WISO DISKURS

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René Bormann, Philipp Fink, Helmut Holzapfel, Stephan Rammler, Thomas Sauter-Servaes, Heinrich Tiemann, Thomas Waschke, Boris Weirauch

THE FUTURE OF THE GERMAN AUTOMOTIVE INDUSTRY

Transformation by disaster or by design?

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SUMMARY

Across the world, the established models of the automotive industry of the 20th century are increasingly dissolving. The enormous implications of that shift on economic, employment, and innovation policies have put the automotive industry in Germany and Europe under pressure. This is happening at a time when the industry is on an expansion course, with rising sales, growing employment, and increasing exports.

Our mobility is undergoing change from strong and globally relevant megatrends, new mobility needs in urbanising transport markets, and hitherto unknown forms of competition, for instance from the up-and-coming IT sector, but also from China's industrial policy objectives. The concomitant trends towards electrification, networking, automation, and sharing are revolutionising the automotive industry and will lead to a new form of automobility. Fossil-fuel based propulsion is being replaced by electromotive motors and batteries; the notion of driving the car yourself is being replaced by concepts of assisted, automated, and autonomous driving, and ownership is being replaced by a digital platform ecology with new business models and forms of distribution.

The cumulative effect of those developments on the automotive industry in Germany and Europe has been dramatic changes in supply and demand, which have cast doubt on previous business models. These transformation processes can no longer be managed with automotive policy regulation and internal corporate self-transformation. Governments, companies, trade unions, and consumers must work together to promote change in the automotive sector.

That can only succeed with a mobility pact for the future that combines entrepreneurial, political, and social strategies with the aim of transforming transport in society as a whole. It stands in the tradition of cooperative management of economic, social, and societal change. The guiding political principle behind this shift must be to create a sustainable and integrated overall transport system that includes the automobile as a building block in intermodal transport and action chains.

The onus is on the federal government as the central state actor to coordinate and moderate the processes in concert with the German states and municipalities. It must create the regulatory, fiscal, and structural policy framework for action, while private enterprise and policymakers should encourage society at large to discuss a future mobility pact through a transparent consultation mechanism.

As a first step, a politically moderated and regulated consumer-side market transformation programme for electric mobility should be set up and implemented. The key concern here is to shape consumer behaviour in such a way as to generate demand for new and future-oriented products. At the European level, for example, the pact for the future should involve initiating a project aimed at making the technological leap towards electric mobility. In addition, as part of the market transformation programme, municipalities must be more strongly and comprehensively empowered to promote communal laboratories in which both the car industry and public transport operators can develop new forms of cooperation with a view to new mobility.

1

INTRODUCTION

The mobility economy is undergoing a rapid transformation. The megatrends of sustainability, urbanisation, individualisation, and digitisation require and enable both technological and social mobility innovation on a large scale. In 2010 and 2014, two projects by the Friedrich-Ebert-Stiftung (FES) dealt in detail with this transformation dynamic in global transport markets and the resulting challenges for the German automotive industry. It is now clear that these changes have entered an accelerated phase that brings with it completely new qualitative challenges. That raises the issue not only of the further innovations, and organisational cultural adaptations facing this sector of the economy, but also of how and under what conditions it can continue to exist. In this context, the spotlight is on issues of added value, employment, and social security in the regional automotive clusters and ultimately the overall economic resilience of the Federal Republic of Germany.

All of this is taking place at a time when the power technology that has thus far been the standard bearer for the European and especially the German car industry, the diesel engine, has come under strong criticism in Europe's urban regions. The industry is facing allegations of illegal practices and agreements contravening antitrust laws. In other words, the automotive industry is currently undergoing a transformation by disaster in which the usual procedures and arrangements have become obsolete. The sector's organisational disunity, with grandiose statements to the public accompanied by an internal clinging to often-rigid corporate hierarchies has not helped this situation. Management's actions have not only damaged the German automotive industry's reputation, but could also taint it as an industrial site, and its core brand, "Made in Germany".

In this context, it is necessary to make a virtue out of necessity and switch to the transformation by design mode. Change stops for no one. And in addition to this unregulated and unclear empirical transformation, there is also a need for normative transformation. This need has resulted on the one hand from fossil fuel emissions from road transport and its use of space and resources. On the other hand, however, it is above all due to the obligation to long-term maintenance of employment and social security in Germany as a production location. For industry, taