predict. In particular, linear projections from the past are not helpful. Nevertheless, managers must make decisions and commit resources. This is only possible if uncertainty is accepted and made an integral part of strategic decision-making. Traditional strategic planning tools tend to be inadequate under these conditions because they do not take uncertainty sufficiently into account. Scenario planning differs fundamentally from conventional strategy tools in that it attempts to capture a wide range of alternative developments, thus encouraging strategic decision-makers to consider influencing factors that they might otherwise ignore.

Our scenario study of the German automotive electromobility market helps managers in this endeavor. We have developed four scenarios for the industry in 2030, based on several key uncertainties and key industry trends. We hope these scenarios will inspire you and help you manage the opportunities and threats in this dynamic industry. We wish you an insightful journey through the current situation and potential future of the the German automotive electromobility market.

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2 Executive Summary

The growth in the number of cars in Germany continued in 2022, reaching 48.5 million cars (KBA, n.a.a). This marks the partial recovery of the automotive industry from the disruptive effects caused by the COVID-19 pandemic. After two years of negative sales figures, the German market reached a turning point with 1.1% sales growth in 2022 (KBA, 2023). However, one can ask whether this is a good sign for the protection of our living environment. CO_2 emissions in the traffic sector slightly rose to 150 Mt of CO_2 in 2022 and thereby significantly missed its target of 139 Mt (Focus, 2023). However, the rising popularity of EVs is a promising signal for the realization of climate neutrality in Germany by 2045 in line with the national climate protection law (BMWK, 2022a). Rapidly increasing EV sales by 32% demonstrated the highest growth rate across all drivetrains in 2022. Hereby, the share of EV sales rose to 18% of car sales overall (KBA, 2023). However, the share of EVs throughout Germany's car pool overall is still at a low level of 2% (KBA, 2023; KBA, n.a.a).

What will the mobility of the future look like? Besides EVs, other sustainable drivetrain technologies like H_2 fuel cell cars will play a minor role in the future (BCG, 2021) and car sharing can solve the problem only to a limited extend as CO_2 emissions for utilization ultimately depend on the car's drivetrain technology. Switching to public transport seems to be a nerve-racking decision as the Deutsche Bahn just reached its peak of delays in 2022 (Spiegel, 2022). Moreover, e-fuels for a climate-neutral usage of ICEs are rather a solution to reduce CO_2 emissions of the existing fleet than a valid argument for an exemption of the EU-wide sales ban on ICEs by 2035 (Dlf, 2022). As a result, shifting to electromobility is the most probable solution to comprehensively satisfy future customer demand in a climate-neutral way.

Reaching over one million EVs in Germany by 2022 showcased an initial accomplishment resulting from the vital transformation to electromobility in the automotive industry (KBA, 2023; KBA, n.a.a). Continuing on this national journey is also critically important for achieving EU climate targets as Germany is by far the highest emitter of greenhouse gas emissions across all 27 EU countries (UBA, 2022a). Europe wants to be a role model for climate change by becoming the first climate-neutral continent (EC, n.a.a) which would be a great signal on the way to successfully fulfilling the Paris Agreement. It is a legally binding contract in which 196 countries committed to the

target of stopping global warming to preferably 1.5 but at least to well below 2 degrees Celsius above pre-industrial levels (UN, n.a.).

For maintaining national sales growth at a high level in the years ahead, key challenges need to be overcome. The decarbonization of the full lifecycle of EVs is essential, especially due to 80% higher production emissions for EVs in comparison to ICEs today (McKinsey, 2021a). Battery cell production has become increasingly important in the value chain, accounting ofr 40% of the total value creation (BMWK, n.a.). Thereby, strategic options for creating a sustainable competitive advantage change substantially leading to a reorientation of the market power. Another key success factor is the maturity of the charging infrastructure network in terms of publicly available charging hubs and wallboxes in private households. Customers especially demand more fast chargers and longer driving ranges of EVs (Strategy&, n.a.). Overall, changing electromobility-specific parameters are causing a dynamic development of the German automotive electromobility market of passenger cars. The rising number of global crises complicates the predictability of future market conditions additionally. As a consequence, decision-makers need to integrate uncertainty into their strategic planning process. Since this is not possible with traditional planning and analysis tools, scenario-based strategic planning can help managers to handle uncertainty as part of their strategic decision-making.

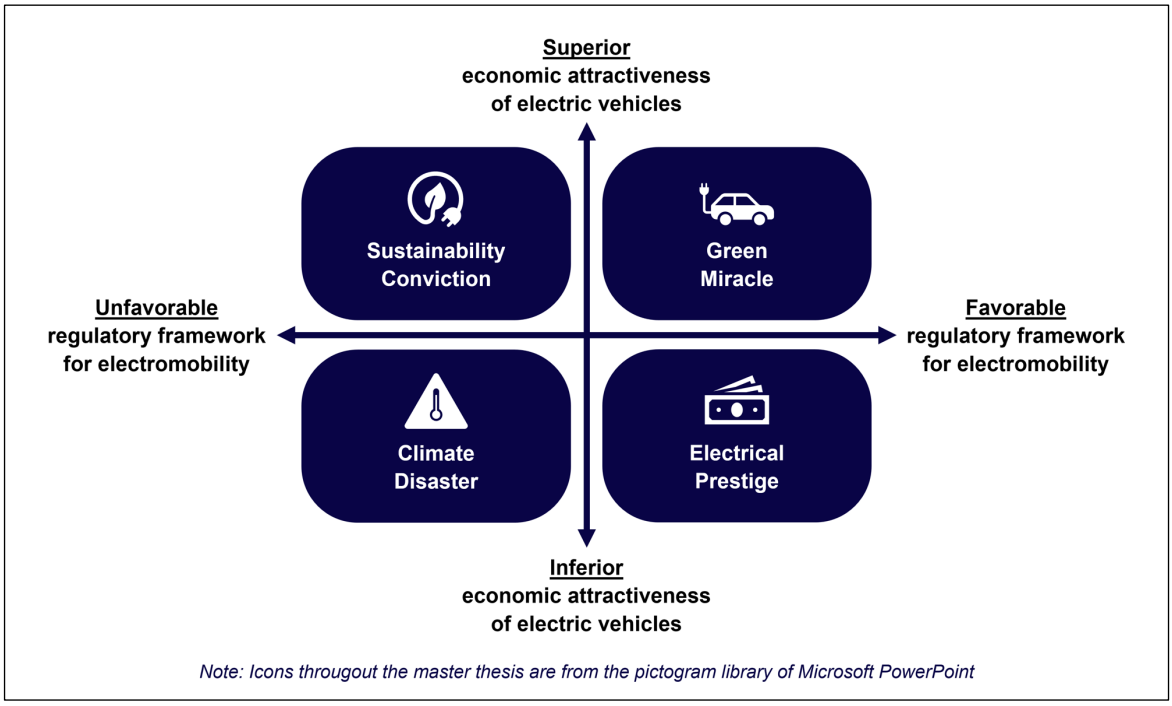
To address these challenges and help managers in the industry plan for the future, we have prepared this study using our innovative approach to scenario-based strategic planning, developed jointly by HHL and Roland Berger Strategy Consultants. Our scenarios are based on extensive research and industry-wide surveys of various stakeholder groups. This has helped us gain a holistic picture of the relevant trends and drivers in the industry and ensures the quality of the scenarios.

The four scenarios we have developed are built around two critical uncertainties identified in our survey of industry experts. These two critical uncertainties, which form our scenario dimensions, are:

- **Economic attractiveness of EVs**
- **Regulatory framework for electromobility**

Based on these critical uncertainties as well as additional trends and influence factors, four plausible scenarios emerge on how the German EV market could fare until 2030. These four scenarios are the following:

Figure 1: Scenario Matrix for the German EV Market



Note: Icons througout the master thesis are from the pictogram library of Microsoft PowerPoint

Scenario A: Green Miracle

"Green Miracle" describes Germany's successful transition to electromobility by 2030, making the country a global model for sustainable mobility. This is due to a favorable regulatory environment, technological advances, and demographics. Affordable EV models, local battery production, and cooperation with other countries have made the market accessible to everyone. Oil supply disruptions, high CO_2 levies and the expansion of renewable energy are leading to rising fuel costs and falling electricity prices, making EVs more attractive. Germany achieves its target of 15 million EVs and a reduction of CO_2 emissions to 85 Mt CO_2 thanks to strengthened global partnerships, diversified supplier networks and local component production.

Scenario B: Electrical Prestige

"Electrical Prestige" paints a picture of a market in which EVs are affordable only to wealthy customers. As a result, EVs become a status symbol while large segments of society are forced to switch to public transportation. Lack of key EV components and high electricity prices for charging contribute to the low economic attractiveness of EVs. Despite large budgets for public charging infrastructure and an expanded list of subsidized vehicles, only 7 million EVs are sold, creating a social divide along income lines. CO_2 emissions are significantly reduced to 100 Mt CO_2 by 2030 due to fewer cars on

German roads, but EVs remain a status symbol for the affluent due to their persistently high total cost of ownership. As EVs are only relevant for limited social groups, this scenario creates conditions that lead to slower progress in electric mobility.

Scenario C: Climate disaster

“Climate disaster” envisions a future in 2030 where Germany's transition to EVs has been slower than expected due to political and economic challenges, resulting in only four million EVs on the road. The government has focused more on improving public transportation and introducing stricter CO_2 emission regulations, while EV subsidies are limited. Charging infrastructure is still underdeveloped, leading to range anxiety among consumers. Despite these challenges, demand for EVs has increased due to technological advances, lower battery costs, and a shift in consumer attitudes toward sustainability.

Scenario D: Sustainability Conviction

“Sustainability Conviction” describes a future in which the German EV market grows due to early adopters with strong environmental concerns, supported by reliable supply chains and lower electricity prices. However, an unfavorable regulatory framework and the continued popularity of ICE vehicles limit the reduction of CO_2 emissions. In this scenario, global trade diversification and sustainable material supply chains strengthen Germany's position as a supplier of low-cost EV models. Meanwhile, volatile and inflated oil prices are countered by falling electricity prices and increased renewable energy production.

3 The German Automotive Electromobility Market

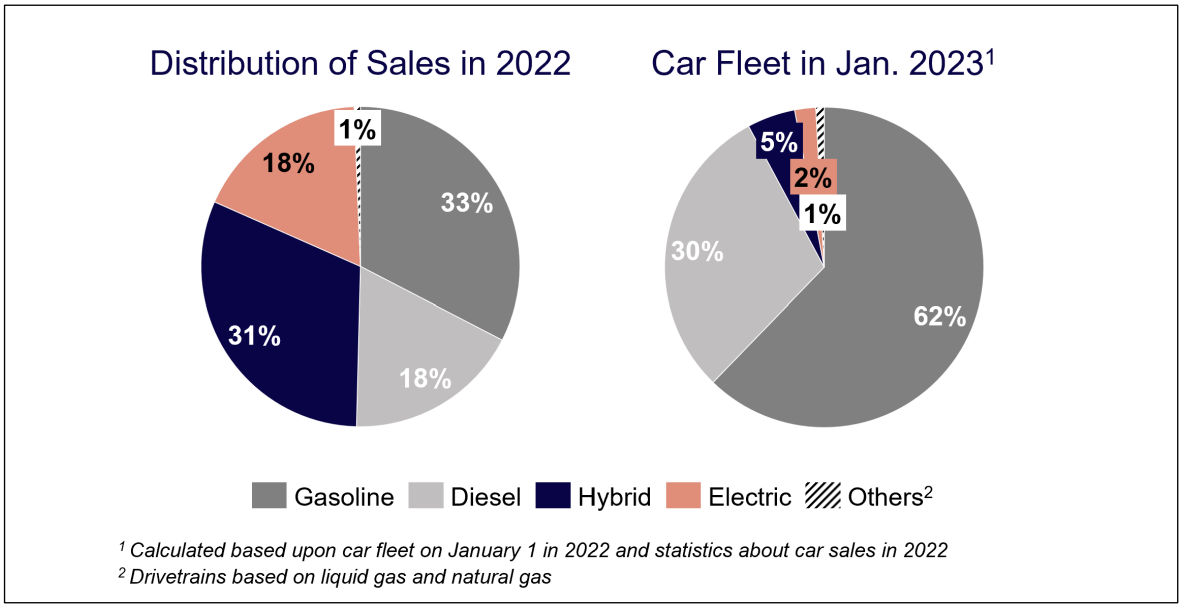
This chapter provides an overview of the German automotive electromobility market of passenger cars and highlights key milestones leading to an accelerated rise of EVs in recent times. Major challenges are explained which are critical on the way to reaching climate neutrality of Germany’s traffic sector by 2045.

Overview and German Market Structure

The COVID-19 pandemic caused major disruptions in the automotive industry resulting in strongly declined sales figures of 19.1% (2020) and 10.1% (2021) in Germany (KBA, n.a.b; KBA, 2022a). In 2022, automotive companies could stop the negative trend by selling 2.65 million passenger cars in Germany which is a plus of 1.1%. Hereby, the share of alternative drivetrain technologies increased while ICEs recorded declining

sales records. EV sales grew by 32% accounting for 18% of total car sales in Germany (see figure 2). PHEV sales rose by 10% and thereby almost caught up with ICE sales volumes which dropped by 11%. Although a strongly growing share of EV sales was registered (KBA, 2023), approximately 1.1 million EVs accounted for 2% of total passenger cars in January 2023 (KBA, 2023; KBA, n.a.a).

Figure 2 Distribution of Passenger Car Drivetrains in Germany



Source: Own illustration, following KBA (2023; n.n.a)

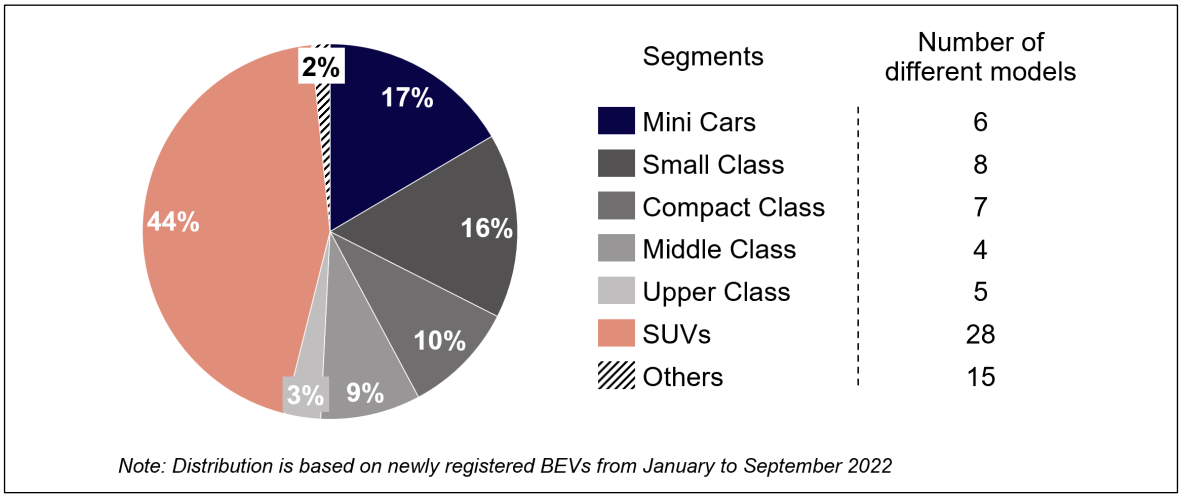
Therefore, ICEs (92%) still have a strong market dominance but current market dynamics suggest a rapidly rising importance of EVs in the years ahead (KBA, 2023; KBA, n.a.a). Automotive corporates demonstrated a strict prioritization of EV production while supply chains deteriorated and a shortage of semiconductors restricted manufacturing quantities (McKinsey, 2022).

In 2022, VW defended its position as the leader in the German automotive market with an 18% market share. Followed by Mercedes (9%), Audi (8%), and BMW (8%), German corporates dominated the local automotive market overall (KBA, 2022b). However, only VW could defend its dominant position in the local market for electric passenger cars measured by the number of newly registered EVs. VW realized 26% of EV sales in the German market followed by Stellantis (17%) and Tesla (15%) in the second and third positions while Mercedes (8%) and BMW (8%) played a minor role. Tesla and Stellantis demonstrated outstanding sales growth rates in the German market above 70% in 2022 (Bay, 2023). A sustainable product portfolio with technological

innovations is the key to leveraging EV growth opportunities in the future (McKinsey, 2021b).

Electric SUVs were by far the most popular segment in 2022 accounting for 44% of EV sales overall followed by mini (17%) and small (16%) cars (see figure 2). Automotive corporates focused heavily on the rollouts of multiple SUV models by neglecting other segments. As a result, a comprehensive product portfolio of 28 different SUV models was purchased in Germany (CAM, 2022). The most demanded SUV in particular was Tesla's Model Y which was the best-selling EV overall as well. The second and third most popular model was Tesla's model 3 followed by the Fiat 500. VW and Opel were the only German corporates achieving leading sales positions with VW's ID.4/ID.5 and E-Up as well as the Opel Corsa-e (Bay, 2023). Overall, 10.3 million EVs were sold globally in 2022 with Europe and China as the leading markets worldwide (BNEF, 2022). Germany sold around 470,000 EVs while China achieved a new sales record with over 4 million EVs sold in 2022 (Cheng, 2023).

Figure 3 Distribution of EV Segments in Germany (2022)



Source: Own illustration, following CAM (2022).

Historical Development and Key Regulations

Gustave Trouvé invented the first battery-powered tricycle in 1881. Afterward, electromobility gained large public interest, especially after an EV set a new world record with a speed of around 100 km/h in car racing in 1899 (Schmitz, 2022). Ferdinand Porsche introduced a revolutionary EV at the world exhibition in Paris in 1900 and invented the first hybrid vehicle by combining it with an ICE in the same year (Maxwill, 2012). This milestone paved the way for the rise of electromobility at the beginning of the 20th century. The booming US market reached its peak in 1912 with around 34,000 EVs showcasing driving ranges above 100 km (Schmitz, 2022). Hereby, the trend from the US also gained attraction around the world (Maxwill, 2012) and thereby Berlin became Germany's center for electromobility (Schmitz, 2022). However, the uprising trend of electromobility experienced an abrupt ending after a breakthrough by Charles Kettering in 1911. The invention of electric starters solved the troublesome starting process of ICEs. The increased convenience and ICE's superior driving range untimely led to a revival of ICEs and a decline in EVs (Maxwill, 2012). A long time thereafter, California's government commission adopted a regulation for the promotion of climate-neutral cars in the 1990s due to the rising environmental conscious. However, no breakthrough was accomplished until Tesla's rollout of the Roadster in 2006, showcasing a driving range of 350 km (Schmitz, 2022). This laid the foundation for a revival of EVs in recent times. However, automotive corporates in the German market continuously relied on a product portfolio based upon core engineering capabilities for ICEs and thereby missed

the chance to leverage a first-mover advantage, particularly in battery cell production (Hoenig & Strünkelnberg, 2018). Climate targets enforced by regulations on the EU and national level marked key milestones for the development of the German automotive electromobility market of passenger cars. The following paragraph explicitly focuses on major agreements serving as the basis for the regulatory framework.

On 12 December 2015, 196 countries voted for the Paris Agreement, a legally binding treaty to stop global warming to preferably 1.5 but at least to well below 2 degrees Celsius above pre-industrial levels (UN, n.a.). To fulfill the Paris Agreement and to become the first climate-neutral continent, the EU developed the “Green Deal” which is a holistic approach that includes several initiatives to reach climate neutrality by 2050. Hereby, the „Fit for 55“ initiative and the European climate law not only define a 55% reduction of greenhouse gas emissions by 2030 compared to 1990 but also made it legally binding for all EU countries (EC, 2022). However, those regulations were not far-reaching enough for selected European countries (BCG, 2021). With setting the new target of climate neutrality by 2045, Germany is the first EU country that implemented more ambitious climate targets on the national level. Germany’s adapted climate protection law not only sets the goal of climate neutrality by 2045 but also states the reduction of 65% and 88% reduced greenhouse gas emissions by 2030 and 2040 respectively. The implementation of tightened climate targets is a consequence of stricter regulations by the German Federal Constitutional Court and the fact that Germany is responsible for the highest share of CO_2 emissions in Europe (BMWK, 2022a). With 729 Mt of CO_2 emissions in 2020, Germany accounted for 22% of total emissions among all 27 EU countries and thereby being the largest polluter far beyond France (12%) in the second place (UBA, 2022a). Contrary to the intended goals, Germany’s total emissions further increased after an economic downturn enforced by the COVID-19 pandemic. In 2021 and 2022, CO_2 emissions rose to 762 Mt (UBA, 2022c) and 761 Mt (Handelsblatt, 2023) respectively. Germany’s fulfillment of climate targets is essential by considering Europe as a role model for climate protection with its target to become the first climate-neutral continent (EC, n.a.a).

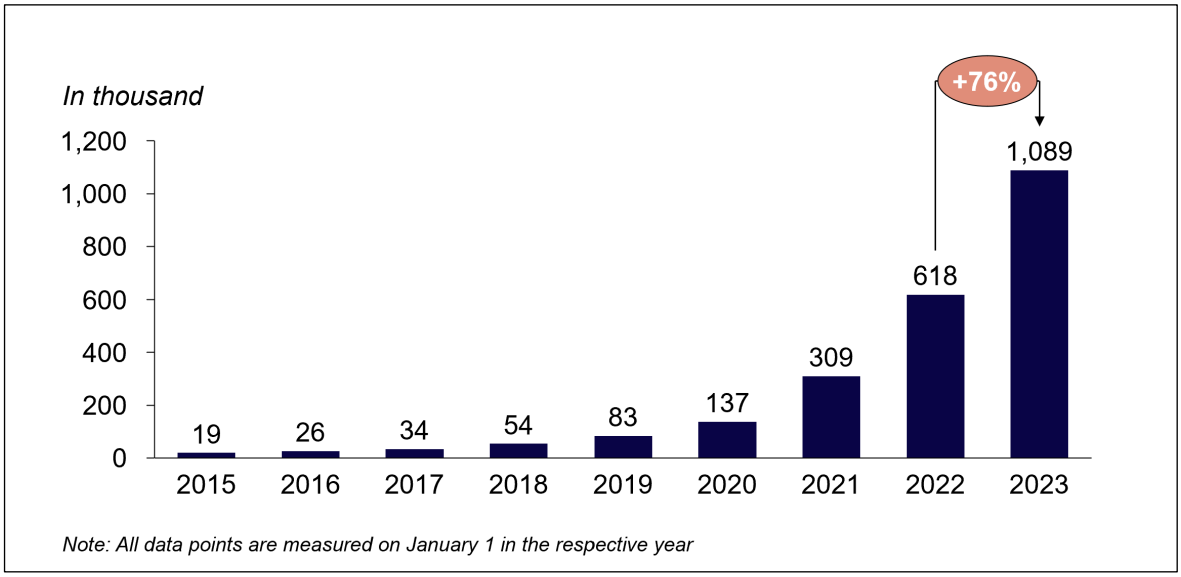
Regulations on the EU level targeting a reduction of traffic emissions in particular include fleet targets for newly-sold passenger cars allowing CO_2 emissions of up to 95 g/km between 2020 and 2024. They will be tightened by 15% from 2025 and 37.5% from 2030 onwards and measured with the Worldwide harmonized Light vehicles Test

Procedure (WLTP), a revolutionized emission test procedure for realistic measurements to close loopholes for manipulations (EC, n.a.b). In 2022, the EU parliament decided on a complete sales ban on emitting cars by 2035 (Tagesschau, 2022a). Moreover, the EU Emission Trading System (ETS) affects the energy-heavy automotive supplier industry, e.g. the production of vehicle structure parts through aluminum die casting. In the ETS, CO_2 certificates are traded across industries to compensate for emissions. Thereby, CO_2 prices increase over time because of a reduction of certificates overall which will be amplified through a declining number of free certificates from 2026. A new Emission Trading System (ETS II) will be adopted in 2027 which will include the whole automotive sector (EP, 2022).

Germany aims to reduce greenhouse gas emissions of the traffic sector between 1990 and 2030 by 48% reaching 85 Mt of CO_2 per year (UBA, 2022b). According to the German government, the accountable share of reduced CO_2 emissions from passenger traffic should be achieved through 15 million EVs with one million public charging points by 2030 (Bundesregierung, 2022). Hereby, the share of renewable sources in electricity production should account for 80% by 2030 (Bundesregierung, 2023). To achieve the specified goals, the German government introduced several instruments to stimulate a rapid shift to sustainable mobility modes of individual traffic. Disbursements for the purchase of EVs and PHEVs reached a peak of 3.2 B€ in 2022 through Germany's environmental bonus which was doubled in 2020 by implementing a complementary innovation bonus (Tagesschau, 2022b). However, subsidies will decline in the years ahead to a maximum of 6,750 € and 4,500 € for EVs in 2023 and 2024 respectively. Hereby, one-third of the bonus will be carried by automotive companies (ADAC, 2023) and the bonus will fully expire in December 2025 (Belluomo et. al, 2022). Moreover, the purchase of wallboxes for private households was subsidized up to 900 €. However, the available budget was maxed out in October 2021 and a prolongation is not intended yet (Jeß, 2022). For the professional utilization of cars, the German government adopted favorable tax laws for EVs and PHEVs. While 1% of ICEs' purchase prices need to be taxed, 0.5% and 0.25% are taxable for PHEVs and EVs respectively (ADAC, 2022a). However, a new taxation system for cars will decrease EVs' benefits post-2030 compared to the currently applicable regulation (ADAC, 2022b). Last but not least, increasing CO_2 charges will amplify fuel price increases. Hereby, CO_2 costs will rise from 30 €/t in 2022 to 55 €/t in 2026 which translates into an increase in fuel prices to 15.9 ct/l for gasoline and 17.0 ct/l for diesel (ADAC, 2022c).

Since the Paris Agreement in 2015, multiple restrictions and incentivizing instruments were adopted on an EU and national level to accelerate the shift to EVs. Progress in the German market became evident in 2021 with strong growth until January 2023, as shown in figure 4. However, despite EVs' growth rate of 76% (KBA, 2023; KBA, n.a.a), CO_2 traffic emissions recorded rising figures to 150 Mt in 2022 and thereby significantly missed its target of 139 Mt (Focus, 2023). Besides stricter regulations enforced by politics, automotive companies can leverage key growth opportunities to boost EV sales (see chapter 2.3).

Figure 4 EV Development in Germany (2015-2023)



Source: Own illustration following KBA (2023; n.a.a)

Major Challenges and Growth Drivers

The German automotive industry is currently undergoing a large-scale transformation to successfully shift to EVs. 40% value creation in battery production caused an upward movement of revenue potentials on the value chain (BMWK, n.a.). Selected car components change, the competitiveness for critical raw materials rises and the public charging network impacts EV demand heavily (McKinsey, 2021c).

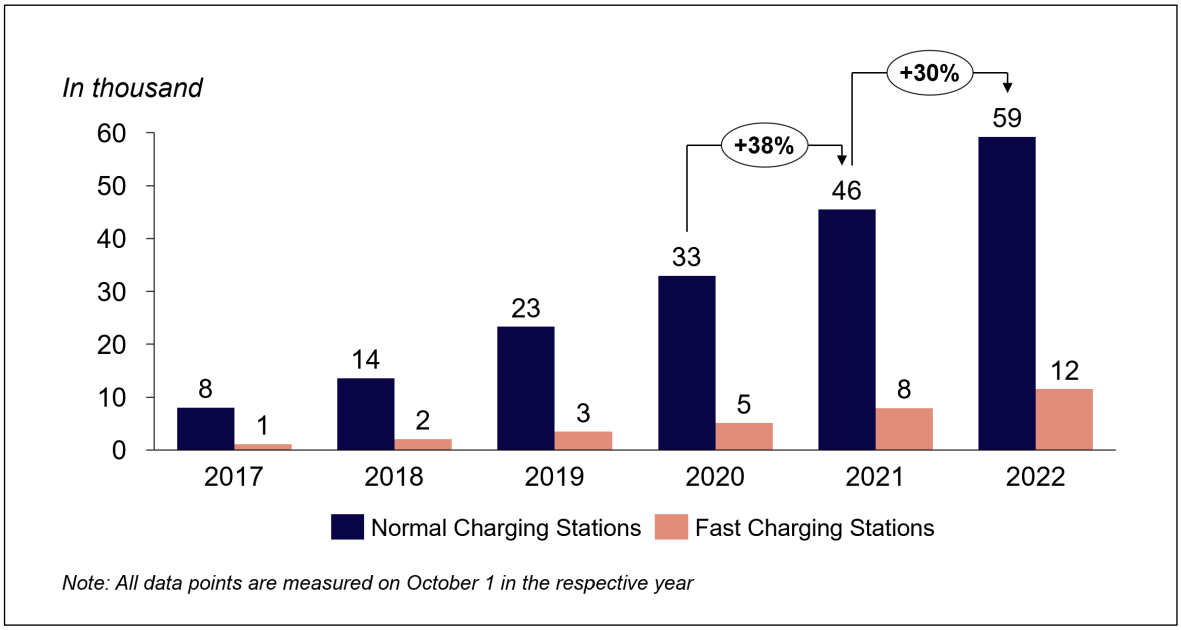
German corporates increasingly ramp up local battery production instead of exclusively importing from Asia as in the past. Several gigafactories will emerge in Germany in the years ahead to expand battery production, also under the umbrella of automotive corporates to regain control over critical parts of the value chain (McKinsey, 2021c). For instance, VW recently started building its first gigafactory in Salzgitter in cooperation

with Wuxi Lead, a Chinese specialist in battery cell production (Frese, 2022). Meanwhile, both BMW and Mercedes already produce battery modules in Saxony (Harloff et. al, 2022). However, the global battery market today is still largely dominated by Asian players. The Chinese company CATL accounts for 35% of the global market for vehicle batteries followed by LG Energy Solution (16%) from South Korea and BYD (11%) from China as well. All of the ten leading producers of battery cells are located in China, South Korea, or Japan (Zhang, 2022). Nevertheless, Germany has the potential to catch up. According to Fraunhofer, 6.5 million EV batteries will be produced in Germany by 2030 (FAZ, 2022). To satisfy the rising demand for critical raw materials, the discovery of Europe's largest rare metals deposit in Sweden could decrease the risk of shortages in the future (Reuters, 2023).

EVs emit 65% to 80% fewer CO_2 emissions compared to ICEs over the entire lifecycle. However, the production of EVs causes almost 80% higher emissions in comparison to ICEs (McKinsey, 2021b). Especially reducing scope-3-emissions will be crucial. Those are emissions that were caused throughout the supply chain of automotive corporates currently responsible for 98% of greenhouse gas emissions in the automotive sector (McKinsey, 2021b). However, the pressure on traditional suppliers in the automotive industry rises due to declining EBIT margins limiting the financial leeway for complete decarbonization (Bain, 2022).

Customers demand a mature public charging network with more fast chargers and longer driving ranges of EVs (Strategy&, n.a.). Early adopters mainly relied on private chargers while future customers mainly live in high-density areas without the possibility to install a wallbox (McKinsey, 2021c). Lowering bureaucratic hurdles and fastening approval procedures will be critical for an accelerated expansion of the public charging network (Strategy&, n.a.). Large revenue potentials can be exploited as the market is expected to grow to 3.3 B€ by 2030 (EuPD, n.a.). However, current growth rates, as shown in figure 5, are not sufficient to reach the target of one million public charging points by 2030 (Bundesregierung, 2023).

Figure 5 Number of Public Charging Stations in Germany (2017-2022)



Source: Own illustration following Bundesnetzagentur (2022)

Apart from multiple electromobility-specific challenges, the rising number of global crises further impacts the German EV market. Disrupted supply chains and chip shortages were effects of the COVID-19 pandemic and the war in Ukraine decelerated the transformation as well (Strategy&, 2022b). Furthermore, potential customers fear that they cannot afford EVs in the future due to rising energy prices (Automobilwoche, 2022) and an all-time high inflation rate (Tagesschau, 2022c).

Market Outlook

The German EV market is currently progressing dynamically with a strong growth tendency. However, Germany is already lacking behind its climate targets (Focus, 2023). German automotive corporates' market position could further decline due to delayed progress in building out core competencies for the mobility market of the future. Amplified efforts particularly from automotive players and politicians will be necessary to achieve the target of 15 million EVs in Germany by 2030 (Bundesregierung, 2022). Most German automotive corporates already announced a date when they want to stop selling ICEs in the EU. Opel will be the first in 2028, followed by Mini and Mercedes in 2030, and lastly Audi and VW in 2033. Porsche and BMW have not stated a complete ban on ICE sales for a specific time ahead yet (ADAC, 2022d). And the regulatory framework will become tightened to further restrict CO_2 emissions. Besides an

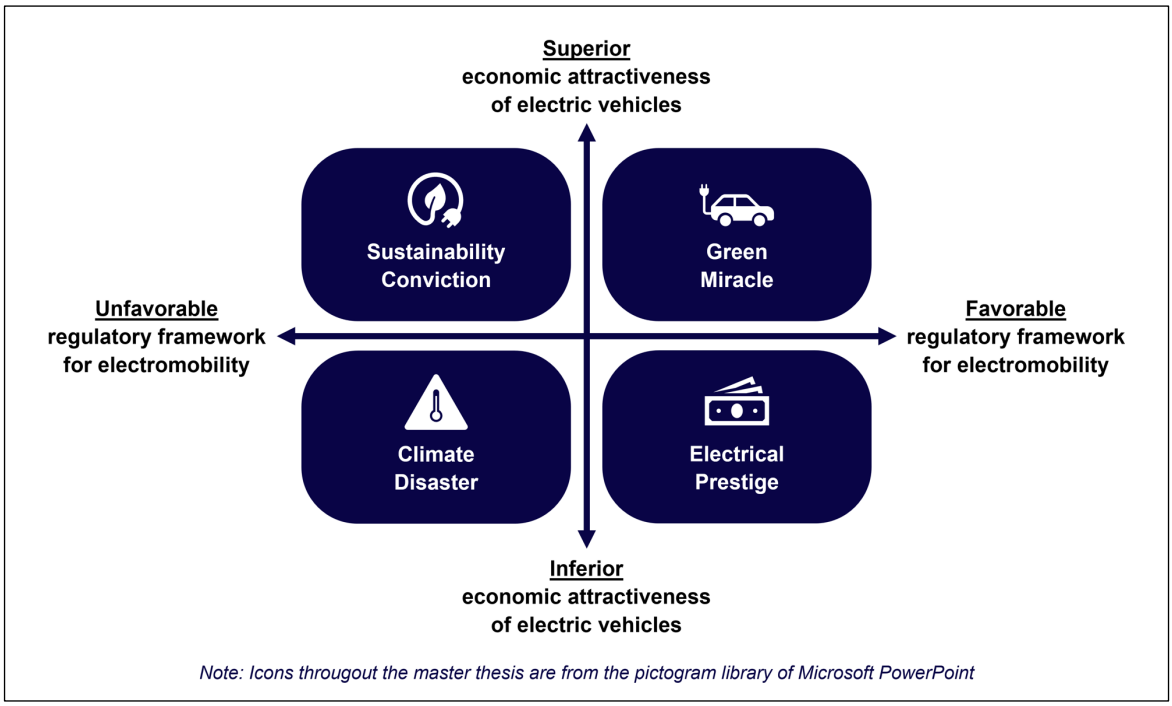
EU-wide sales ban on emitting cars by 2035, EU fleet targets will decline by 15% from 2025 and 37.5% from 2030 onwards (EC, n.a.b). In 2026, the EU will additionally revise the sales ban on emitting cars including ICEs which run based on e-fuels – fuel types produced from renewable sources or decarbonized electricity. This could serve as a turning point for EV growth rates in case of a favorable outcome for e-fuels (Tagesschau, 2022a).

According to Greenpeace, Germany will most likely miss its target of limiting the CO_2 emissions of the traffic sector to 85 Mt per year by 2030. This target could only be reached by selling 20 million EVs and thereby outperforming Germany's target of 15 million EVs in the same period considered. However, calculations from Greenpeace indicate that Germany will even fail to achieve its target of 15 million EVs in 2030 (Greenpeace, 2022). According to Strategy&, forecasted numbers project 10.5 million EVs requiring 340,000 public charging points by 2030. Hereby, Strategy& questions the rapid development of a mature public charging network and projects 130,000 missing charging points in 2030 based upon the projection of 10.5 million EVs (Strategy&, 2022b). Overcoming major challenges (see chapter 2.3) and adopting stricter regulations (see chapter 2.2) will be critical to growing sustainably and paving the way for a 65% reduction of national CO_2 emissions overall by 2030 as an intermediate target for reaching climate neutrality in 2045 (BMWK, 2022a).

4 Scenarios

Based on the market situation and the various trends in the German automotive electromobility market described above, we have developed four scenarios that present different possible pictures for the industry's future in 2030. These scenarios are determined primarily by the two critical uncertainties, that form the dimensions of our scenario matrix – *economic attractiveness of EVs and regulatory framework for electromobility.* We have named the resulting scenarios "Green Miracle", "Electrical Prestige", "Climate Diaster", and "Sustainability Conviction" (see figure 6). They are described in the following, first briefly and then in more detail.

Figure 6: Scenario matrix for the German EV market



Source: Own illustration, following Schenker & Wulf (2013), p. 106

Overview

Scenario A: Green Miracle

"Green Miracle" describes Germany's successful transition to electromobility by 2030, making the country a global model for sustainable mobility. This is due to a favorable regulatory environment, technological advances, and demographics. Affordable EV models, local battery production, and cooperation with other countries have made the market accessible to everyone. Oil supply disruptions, high CO_2 levies and the expansion of renewable energy are leading to rising fuel costs and falling electricity prices, making EVs more attractive. Germany achieves its target of 15 million EVs and a

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Scenario C: Climate disaster

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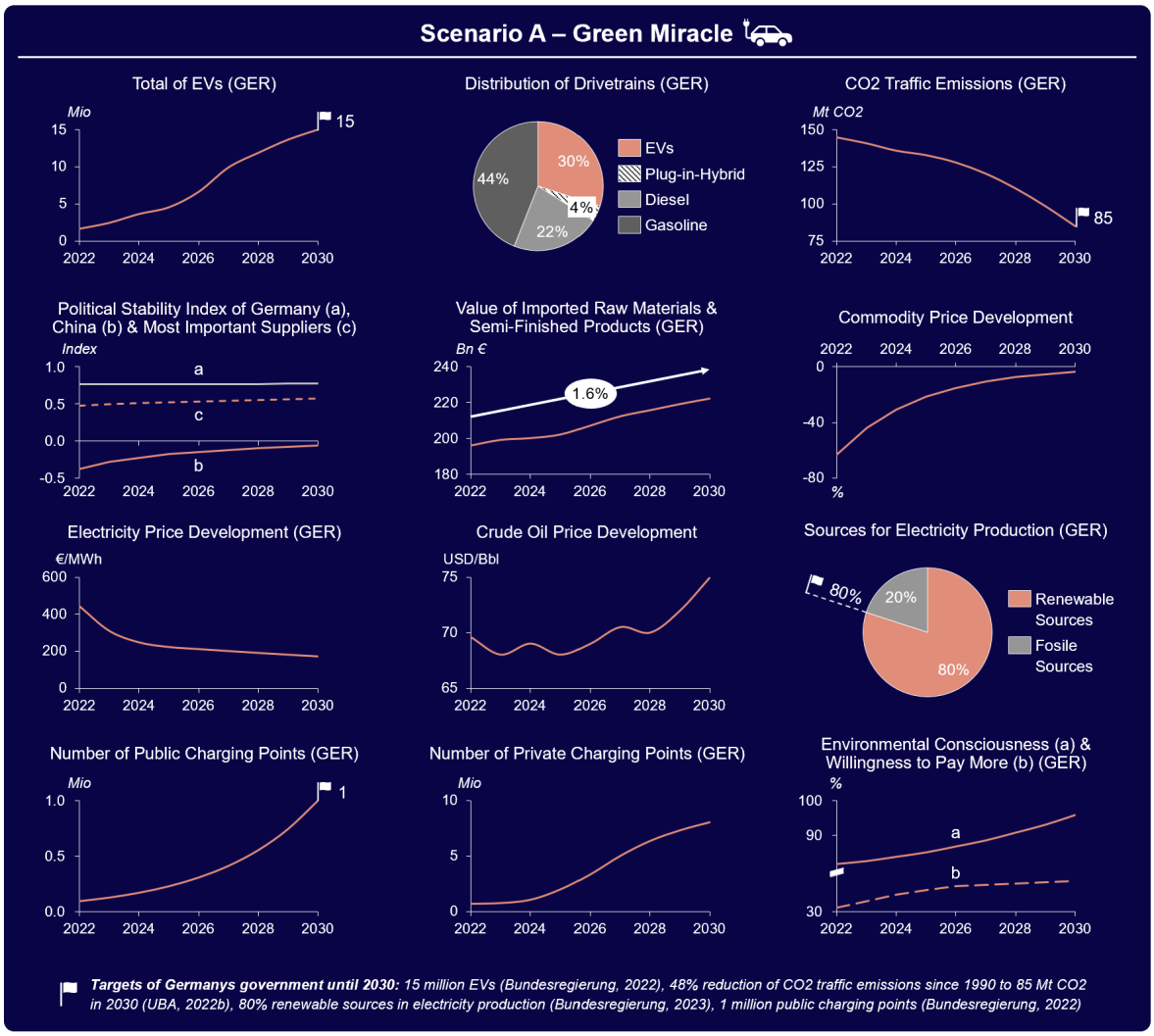
Scenario D: Sustainability Conviction

“Sustainability Conviction” describes a future in which the German EV market grows due to early adopters with strong environmental concerns, supported by reliable supply chains and lower electricity prices. However, an unfavorable regulatory framework and the continued popularity of ICE vehicles limit the reduction of CO_2 emissions. In this scenario, global trade diversification and sustainable material supply chains strengthen Germany's position as a supplier of low-cost EV models. Meanwhile, volatile and inflated oil prices are countered by falling electricity prices and increased renewable energy production.

Scenario A: Green Miracle

December 2030 – Successful shift to electromobility in Germany

In 2030, electromobility developed into a national success story and Germany became a role model for sustainable mobility around the world. Hereby, the availability of small and low-budget EV models made the electromobility market accessible for citizens across all income classes. A superior economic attractiveness of EVs was formed through reliable supply chains and decreased utilization costs of EVs compared to ICEs. China de-escalated its conflict with Taiwan and remained a reliable business partner while Germany successfully strengthened collaborations with aspiring countries to diversify the supplier network. Intensified local production of EV batteries ensured higher control over the value chain. The insufficient supply of oil due to Russia's long-lasting war and selected OPEC agreements resulted in rising fuel costs, additionally amplified by higher CO_2 charges. Meanwhile, large liquid gas deliveries and an accelerated expansion of renewable energy sources led to sustainably declining electricity prices. EVs' TCO were further pushed down through prolonged subsidies for EVs and reinstated support for wallboxes. A favorable regulatory framework for electromobility was created by prioritizing the public charging network and adopting tightened emission restrictions. Smoother processes and financial incentives led to a rapid expansion of the public charging infrastructure ultimately increasing EVs' practicability in everyday use. Stricter CO_2 emission limits on the EU level and nationally banned sales of high-emitting cars paved the way for compliance with climate targets. A combination of positive milestones regarding economic and regulatory aspects led to a widespread shift of societal perception toward great approval for EVs. This evolution was reinforced by technological advancements and demographic change. Revolutionized driving ranges, especially of low-budget models, increased EVs' convenience. A strong voice of generation Z amplified the green mindset with the desire to drive electrical and fostered the stigmatization of ICE drivers. Overall, Germany successfully achieved its targets of 15 million EVs and a reduction of CO_2 emissions to 85 Mt CO_2 by 2030.



Source: Own illustration, following Schwenker & Wulf (2013), p. 118

Developments in the EV market between 2022 and 2030

1) Until 2030, various geopolitical circumstances have developed in favor of reliable supply chains and reduced electricity for a *Superior economic attractiveness of EVs*. A de-escalation of China's threat of a military conflict with Taiwan in 2023 has enabled a closer partnership with Germany which is especially relevant for a sufficient supply of batteries, chips, and semiconductors. China has successfully diminished supply chain disruptions at the beginning of 2023 resulting from a COVID-19 outbreak. However, the incipient problem of demographic change, in the sense of an aging population as a result of the one-child policy, has slowly reduced economic output in the long term. Germany has not only relied on collaborations with China but has also successfully strengthened partnerships with countries worldwide to diversify the supply chain hence decreasing the risk of disruptions and shortages. Aspiring partnerships with India and Vietnam have strengthened in the first half of the decade to ensure the reliable

production of EV components by maintaining low labor costs. The Comprehensive Economic and Trade Agreement between the EU and Canada has opened up new opportunities for the sourcing of critical raw materials for EVs. Imports of Canada's copper, nickel, and graphite have increased since 2023 onwards and German companies have settled down in Canada for lithium and cobalt mining close to the end of the decade. Local lithium mining in Germany, e.g. under the Rhine river, and systematic recycling of batteries have both start in the second half of the decade to reduce dependencies on supplying countries. Meanwhile, commodity prices have shrunk gradually over the years due to discoveries of new mining fields, improved efficiency of raw material utilization, and increasingly digitized logistics minimizing unexpected disruptions. For instance, the discovery of Europe's largest rare earth deposit in Sweden has decreased the risk of shortages by the end of the decade. In the EU, the election of right-wing governments was stopped resulting in greater cohesion with critical countries for the German automotive industry like Hungary, Poland, and Italy which increases the attractiveness of nearshoring. A combined result of the explained developments on a global scale has lead to an increasing connectedness and wealth in Germany's economy overall. Hereby, the automotive industry has benefited from a flourishing supply chain with growing imports of raw materials and semi-finished products. The local production of EV components has developed rapidly. Several gigafactories for the production of EV batteries have emerge until 2030 making Germany the center of EVs' value chain in Europe. Thereby, automotive corporates have aimed to increase their control over major parts of value creation by building their gigafactories. Additionally, global technology companies have settled down in Germany for the production of chips and semiconductors. For instance, Intel to built its first chips in Magdeburg in 2027. All in all, strengthened global partnerships, a diversified supplier network and a ramp up of local production have ensured a reliable supply of EV components and raw materials leading to higher competitiveness of German companies through decreased production costs, and affordable EV purchase prices for customers.

2) Russia has further escalated the war in Ukraine in 2023 at the end of the cold season and thereby partially lost remaining support from the world community. After ending the military conflict in the winter of 2023, numerous countries have persistently boycotted Russia's activities on the market resulting in a limited supply of oil. Additionally, agreements between OPEC states have lead to lower oil production to inflate oil prices artificially. Strategies based on oil scarcity have been supported by most countries due

to increased margins and distributed earnings over a longer timespan which had become important for selected countries with imminent ending oil reserves. However, not every oil-producing country has endorsed OPEC agreements hence crude oil prices have become volatile and rose drastically until 2030, with fuel prices increasing accordingly. Furthermore, a sharper increase in CO_2 prices in Germany has become effective in the following years reaching 55 €/t CO_2 in 2025 which has significantly increased gasoline and diesel prices. The national system to regulate CO_2 emissions has been replaced by the EU-wide Emissions Trading System (ETS II) from 2027 onwards which has been adopted without an initially planned price cap for CO_2 prices. Additionally, stricter regulations concerning the carbon leakage list and fewer CO_2 certificates have increased CO_2 prices for industrial production. Gas has been the most expensive source for the development of electricity and therefore determined Germany's electricity price according to the merit order principle. While the volume of gas supply from Germany's key exporting countries Norway, the Netherlands, and Belgium had been maintained, the increasing import of liquid gas from the U.S. and Qatar has compensated for the lack of gas caused by a persistent boycott of Russia. A downturn in diplomatic relations between Germany and Qatar, mainly because of accusations about human rights violations during the FIFA World Cup 2022, has been overcome and new deals with Qatar have ensured larger deliveries of liquid gas. For this purpose, Germany has prioritized the development of an appropriate infrastructure for liquid gas imports. Two LNG terminals in Wilhelmshaven and Brunsbüttel has received their first deliveries in spring 2023 and four additional LNG terminals have went operational in 2025. The implementation of a gas price limitation and the formation of a collective purchase unit on the EU level from 2023 onwards has lowered the price additionally. Germany has successfully ramped up and diversify its electricity production while increasing the efficiency of electricity consumption. The running time of three nuclear power plants in Germany have been prolonged until spring 2024 and the expansion of renewable energy production has been accelerated. A key success has been the development of solar parks in unpopulated areas, e.g. around highways, and private photovoltaic systems, also enforced by a higher willingness to install bidirectional charging systems. New wind power parks in the north of Germany and the Baltic Sea have been another important pillar to reaching an energy mix with at least 80% of electricity produced from renewable sources in 2030 and thereby increased control over the electricity supply. The price cab for gas and electricity for 80% of consumption from the

previous year decided in 2022 has successfully broken the steep increase in electricity consumption in the upcoming years. The energy-heavy production of EVs requires more electricity compared to ICEs. Consequently, to decrease the rising financial attractiveness to produce ICEs during electricity price peaks, the German government has adopted subsidies specifically for the production of EVs. The elimination of the EEG law in summer 2023 and a decreasing supply of electricity for France has additionally amplified a significant drop in electricity prices until 2024. All in all, a stable supply of gas and boosted electricity production on the national ground has lead to decreasing electricity prices while volatile oil prices and CO_2 charges raise fuel costs – both developments support the economic superiority of utilizing EVs.

3) The increased visibility and occurrence of climate change effects worldwide have lead to a raising percentage of people that are willing to pay a significant surcharge for EVs until 2025. However, EVs' purchase prices have been further pushed down to enable access to electric mobility for people across all income classes. In 2023 and 2024, planned subsidies of up to 6,750 € and 4,500 € respectively have become effective for customers as part of Germany's environmental bonus (Umweltprämie) while the fund has been nearly exhausted in 2025. Hereby, PHEVs has not been subsidized and one-third of subsidies have been carried by automotive companies. Before the federal elections in 2025, sustainability topics have dominated campaign pledges. The elected government will opt for an extension of the funding scheme as a result of a weakened growth rate of EVs in Germany. Further subsidies for EVs up to purchase prices of 40,000 € until 2027 have lead to accelerated sales of small and low-priced EV models. The decision for maintained subsidies has also been driven by an urgent need to keep up domestic EV sales for the persistent competitiveness of German companies against foreign manufacturers and tech companies. Additionally, German politics has supported the installation of charging points in private households by adopting subsidies of up to 500 € from 2026 until 2027. Consequently, wallboxes have been purchased massively reaching eight million private charging points in 2030 which is more than 50% of EV owners. Hereby, more and more customers have relied on bidirectional charging systems to ensure an autonomous energy supply and to benefit from efficiency gains and shorter charging times. Moreover, the duration and deadline of the currently applicable tax exemption for the private utilization of EVs has been prolonged. The shift to purely electric drivetrains has been additionally incentivized as PHEVs for professional utilization were taxed like ICEs from 2024 onwards. All in all, Germany's

government has successfully steered EV sales through monetary incentives leading to reduced TCO.

4) The German population has been hit by an increased frequency and destructiveness of environmental catastrophes as a result of climate change. Floods with severe consequences have occurred in recent years and harvest failures of domestically produced nutrition have become obvious in supermarkets. Additionally, global incidents of wildfires, floods, and heat waves have dominated the news while the fast-increasing temperature has led to crossing the threshold of selected tipping points before 2030. For instance, an abrupt thaw of the boreal permafrost has released methane and carbon dioxide causing an acceleration of climate change. All of the above-described events have resulted in a widespread general environmental consciousness in German society which has been reflected in political decision-making. Hereby, politics has set a favorable regulatory framework for electromobility independent of monetary incentives. Stricter regulations have been adopted on the national level to enforce compliance with EU-wide fleet targets which in turn have been tightened throughout the decade as well. This has included a national sales ban on cars emitting more than 20% above the defined CO_2 limits from 2025 onwards. The emission control of newly-released cars has been improved to close loopholes for manipulations of CO_2 levels. Furthermore, more German cities have implemented driving bans for specific diesel cars like Munich in 2023 because of dangerous levels of particulate matter and nitrogen oxides. All in all, stricter regulations for passenger cars with seamless monitoring techniques have driven the decarbonization of Germany's traffic sector.

5) The development of a comprehensive public charging infrastructure, including charging hubs exclusively provided for companies or certain municipalities, has increased EVs' convenience in everyday use. A demand-driven expansion has been pursued to reach one million public charging points by 2030 in line with the development plan of the German government. Hereby, most subsidies until 2024 have incentivized the installation of fast chargers on motorways and in high-density areas to make electromobility accessible for everyone. Additionally, targeted grants for municipalities from 2024 onwards have supported the development of charging hubs in isolated areas. Most funds have been received by energy companies while automotive companies have accounted for a small share of public charging points by 2030, except for Tesla, hence their economic benefit is limited. The German government has

successfully approved new financial instruments and has shifted grants, e.g. within the national climate and transformation fund, to increase available resources. The exploding market growth has additionally attracted money from private investors. To speed-up approval procedures, collaborative inspections by public authorities and infrastructure developers have enabled faster identification of suitable spaces for charging hubs in Germany's major cities. Lowered bureaucratic obstacles concerning approval procedures and applications for subsidies have fastened and simplified the overall process from 2024 onwards. The German government has adopted comprehensive standardization laws in 2024 to force infrastructure developers and automotive companies to harmonize charging procedures through unified power plugs and universal payment systems. All in all, financial incentives have steered the expansion of the public charging network. Hereby, automotive companies and customers have benefited from the high convenience of EV utilization through a mature public charging infrastructure which has led to increased demand for EVs.

Scenario B: Electrical Prestige

December 2030 – Wealthy customers dominate the electromobility market

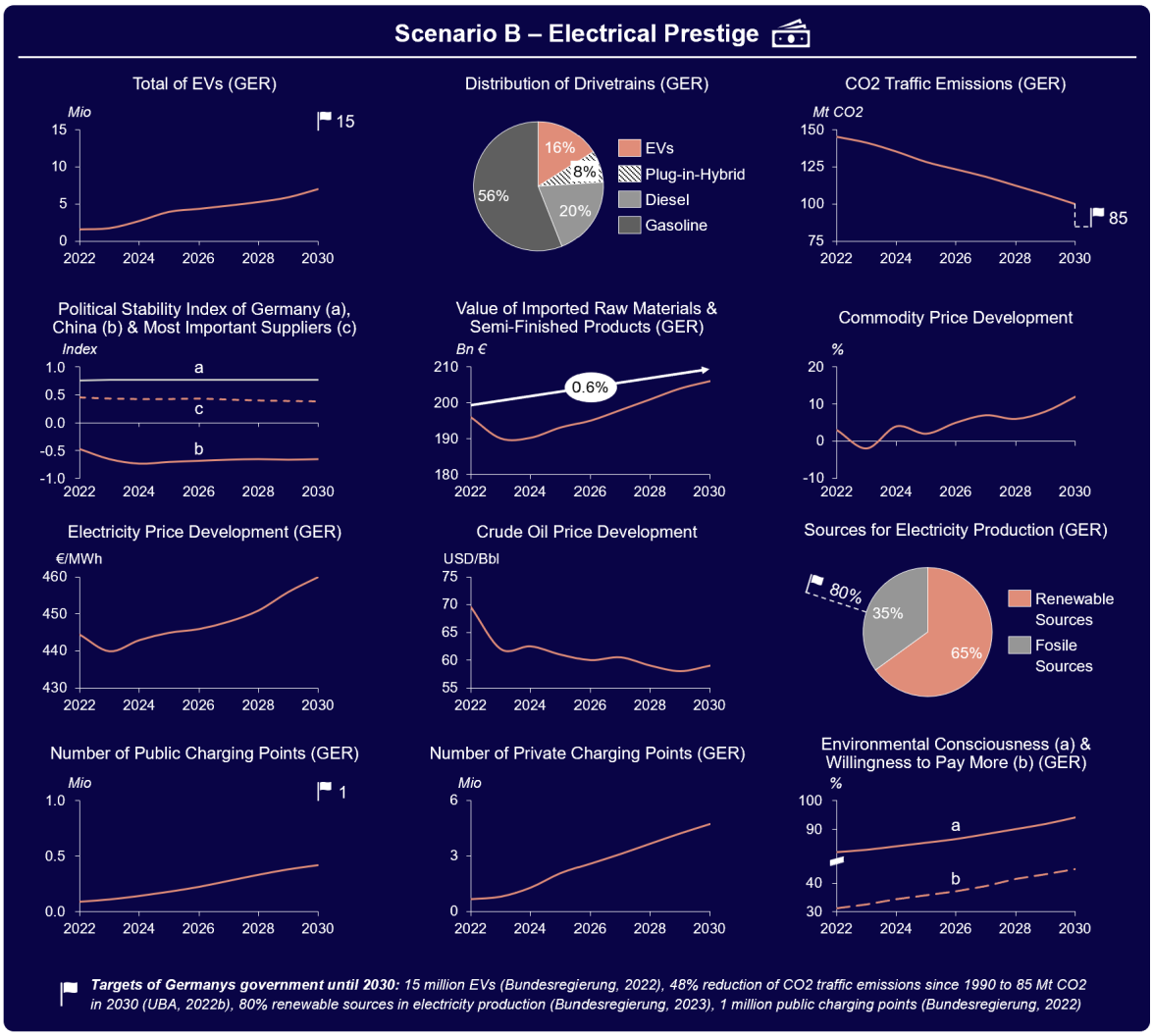
In 2030, Germany steered into a two-tier society as EVs became exclusively affordable by prosperous customer groups. Meanwhile, people from societal parts with middle and lower incomes kept older ICEs or were forced to switch to public transport due to fewer affordable alternatives. An inferior economic attractiveness of EVs originated from deteriorated global trade and hampered electricity production while fuel costs declined significantly. China's exacerbated conflict with Taiwan and the adoption of advantageous regulations for Chinese competitors resulted in decreased supply of essential EV components for the German automotive industry. Greater oil production by Russia and Saudi Arabia created cheap oil prices which weren't balanced through increased CO_2 prices hence fuel costs fell sharply. Simultaneously, lacking gas deliveries, a slow expansion of renewable energies, and an exploding energy consumption led to high electricity prices for EV charging. To boost EV sales, the list of subsidy-eligible cars concerning Germany's environmental bonus was extended which increased the predominance of electric middle and upper class models and SUVs. A favorable regulatory framework for electromobility was shown by disproportionately high budgets for the realization of public charging infrastructure projects while Germany lacked financial resources overall due to an economic downturn. The German government adopted stricter regulations including sales bans on high-emitting cars to lower traffic emissions overall, as EV growth rates stagnated over time. However, the favorable regulatory framework couldn't fully equalize the negatively developing economy. As a consequence, electromobility became a popularizing topic with tensions as it divided society along income classes. Due to the persistently high TCO, EVs became a status symbol for prosperous parts of society. Overall, even though only seven million EVs were sold in total, CO_2 emissions were significantly reduced to 100 Mt CO_2 by 2030 because of fewer cars on German streets altogether.

Developments in the EV market between 2022 and 2030

1) Until 2030, geopolitical crises have led to disrupted supply chains, cheap fuel costs, and electricity shortages resulting in an inferior economic attractiveness of EVs. An exacerbation of China's conflict with Taiwan in 2023 and intensified oppression of the

Uyghurs in automotive-heavy areas have weakened diplomatic relations with Germany.

Figure 7 Fact Sheet Scenario B - Electrical Prestige



Source: Own illustration, following Schwenker & Wulf (2013), p. 118

Additionally, China has claimed nationally produced EV components for local car manufacturers while import duties for foreign vehicles have secured their competitive advantage in the Chinese market. German companies have tried to compensate for dropping imports from China through strengthened partnerships with other low-cost countries and boosted production in Germany. However, increased deliveries from newly established manufacturing sites have not provided enough EV components to satisfy the rising demand, especially EV batteries, chips, and semiconductors which have become rare. Production in locally emerging gigafactories has been delayed, also because of automotive companies' little financial leeway due to lacking sales of high-margin premium cars in the Chinese market. The raising demand for raw materials has

created an upward spiral of commodity prices until 2030 and the pressure to incorporate ESG-conform practices throughout production has intensified the price hike. Efforts to better control the supply of critical raw materials from abroad have not been successful and civil protests with public turmoil have hindered the extraction of lithium in Germany. The reuse of raw materials through recycling methods will become important post-2030. Therefore, German companies have suffered from sustained price hikes for EV components and raw materials. Fast-growing automotive players abroad and EV rollouts by tech companies have increased global competition additionally. For instance, Apple plans to roll out its first EV by 2026. All in all, unfruitful global collaborations and delayed local production have not met the heavily rising demand for critical EV parts and precious metals resulting in high production costs for automotive companies which have been reflected in expensive EVs for customers.

2) Russia has upheld its volume of oil supply to finance the ongoing war in Ukraine and Saudi Arabia has intensified production to be able to maintain high investments for the realization of its vision 2030. Both China and India have supported the development and increasingly bought oil to boost their economic growth. As a consequence, large quantities of exploited oil have led to a decrease in crude oil prices while Germany has not prevented simultaneously dropping fuel costs through a sharper raise in CO_2 charges. In 2027, the national system to regulate CO_2 emissions will have been replaced by the EU-wide Emissions Trading System (ETS II) including a planned price cap of 45 €/t CO_2 by 2030 which is lower than Germany's CO_2 price of 55 €/t CO_2 in 2026. This will have amplified the decline of fuel costs in the second half of the decade and will have signaled a raising attractiveness of ICEs. On the other side, efforts to reduce Germany's electricity price sustainably will not have paid off until 2025. Throttled gas deliveries from key suppliers in Europe and ponderous negotiations for larger liquid gas deals with Qatar and the U.S. will have led to an insufficient supply of gas. Heavy gas consumption by heaters in cold winter periods will have intensified the scarcity of gas for electricity production resulting in high gas prices that ultimately determine the electricity market price in line with the merit order principle. Furthermore, the deployment of renewable energies will have developed slowly and will thus only have reached 65% of renewable sources in Germany's energy mix for electricity production by 2030. Hereby, especially bureaucratic approval procedures for solar and wind parks and the unpopularity of private photovoltaic systems will have hampered progress. Accelerating electricity consumption will have continued driven by a skyrocketing demand

in the industry. Consequently, electricity prices will have increased despite the elimination of the EEG law in summer 2023. All in all, the abundance of cheap oil and a shortage of electricity will have created an economic supremacy of ICEs in comparison to EVs. ICE drivers will have benefited from low fuel costs while companies avoid the energy-heavy production of EVs.

3) The effects of climate change have increasingly become visible to the German population, and environmental consciousness throughout society has grown as a consequence. However, politics have not succeeded in offering electromobility for customers across income classes because of lacking financial resources and misguided subsidies. Subsidies of up to 6,750 € and 4,500 € have become effective for the purchase of EVs as part of Germany's environmental bonus in 2023 and 2024 respectively. Due to the lacking availability of smaller low-budget EV models, the German government has expanded the list of subsidy-eligible cars in 2024 to accelerate EV sales by targeting wealthy customers. Hereby, subsidies for relatively expensive EVs up to 65,000 € have been maintained. However, people have hesitated to order EVs because of persistently long waiting times, making it unpredictable if the environmental bonus will be paid, as the disbursement depends on the availability of funds when receiving the car. Until the end of the current legislative period, the purchase of wallboxes has not been subsidized anymore. After the federal elections in 2025, financial resources are very limited for the years ahead because of exploding expenditures for defense as well as social and health systems. No further grants for EVs or private charging stations have been adopted while Germany's new government has focused its efforts on a rapid expansion of the public charging network, as explained in the next paragraph. Nevertheless, the number of wallboxes and bidirectional charging systems has increased, albeit somewhat slower because of their decreased economic attractiveness, as most EV drivers have been particularly the ones that possess a private house with the possibility to install a charger. Moreover, the implementation of a new taxonomy for the private utilization of EVs from January 2031 has gotten closer. Hereby, eliminating EVs' full tax exemption has signaled a decreasing attractiveness of EVs before 2030. All in all, EVs' TCO has sustained at a high level, and instruments to accelerate EV sales have encouraged wealthy customers to purchase EVs while the rest of society has been left behind.

4) Sustainability topics have become more and more important as an increased frequency and destructiveness of environmental catastrophes caused by climate change have hit the German population in recent years. Hereby, politics have set a favorable regulatory framework for electromobility independent of monetary incentives. Stricter regulations have been adopted on the national level to enforce compliance with EU-wide fleet targets which in turn have been tightened throughout the decade as well. Newly adopted regulations aim to decrease total CO_2 emissions of the traffic sector by compensating for the slow growth of EV sales, as explained in previous paragraphs, with low-emitting ICEs and fewer car sales altogether. This includes a ban on sales on German ground for cars emitting more than 15% above the defined CO_2 limits from 2025 onwards which has resulted in dropping car sales overall with especially fewer diesel cars. Additionally, the emission control of newly-released cars has been improved to close loopholes for manipulations of CO_2 emission levels. Furthermore, more German cities have implemented driving bans for specific diesel cars – like Munich in spring 2023 – because of dangerous levels of particulate matter and nitrogen oxides. All in all, stricter regulations including sales bans on specific passenger cars on the national level have led to a reduced number of cars on German streets and decreased CO_2 emissions.

5) The convenience of EVs has been increased by the development of a comprehensive public charging infrastructure network until 2030, including charging hubs exclusively provided for companies or certain municipalities. A demand-driven expansion has been pursued in the past years to reach one million public charging points by 2030. Hereby, the widespread installation of Smart-Meter-Gateways in EVs – devices that measure, send, and receive data in real-time – and a fostered exchange between key players in the industry and politics have laid the foundation for effective subsidies. Until 2024, most grants have incentivized the development of fast chargers on motorways and in high-density areas to make electromobility accessible for everyone. Additionally, subsidies for municipalities from 2024 onwards have supported the development of charging hubs in isolated areas. Most funds have been received by energy companies while automotive companies have accounted for a small share of public charging points by 2030, except for Tesla, hence their economic benefit is limited. After the federal elections in 2025, the new German government has lacked financial resources because of exploding expenditures for prioritized domestic issues. No further grants for EVs or wallboxes have been adopted, as explained in a previous paragraph.

Germany’s new government has focused its efforts and available budgets on a rapid expansion of the public charging network. The strong growth rate of the charging market has additionally attracted money from private investors. To speed-up approval procedures, collaborative inspections by public authorities and infrastructure developers have enabled faster identification of suitable spaces for charging hubs in cities. Lowered bureaucratic obstacles and the implementation of a digital application for approval procedures and applications for subsidies have fastened and simplified the overall process from 2024 onwards. The German government has adopted standardization laws in 2024 to force infrastructure developers and automotive companies to harmonize charging procedures through unified power plugs and transparent charging possibilities like universal payment systems. All in all, prioritizing the development of public charging stations by politics has fastened the realization of expansion plans to reach more than 400,000 public charging points by 2030. This has been sufficient for seven million EVs with most owners having a wallbox at home. Automotive companies and customers have benefited from the mature public charging infrastructure network leading to EVs’ high practicability in everyday use.

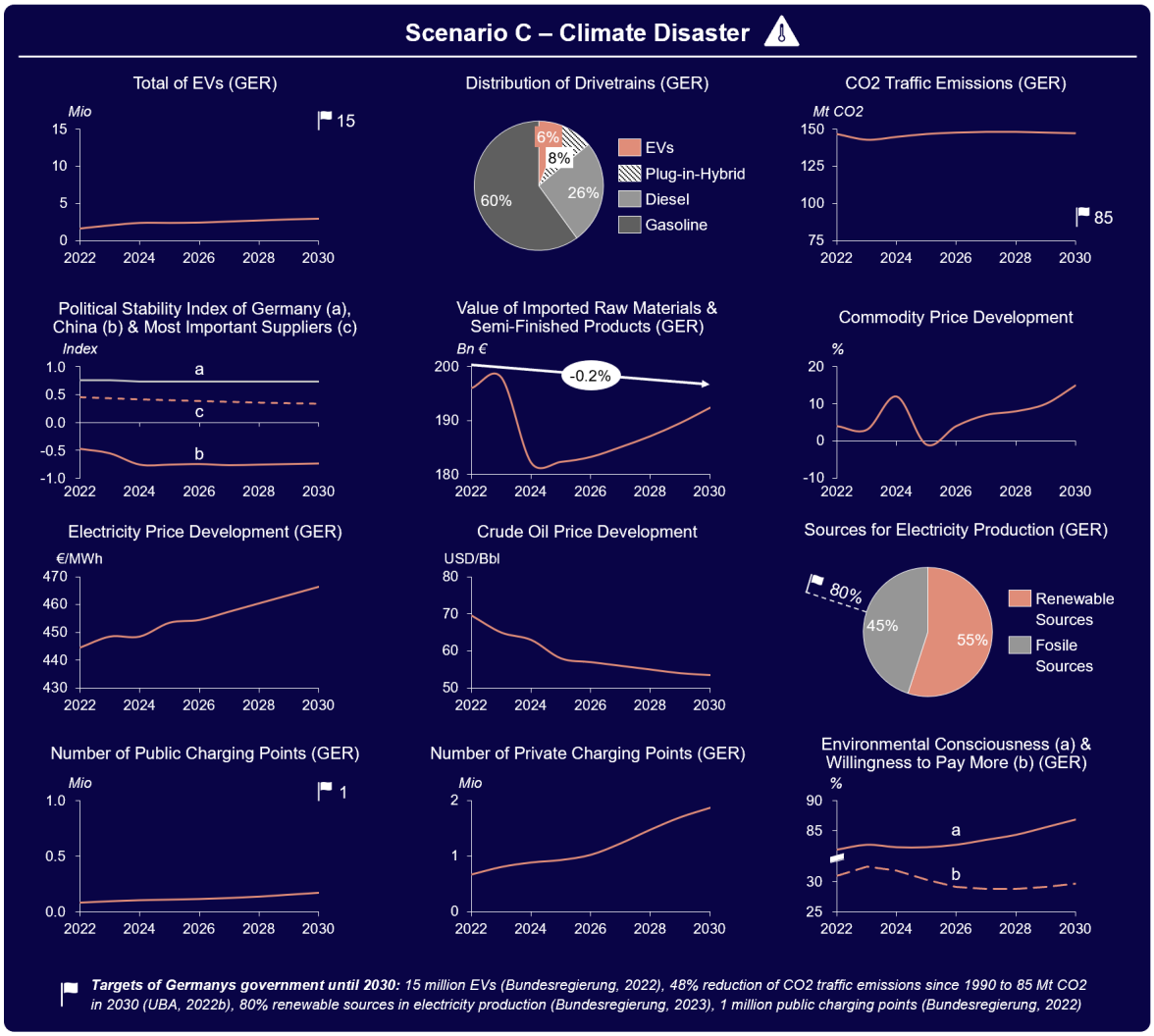
Scenario C: Climate Disaster

December 2030 – Emission-rich mobility forms accelerate climate change

In 2030, climate neutrality of Germany's traffic sector by 2045 became unattainable because of the strongly underperforming EV market and the high popularity of ICEs. EV sales stagnated over time and the used car market for older ICEs experienced a revival. An inferior economic attractiveness of EVs resulted from an insufficient supply of EV components while electricity prices reached their all-time high. A threatening outbreak of a military conflict between China and Taiwan led to an EU-wide boycott of trade with China. As a consequence, the automotive industry suffered from broken supply chains and shortages, especially for EV components, ultimately leading to increased EV purchase prices. Rapid exploitation of Venezuela's oil reserves and amplified oil production by Russia and Saudi Arabia stimulated a price war resulting in an abundance of cheap fuel. Meanwhile, electricity prices in Germany jumped significantly due to failed negotiations for larger liquid gas deliveries, a skyrocketing demand from manufacturing industries, and a slow expansion of solar and wind parks. An unfavorable regulatory framework for electromobility arose as the political agenda was dominated by emerging topics around foreign affairs and financial resources became limited because of a deteriorated economic situation. Subsidies for EVs were cut and politics missed the chance to implement effective incentivization mechanisms for facilitating charging infrastructure expansion plans. The absence of comprehensive standardization laws for public chargers intensified competitive market dynamics between automotive players that created brand-specific charging networks. Relaxed CO_2 emission limits and a postponement of the sales ban on emitting cars to post-2035 increased ICE's attractiveness. Cheap fuel costs and the declining purchasing power of the German population led to an upswing in the used car market for ICEs. Overall, stagnated sales resulted in

1) The impact of geopolitical tensions on Germany's automotive industry has increased until 2030. Political instabilities and damaged diplomatic relations with critical trading partners have led to an insufficient supply of EV components and raw materials, hence EV purchase prices have remained high. An inferior economic attractiveness of EVs has been additionally aggravated through sustainably reduced fuel costs while

Figure 8 Fact Sheet Scenario C - Climate Diaster



Source: Own illustration, following Schwenker & Wulf (2013), p. 118

electricity prices have reached an all-time high. The impact of geopolitical tensions on Germany's automotive industry has increased since 2021. Political instabilities and damaged diplomatic relations with critical trading partners have led to an insufficient supply of EV components and raw materials, hence EV purchase prices have remained high. The inferior economic attractiveness of EVs has been additionally aggravated through sustainably reduced fuel costs while electricity prices have reached an all-time high. The imminent outbreak of a military conflict between China and Taiwan in 2024 was expected to lead to an EU-wide boycott of trade with China. Even though imports of critical products, like selected EV components, will remain to prevent an economic recession, the German automotive industry has suffered from broken supply chains. Especially semiconductors and advanced chips have become rare as global demand is nowadays mainly satisfied by Taiwanese productions and their facilities have been shut down as a consequence of the threatening war. To compensate for the abrupt

decline in imports, Germany has strengthened partnerships with other countries and has accelerated the establishment of manufacturing facilities in Germany. However, built production sites abroad and locally emerging gigafactories have not delivered sufficient EV components in the past years, also because of automotive corporates' little financial leeway due to lacking sales of high-margin premium cars in the Chinese market. A deterioration of eastern European countries' political stability has additionally limited the number of attractive production locations. Hereby, nearshoring in eastern Europe to lower shipping costs and risks of logistical breakdowns compared to southeast Asia has not lasted as a promising option. A strongly raising global demand for critical raw materials built-in EVs has resulted in an upward spiral of commodity prices until 2023. Efforts to better control the supply of critical raw materials from abroad have not been successful. The production of lithium and cobalt in Canada has become increasingly competitive and has turned out to be troublesome for the natural environment. Civil protests with public turmoil have hindered the extraction of lithium in Germany, and the reuse of raw materials through recycling methods has not come to a breakthrough. So, automotive companies have faced increasing competition for EV parts and critical raw materials. Renowned car brands have decelerated the rollout of new EV models and have focused on sales of high-margin premium ICEs and PHEVs to secure their market position. All in all, the unforeseen rupture in relations with China has resulted in a severe downturn in the German automotive industry through broken supply chains. Consequently, the transition to electromobility has decelerated, and EV models have become more expensive.

2) Saudi Arabia and Russia have gradually increased their oil production, leading to a price war over the decade. Russia has needed to maintain large exports to finance the ongoing war in Ukraine, while Saudi Arabia – OPEC's largest oil producer – has needed to cover investment costs for the realization of its vision 2030. China and India have increasingly bought cheap oil from Russia over the next years to boost their economic growth, thereby reinforcing the vicious circle of larger production volumes and undercut prices. The exploitation of Venezuela's largest oil reserves worldwide has amplified the price pressure from 2025 onwards. Moreover, the EU-wide embargo of Russian oil has rather had a symbolic character as oil supply for selected countries, e.g. to Hungary through the Druzhba pipeline, has been maintained to prevent collapses, especially before alternative oil supply has run smoothly. The large volumes of exploited oil have led to a decrease in crude oil prices while Germany has not

prevented simultaneously dropping fuel prices through a sharper raise in CO_2 costs. In 2027, the national system to regulate CO_2 emissions has been replaced by the EU-wide Emissions Trading System (ETS II) including a planned price cap of 45 €/t CO_2 by 2030 which is lower than Germany's CO_2 price of 55 €/t CO_2 in 2026. In 2023, the German government approved fuel vouchers to facilitate commuters through times of volatile price highs as seen in 2022. On the other side, efforts to reduce Germany's electricity prices sustainably will significantly pay off post-2030 at the earliest. Throttled gas deliveries from key suppliers in Europe and failed negotiations for larger liquid gas deals with Qatar and the U.S. have led to an insufficient supply of gas. Heavy gas consumption by heaters in cold winter periods has amplified the scarcity of gas for German electricity production, resulting in high gas prices that ultimately determine the electricity market price in line with the merit order principle. Moreover, the expansion of renewable energies has developed slowly and has thus only reached 55% of renewable sources in Germany's energy mix for electricity production by 2030. Hereby, especially bureaucratic approval procedures for solar and wind parks as well as unpopular private photovoltaic systems have hampered the progress. The absence of subsidies for private charging points has decelerated the number of installed bidirectional charging systems, resulting in a sunken interest in photovoltaic technologies. The accelerating consumption of electricity in total has continued throughout the decade mainly driven by a jumping demand in the industry. Consequently, electricity prices have increased heavily despite the elimination of the EEG law in summer 2023. All in all, excessive oil supply and lacking gas deliveries have ultimately resulted in economically unattractive EVs. Driving electric has become very expensive and EVs' energy-heavy production has led to exploding costs for automotive companies.

3) Even though the frequency of climate catastrophes worldwide has increased tremendously, the desire to drive sustainably has only spread slowly throughout the German population because of the threatening impoverishment of poorer parts of society. Politics has also not succeeded in making electromobility attractive to the middle class of society because of lacking financial resources and misguided subsidies. Exploding expenditures for energy subsidies, defense, and social systems have forced the German government to shift public grants away from financial instruments to incentivize the change to electromobility. Planned subsidies of up to 6,750 € and 4,500 € have become effective for the purchase of EVs as part of Germany's environmental bonus in 2023 and 2024 respectively. However, as larger proportions of grants, originally

covering those subsidies, have been shifted to solve prioritized issues, the payment of the environmental bonus has become less likely as the disbursement depends on the availability of funds when receiving the car. Consequently, customers have hesitated to order EVs, and accelerated sales until 2022 have stagnated in the upcoming years. Additionally, the number of subsidy-eligible cars has remained limited as supply chain disruptions have retarded the development of smaller low-budget EV models. Meanwhile, expensive limousines and SUVs have dominated the market as automotive companies have aimed to benefit from high margins by exploiting limited resources efficiently. Until the end of the current legislative period, private charging points haven't been subsidized anymore. After the federal elections in 2025, financial resources will remain very limited hence no further grants for EVs or private charging stations will be adopted. Nevertheless, the number of wall-boxes has increased slowly over the years, as most EV drivers are wealthy customers that possess a private house with the possibility to install a charger. Moreover, the scheduled launch of a new taxonomy for the private utilization of EVs from January 2031 will move closer. Hereby, eliminating EVs' full tax exemption will signal a decreasing attractiveness of EVs before 2030. All in all, EVs' TCO has slightly increased while a deprioritization of electromobility has not only lowered monetary incentives but has also resulted in a failed adjustment of remaining instruments to changed market circumstances over time.

4) Despite the increasingly severe consequences of climate change, the German population has been spared from destructive natural catastrophes. The issue has been prevalent in Germany's news – albeit in a secondary role. Consequently, the environmental consciousness in German society has increased slowly. Meanwhile, arising issues around geopolitical relations, especially about the escalating conflict between China and Taiwan, and pressing national concerns around energy prices, defense, and social systems have dominated Germany's political agenda. They have become polarizing topics that have been debated heavily until the federal elections in 2025. Furthermore, exclusively relying on electromobility to accomplish a successful turnaround of the traffic sector has become risky as supply chain disruptions have hampered the development of smaller low-budget EV models, and utilization costs have remained high due to electricity price hikes, as explained in previous paragraphs. Other sustainable mobility modes have been promoted by the German government from 2026 as EVs have become unattainable for customers across income classes. Hereby, e-fuels and H2 fuel cell cars have gotten a political voice while reliable and affordable public

transport has become a priority. However, those developments have not greatly influenced the evolution of the German EV market as they have been rated as secondary elements in the 360° Stakeholder Feedback (see chapter 4.3). Reaching climate neutrality in other high-emitting industries like in the industrial, building, or energy sector has accomplished major milestones and hence seems to be more promising for political success stories. All of the above-outlined circumstances have led to the creation of an unfavorable regulatory framework for electromobility. As most European companies have struggled to fulfill EU emission targets, the EU has relaxed regulations from 2025 onwards to prevent a breakdown of the automotive industry. Even though the EU has adopted a sales ban on emitting cars in 2035, a revision of the decision in 2026 has led to a postponement signaling a higher attractiveness of ICEs. Furthermore, technological inventions to filter out particulate matter and nitrogen oxides from urban air, like currently used filter towers in Stuttgart, have made driving bans for specific diesel cars unnecessary hence discarded diesel cars have regained popularity in 2025. All in all, relaxed CO_2 emission targets and a postponement of the EU-wide decision to exclusively sell carbon-neutral cars by 2035 have boosted the automotive industry overall while decelerating the shift to EVs.

5) The maturity of the public charging network has ultimately determined EVs' practicability in everyday use. Numerous public charging stations have needed to compensate for the low number of installed wallboxes in private homes, which has been the case because of missing subsidies, as outlined in a previous paragraph. However, Germany has failed to build enough public charging points in highly demanded places. Politicians have mainly been concerned with other emerging geopolitical and domestic issues and have thereby cut financial resources for the transition to electromobility. This has been reflected in sunken subsidies for the realization of public charging infrastructure projects. Additionally, a missing focus on the creation of fast chargers by utilizing the remaining funds has led to an inefficient deployment of scarce labor and deficient charging components caused by disrupted supply chains. Bureaucratic obstacles regarding approval procedures and applications for subsidies have remained a great issue throughout the decade. The deprioritization of electromobility and market insecurities because of long approval procedures have additionally discouraged private investors from participating generously in infrastructure projects. Furthermore, the development of public charging hubs in centers of bigger cities has stagnated because of troublesome approval procedures and lacking spaces. Urbanization, projects to

preserve green areas, and a highly competitive real estate market have made it difficult to release spaces for the construction of charging hubs. The EU and the German government have missed adopting comprehensive standardization laws for a universal application of public charging points for EVs across brands. As a consequence, the serviceable network has become a strategic competitive advantage for automotive players which has resulted in strengthened monopolies of selected brands that have exclusive partnerships with infrastructure developers. The outlined development has complicated charging processes for customers and has lowered EVs' practicability overall because of several brand-specific underdeveloped networks of public charging stations. All in all, decreased subsidies and missing laws to guarantee universal applicability have resulted in an immature public charging network for customers by 2030 hence EVs' practicability has remained low.

Scenario D: Sustainability Conviction

December 2030 – Climate protectionists accept EVs' inconvenient utilization

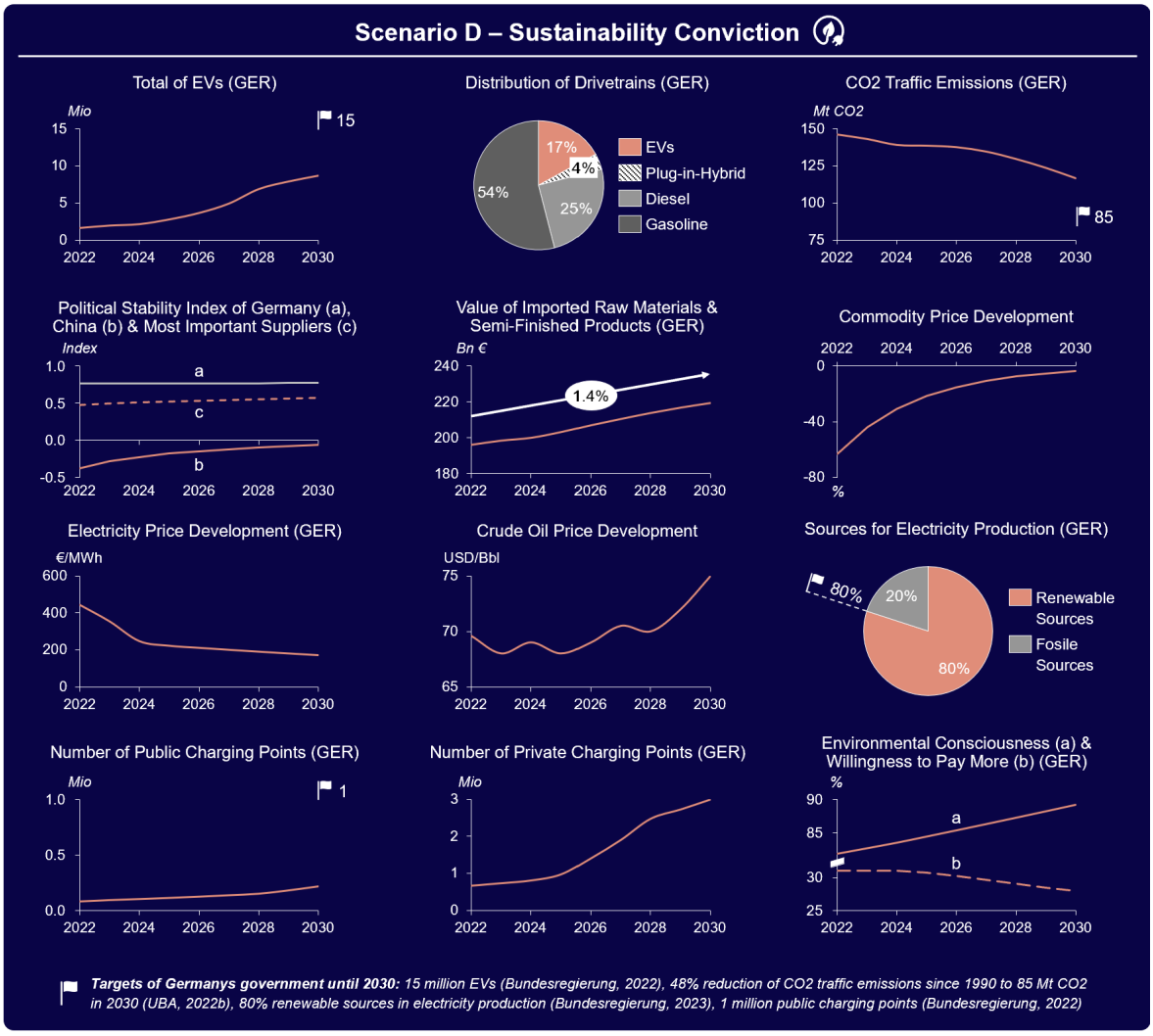
In 2030, the upswing of the German EV market was mainly driven by early adopters. They were willing to accept an immature charging network due to a great environmental mindset and a high confidence to reach climate neutrality through electromobility. A superior economic attractiveness of EVs evolved through reliable supply chains based on a diversification strategy and sustainably reduced electricity prices. Germany's amplified global trade and intensified local production guaranteed a sufficient supply of EV components and precious metals ultimately leading to fast rollouts of multiple low-budget EV models. Initial one-time costs were lowered additionally through subsidies for the purchase of EVs and private charging points. Agreements for large liquid gas deliveries and fast enlargements of wind and solar parks reduced electricity prices while fuel costs rose due to oil scarcity and CO_2 price increases. An unfavorable regulatory framework for electromobility emerged as politics were mainly concerned about emerging domestic issues while facing exploding government expenditures. The German government deployed limited financial resources prioritized for EV subsidies as explained above while neglecting public charging stations due to long-lasting bureaucratic hurdles. CO_2 emission limits on the EU level were lifted to ensure stable sales numbers of cars overall. Decreased pollution levels allowed the abandoning of driving bans for high-emitting diesel cars in larger cities leading to the maintained popularity of diesel drivetrains. The effects of negatively developing regulations on EV sales could partially be compensated by economic advantages. However, society didn't become enthusiastic about EVs but rather regard the transition to electromobility as unavoidable to reach climate neutrality in the traffic sector. Especially revolutionized EV batteries for longer driving ranges increased EVs' practicability significantly by lowering the issue of a persistently immature public charging network. Overall, the high popularity of ICEs and the availability of low-budget EV models led to an increase in cars with nine million EVs and a limited reduction of CO_2 emissions to 120 Mt by 2030.

Developments in the EV market between 2022 and 2030

1) Relaxed geopolitical situations worldwide have led to a superior economic attractiveness of EVs through reliable supply chains and reduced electricity prices compared

to fuel costs. Germany has successfully strengthened partnerships with flourishing economies to establish a robust supply of critical EV components and raw materials. A de-escalation of China's conflict with Taiwan in 2023 has enabled a closer partnership with Germany which is especially relevant for a sufficient supply of batteries, chips, and semiconductors. In 2022, Germany experienced a shocking limitation of political scope with the beginning of Russia's war due to a high dependency on Russian gas. To maintain geopolitical leeway and to decrease the risk of disruptions and shortages, Germany has aimed to diversify trade to lower dependencies on single countries.

Figure 9 Fact Sheet Scenario D - Sustainability Conviction



Source: Own illustration, following Schwenker & Wulf (2013), p. 118

Hereby, aspiring partnerships with India and Vietnam have been strengthened to ensure the reliable production of EV parts by maintaining low labor costs. Meanwhile, the election of right governments in the EU has been stopped resulting in greater cohesion with critical countries for the German automotive industry like Hungary, Poland, and

Italy, leading to a higher attractiveness of nearshoring. Moreover, several gigafactories for the local production of batteries and chips have emerged in Germany until 2030 – partly also on behalf of automotive corporates. Furthermore, discoveries of new mining fields and improved efficiency of raw material utilization have resulted in falling commodity prices. The discovery of Europe's largest rare metal deposit in Sweden has increased the availability of critical raw materials. Thereby, Germany has become the center for European battery production supplied from Sweden. All in all, amplified global trade based on a diversification strategy and a stimulated production locally has ensured a robust supply of EV components and raw materials. This has laid the foundation for the development of competitive and low-budget EV models by German automotive corporates.

2) Multiple global developments have resulted in volatile and inflated oil prices until 2030. Most countries have persistently boycotted Russia's activities on the market, also after the end of military battles against Ukraine in winter 2023. Crude oil prices have increased due to lower oil production by the OPEC. Price strategies based on oil scarcity have been supported by most countries because of increased margins. This has resulted in a sharp rise in fuel prices, amplified by elevated CO_2 costs in Germany reaching 55 €/t CO_2 in 2025. The national system to regulate CO_2 emissions has been replaced by the EU-wide Emissions Trading System (ETS II) from 2027 onwards which has been adopted without an initially planned price cap. Emission-heavy industries have faced rising CO_2 costs due to fewer CO_2 certificates. While fuel prices have reached their all-time high, electricity prices have fallen, also because of low gas prices that ultimately determine the electricity price in line with the merit order principle. Increased imports of liquid gas from the U.S. and Qatar have compensated for the lack of gas caused by a persistent boycott of Russia. Germany has successfully built several LNG terminals by 2030 to receive and process liquid gas. Meanwhile, Norway, the Netherlands, and Belgium have maintained volumes of gas exports to Germany. The implementation of a gas price cap and the formation of a collective purchase unit on the EU level from 2023 onwards have prevented unforeseen price hikes additionally. Germany has boosted its electricity production while increasing the efficiency of energy consumption. Rapid enlargement of electricity production through renewable sources has stabilized the energy supply. Hereby, solar parks and on- and off-shore wind parks have been mainly responsible for reaching 80% renewable energy sources in Germany's electricity mix by 2030. The elimination of the EEG law in summer 2023 has

reinforced declining electricity prices until 2024. All in all, sustainably reduced electricity prices through rising liquid gas deliveries and fast-expanding wind and solar parks have created an economic superiority of EVs while ICE owners have suffered from rising fuel costs.

3) Potential EV buyers, especially those with a strong sustainability conviction, have been spread across income classes. Therefore, EVs' purchase prices have needed to be further pushed down to enable access to electric mobility for people independent of their income. As grants for electromobility have been limited due to exploding government expenditures for energy subsidies, defense as well as social and health systems, the German government has focused the remaining financial resources on subsidies for the purchase of EVs and wallboxes. The development of public charging hubs has been neglected due to burdensome and long-lasting procedures, as explained in the next paragraph. In 2023 and 2024, subsidies of up to 6,750 € and 4,500 € respectively have become effective for customers as part of Germany's environmental bonus. Subsidies for 2025 have been increased to 2024's level to stimulate demand. After the federal elections in 2025, the German government has extended the funding scheme due to a weakened growth rate of national EV sales as many potential buyers in lower and middle income classes couldn't afford to drive electric without financial support. Consequently, further subsidies for EVs up to purchase prices of 35,000 € until 2028 have led to accelerated sales of small and low-priced EV models. To partially compensate for the sluggish growth of the public charging network, the German government has supported the installation of charging points in private households by adopting subsidies of up to 800 € between 2026 and 2028. Consequently, sales have slowly increased reaching three million wallboxes by 2030. However, many EV owners drive electric because of their sustainability conviction, not enabled by a prosperous background, and have been neglected as they do not possess a private house with the possibility to install a wallbox. Furthermore, EVs' currently applicable tax exemption for ten years of private utilization has maintained in the 2030s signaling electromobility's economic long-term attractiveness. All in all, monetary support for the purchase of EVs has made electromobility economically accessible for most parts of German society while subsidies for wallboxes have only partially compensated for the immature public charging network.

4) Until 2025, many potential customers have been waiting for the maturity of electromobility exemplified by a seamless transition from ICEs to EVs without making compromises. However, especially the troublesome expansion of the public charging infrastructure, as explained in the following paragraph, has led to reluctant purchase patterns in the broader society. Thereby, Germany's automotive industry has suffered from slowly growing sales numbers for EVs while the whole economy has experienced an upswing through increased global trade. To maintain automotive companies' market positions and to rescue numerous workplaces, the German government has opted for relaxed emission regulations on the EU level, also enforced by a strong automotive lobby on a national level. Due to Germany's high influence in the EU parliament and the fact that most European automotive companies struggle to fulfill EU emission targets, regulations have been relaxed from 2025 onwards. The intended tightening of CO_2 emission limits by 15% from 2025 has been postponed to 2027. Moreover, a revision of the EU-wide agreement to ban ICE sales by 2035 has resulted in a postponement of the sales ban in 2026. As a result, sales of low-emitting ICEs have been stimulated so that automotive companies can accumulate wealth to cover high investment costs for shifting to EVs. Furthermore, technological inventions to filter out particulate matter and nitrogen oxides from urban air, like currently used filter towers in Stuttgart, have made driving bans for specific diesel cars unnecessary hence discarded diesel cars have once again gained popularity from 2025. All in all, lifted CO_2 emission restrictions and a postponed sales ban on emitting cars have led to increased wealth in the German automotive industry while EVs' rising attractiveness has stagnated throughout the decade.

5) German politics have been facing strong raising government expenditures for energy subsidies, defense, and social and health systems in the years ahead. Those topics have become polarizing and have been debated heavily until the federal elections in 2025. Thereby, the German government has restricted financial resources for the transition to electromobility and has shifted grants to solve prioritized domestic issues. Moreover, reaching climate neutrality in other high-emitting industries like in the industrial, building, or energy sector has accomplished major milestones and hence seemed to be more promising for political success stories. Bureaucratic obstacles regarding approval procedures for public charging stations have remained a great issue throughout the decade. Additionally, projects to preserve green areas, and a highly competitive real estate market through urbanization effects have made it especially

difficult to release spaces for the construction of highly-demanded charging hubs in larger cities. As a consequence, the German government has focused its financial resources on incentivizing the purchase of EVs and private charging points, as explained in a previous paragraph, rather than on the realization of public charging infrastructure projects. However, this has led to the creation of an unfavorable regulatory framework for electromobility as customers have had to deal with an immature public charging network. This issue has been intensified for customers traveling long distances or in case of a lacking possibility to install a wallbox. The deprioritization of the public charging network and market insecurities because of long approval procedures have additionally discouraged private investors to participate generously in infrastructure projects. Missing standardization laws for a universal application of public chargers have lowered EVs' practicability even more as customers have had to rely on the respective brand-specific serviceable network or have had to familiarize themselves with multiple different charging procedures. All in all, limited subsidies and missing standardization laws have led to an immature public charging network that has tarnished EVs' rising image based on high economic attractiveness.

Implications

The four scenarios are not intended to predict the future of the German EV market. Instead, they provide realistic alternative views of the industry's future in 2030. The common denominator of all the scenarios is the magnitude of the expected changes. It is therefore essential for German automotive companies to start preparing today. In this chapter, we highlight some of the strategic implications for each player. However, detailed strategy recommendations can only be derived in light of each company's specific situation.

At the corporate level, strategy recommendations relate to the future design of the group’s portfolio of businesses, products, or services. To develop such a portfolio from the scenarios, managers should start out by asking two questions for each of the four scenarios:

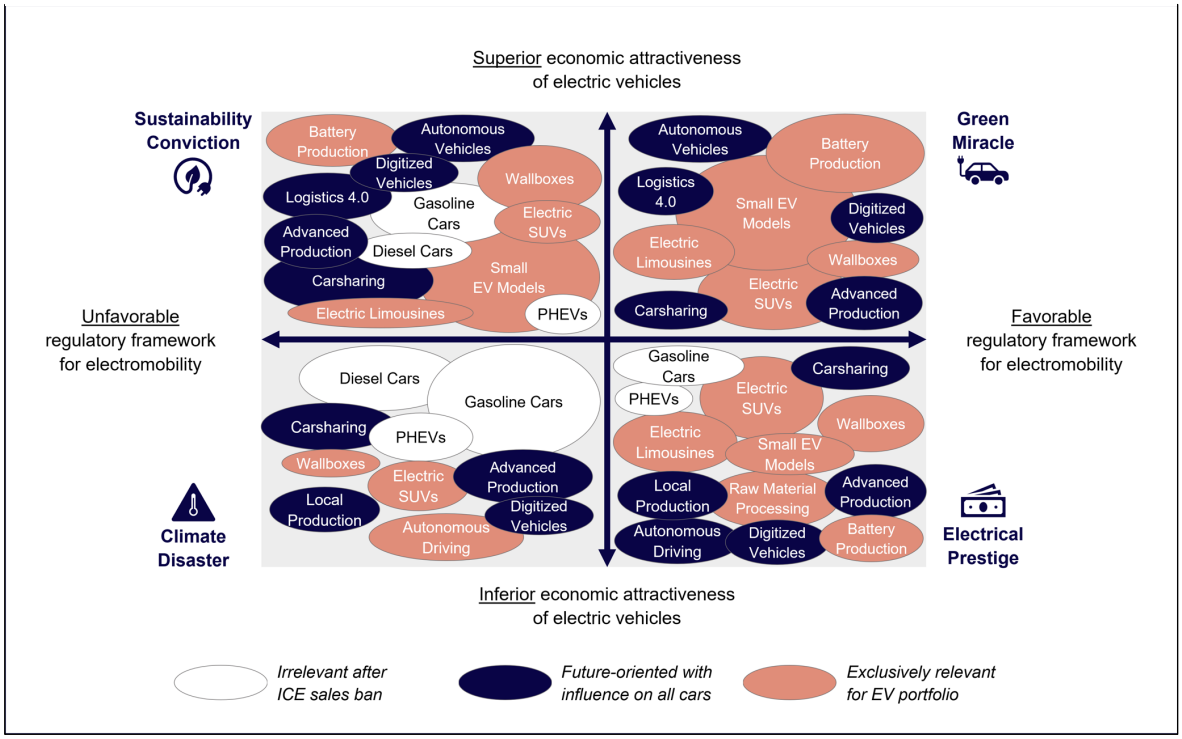
(1) Which of our current businesses, products or services seem particularly promising under the conditions of this scenario?

(2) Which new businesses, products or services are promising under the conditions of this scenario?

The answers to these two questions yield one ideal portfolio of businesses, products, or services for each of the four scenarios, which together form a scenario-based portfolio matrix. Some businesses, products or services will appear in more than one scenario and deserve particular attention.

The scenario-based portfolio matrix provides an overview of promising businesses, products, or services in each of the four scenarios. As figure 11 highlights, the four portfolios are different from each other, and the size as well as the specific orientation of the single businesses, products, or services differ in all four cases. Certainly, companies are not able (and it does not make sense) to invest in all four portfolios at the same time. Therefore, in a second step managers need to ask themselves which of the four scenarios seems most likely to become reality in order to decide which of the four scenario-based portfolios to commit the majority of the resources to. For this, we use the scenario cockpit as well as scenario-based portfolio management as tools.

Figure 10: Portfolio Matrix of Automotive Corporates for Germany in 2030



Source: Own illustration, following Wulf (2022), p. 135

The scenario cockpit is a strategic controlling tool that makes the scenario dimensions measurable. For developing the scenario cockpit, managers need to proceed in three steps:

(1) First, they need to define quantitative measures for the two scenario dimensions. The dimension “regulatory framework for electromobility” can, for example, be measured based on the “enactment of an ealier EU-wide national ban on ICE sales” or “yearly rise of standard public chags in Germany (<22 kW)”. For the dimension “economic attractiveness of EVs” the “yearly change of crude oil prices on average” and the “change of the averaged Political Stability Index of the most crtical countries for the German automotive value chain” might serve as a measure.

(2) Secondly, they need to define “tipping points”, that is: values or value ranges of a measure, that might signal a transition from one scenario to another. An increase of a yearly change of crudeoil prices on average >0, for example, might indicate a more economic attractiveness of EVs. Thus, it signals a transition toward the scenarios “Sustainable Conviction", and "Green Miracle".

(3) Finally, a traffic light system needs to be applied to the data to clearly indicate for each scenario how likely it is to occur. This helps to determine and constantly monitor the dominant, i.e., the most likely, scenario.

Based on the scenario cockpit, managers can decide, which of these scenario-based portfolios the group should focus on, that is: how resources should be allocated to different businesses, products, or services as part of the scenario-based portfolio management. However, the overview of potential portfolios recommends investments in the following areas (Figure 11):

(1) Electric SUVs

(2) Wallboxes

(3) Battery production

(4) Rapid market entry with small EV models.

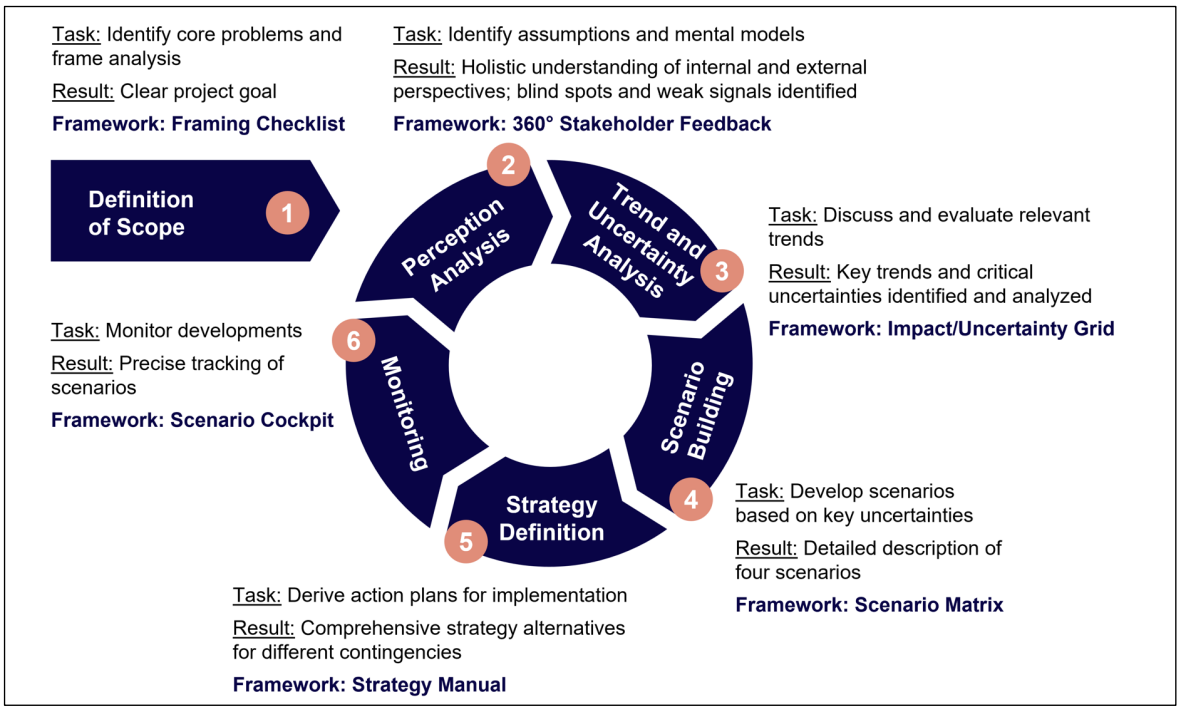
5 Methodology

HHL-Roland Berger Approach to Scenario-Based Strategic Planning

Our scenario study is based upon the approach to scenario-based strategic planning that was jointly developed by HHL and Roland Berger. The approach does not only allow creating scenarios but also enables companies to integrate scenarios into their strategic planning processes.

Our approach consists of six consecutive process steps for each of which we have created a specific tool that eases strategic planning with scenarios in practice. The approach thus enables managers to plan for multiple options. At the same time, it allows managers to integrate and align external and internal perspectives to challenge existing assumptions and mindsets (Schwenker & Wulf, 2013).

Figure 11: HHL-Roland Berger Scenario-Development Process



Source: Schwenker & Wulf (2013).

Description of process steps

Definition of Scope

The first step of the scenario development process is to define the project scope. Experts of our Center for Strategy and Scenario Planning and project partners meet to agree upon the core goal of the project. This includes identifying core problems and framing the analysis. Our Framing Checklist tool makes sure that every important

aspect is covered and that all project partners share a common understanding of the steps ahead.

To create the four scenarios for German EV market we applied the Framing Checklist. We defined the goal of the analysis to be the development of scenarios for the German EV market.

Perception Analysis

In the second step of the scenario development process, we apply our 360° Stakeholder Feedback tool to identify assumptions and underlying mental models of different players in the industry as well as of external stakeholders. This reveals important influence factors, but also possible blind spots and weak signals.

To identify important influence factors for the future development of the German EV market, we sent out two questionnaires to managers as well as external industry experts from research institutions, to consulting companies and to customers to get an overview on their assumptions as well as the trends and factors they considered important for the future of the industry.

After conducting the 360° stakeholder feedback, all factors were consolidated and analyzed. The aim of the so-called trend and uncertainty analysis is to identify the most important driving forces affecting the industry and the corresponding uncertainties behind these factors. These factors were mapped on an Impact/Uncertainty grid to identify the critical uncertainties.

Trend and Uncertainty Analysis

In the third step of the scenario development process, we determine and analyze trends that are likely to impact the project partner in the future. With the help of our Impact/Uncertainty Grid tool, we cluster the trends according to their degree of impact and their level of uncertainty. Factors which score high on both dimensions are then transformed into 'key uncertainties', the basis of the next step in our scenario development process.

Afterwards, different influence factors that were gathered and rated by the experts in the previous process step were transferred into the Impact/Uncertainty Grid and clustered into critical uncertainties, trends, and secondary elements (Figure 14).

Furthermore, two key uncertainties building the basis for the scenario development in the next process step were identified. For this we clustered six factors into two meta-categories, which we call ‘scenario dimensions’. The first meta-category/ scenario dimension is a cluster consisting of three factors. These are:

(1) Ban of ICE sales in German market (2, political)

(2) Prioritization of public & private charging infrastructure expansion (4, political)

Subsidies for public infrastructure pojects have limited direct financial implications for customers or automotive corporates as thes are mainly bulit by energy companies. However, subsidies for the purchase of private charging points are relevant for customers. Therefore, the political factor *prioritization of public and private charging infrastructure expansion (4)* was split into two sub-factors differentiating between *public (4.1)* and *private (4.2)* charging points.

Together they form the scenario dimension **“Regulatory framework for electromobility”.**

The second scenario dimension, **“Economic attractiveness of EVs”** is composed of three subcomponents. These key uncertainties are:

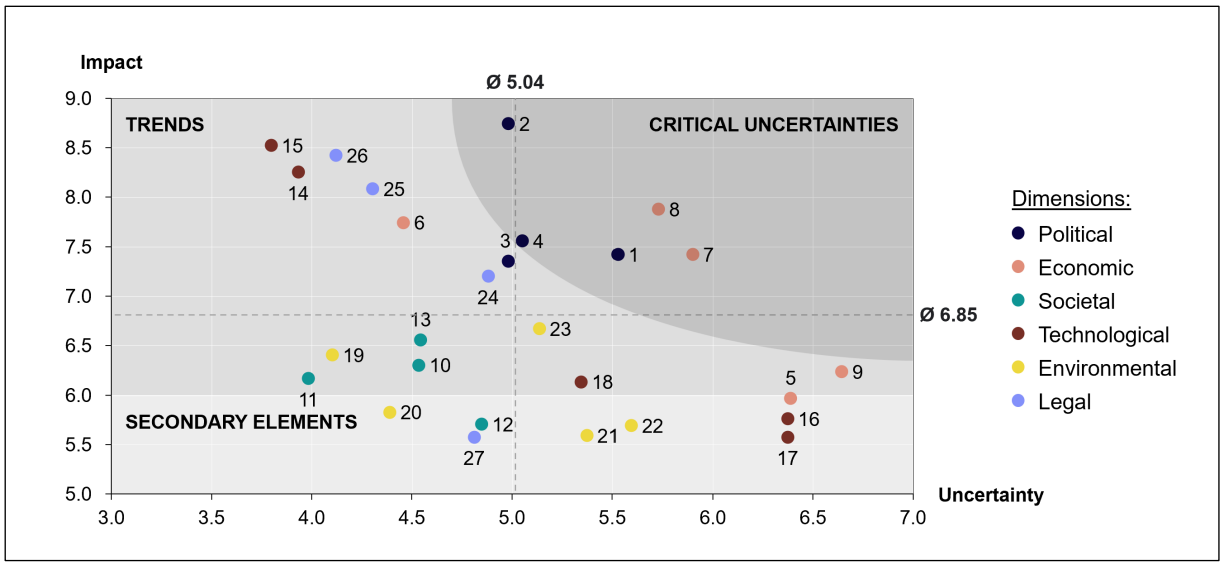
(3) Supply chain reliability of EV components (7, economic)

(4) Lasting reduction of electricity prices in relation to fuel prices (8, economic).

(5) Lasting effects of geopolitical instability (1, political)

These in total six subcomponents mainly capture the regulatory and economic pressures the German EV market faces.

Figure 12: Impact/Uncertainty Grid for the German EV market

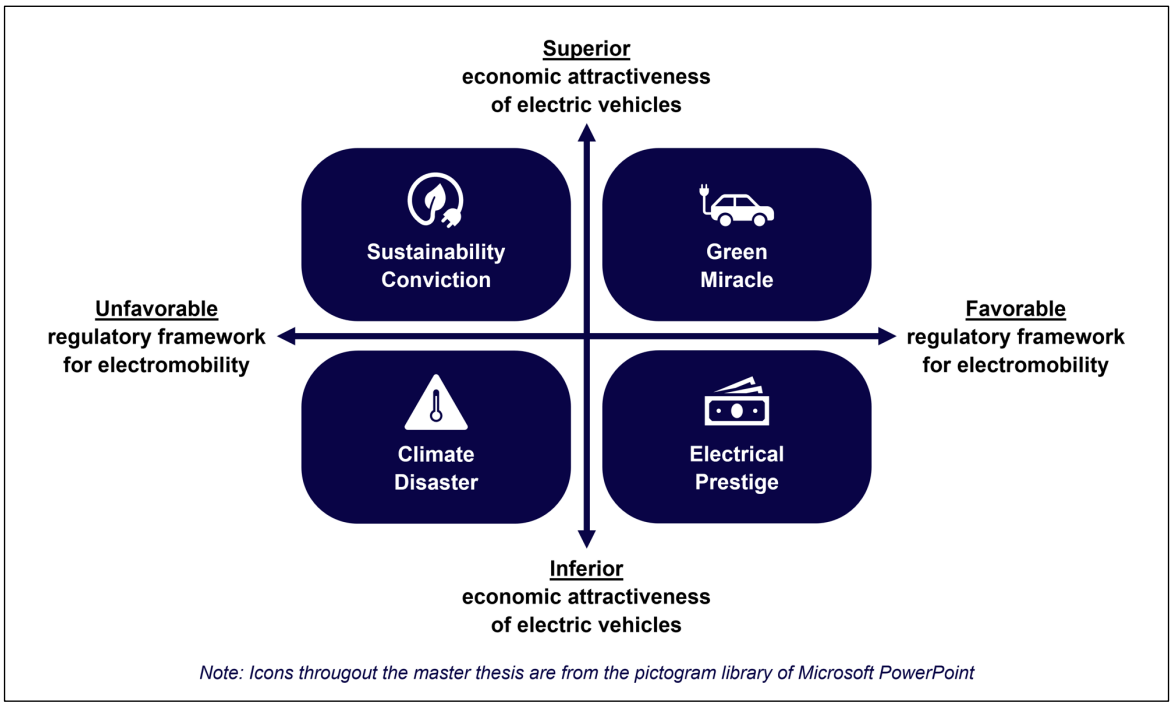


Source: Own illustration, following Schwenker & Wulf (2013).

Scenario Building

In the fourth step of the scenario development process, the scenarios themselves are created. Using the scenario dimensions determined in the previous step, we derive possible pictures of the future and describe them in detail. Typically, four plausible and distinct scenarios are developed. Our Scenario Matrix tool guides this process step. To speed up the process and to make the scenarios as accurate as possible, we also use the know-how of global scenario experts assembled in our Scenario network for this step.

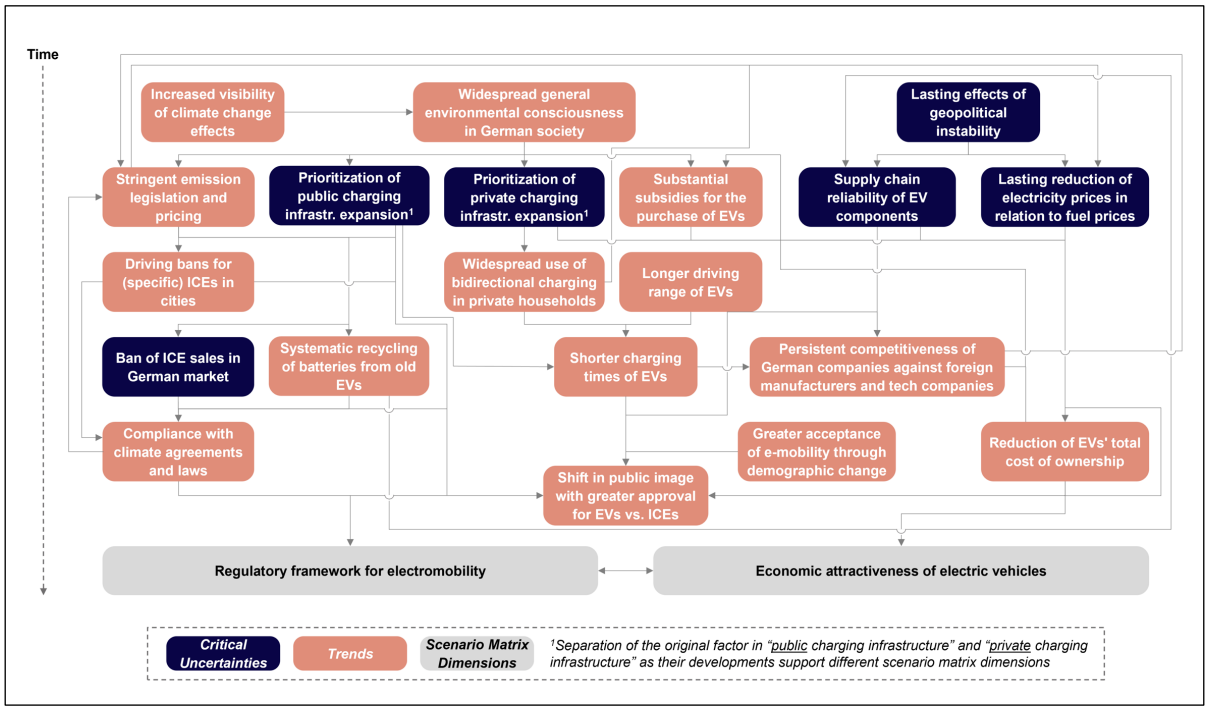
Figure 13: Scenario Matrix for the German EV Market



Source: Own illustration, following Schwenker & Wulf (2013), p. 106.

In the present scenario project, the creation of the scenario matrix resulted in four scenarios for the German automotive EV market as described above (see 5). We named these scenarios ‘Green Mircale’, ‘Electrical Prestige’, ‘Climate Disaster’, and ‘Sustainability Conviction’. To describe these scenarios in more detail, we created an influence diagram. This diagram displays all trends and critical uncertainties as a chain of causes and effects which lead to the two scenario dimensions. This influence diagram forms the basis for the detailed description of the four scenarios presented above (Figure 16).

Figure 14: Influence Diagram for the German EV Market



Source: Own illustration, following Schwenker & Wulf (2013), p. 107.

Strategy Development

The main goal of this step is to develop ideal-typical portfolios businesses or products and services for each of the four scenarios. For the strategy definition we use the scenario-based portfolio matrix as a tool. The scenario matrix serves as a basis for the portfolio matrix. In each of the four quadrants of the scenario matrix, we now display one ideal-typical portfolio that is most adequate for this scenario. To arrive at the ideal-typical portfolios, we first list all existing businesses of the company in question. Then, we go back to the scenarios that we developed. For each scenario we ask two questions:

1. Which of our current businesses, products or services seem particularly promising under the conditions of this scenario?
2. Which new businesses, products or services are promising under the conditions of this scenario?

These two questions are discussed as part of a top management workshop and yield one ideal portfolio for each of the four scenarios. Certainly, specific businesses, products or services can also appear more than once in this portfolio matrix if they fit to different scenarios.

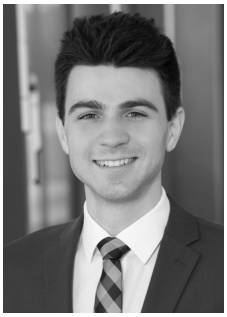
Monitoring

The main goal of this step is to constantly track the development of the company's environment and its influence factors and to allocate or reallocate resources to the most appropriate scenario-based portfolio. For the monitoring step, we use the scenario cockpit as well as scenario-based portfolio management as tools. The scenario cockpit is a strategic controlling tool that comprises several indicators which help us to determine which scenario is most likely to occur. The scenario cockpit lays the essential basis for scenario-based portfolio management. The company's management needs to decide which of the four scenario-based portfolios, which have been defined in step 5, the company should focus on. Scenario-based portfolio management helps to take this decision by answering two questions:

1. Which scenario is the dominant one, that is: Which scenario is most likely to occur?
2. How far are we from reaching certain tipping points, that is: Is the transition from the presently dominating scenario to a different one likely?

After having formulated a company's core strategy as well as coping strategies, the scenario planning process supports managers with a monitoring approach, referred to as *Scenario Cockpit* (Wulf et al., 2012). The *Scenario Cockpit* supports the management in identifying critical indicators for changes in the market environment. Based on defined values for each scenario, a regular assessment enables the management to choose the right strategy for the respective developments. Therefore, the senior management must receive reports regularly to align their perception with objectives, focusing on a few objectively measurable indicators to simplify monitoring (Schwenker & Wulf, 2013).

6 Contacts



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7 HHL Center for Strategy and Scenario Planning

The HHL Center for Strategy and Scenario Planning creates knowledge and acts as an impetus to change the way decision makers think about the future and organizations plan their future. We provide a platform for the exchange of ideas with leading scenario experts. The Center's activities focus on four areas:

1. Research

We advance knowledge about scenarios by developing new methods and tools for strategic planning, exploring the cognitive and behavioral implications of using scenarios in strategic decision making, and developing new scenarios across a broad range of domains.

2. Teaching

We teach scenario planning to business leaders and strategic planners in executive seminars and workshops, to graduate students in summer seminars, and to MBA and MSc students at HHL studying strategic management.

3. Consulting

We advise corporate, public, and civil organizations on establishing scenario planning structures and processes, reviewing, and adapting existing planning processes, and communicating effectively with all stakeholders in times of uncertainty.

4. Networking

We provide a platform and act as a facilitator to bring together scenario experts from around the world, bridge the gap between theory and practice, and share ideas about what the future will look like.

For more information about the Center, visit *www.scenarioplanning.eu*.

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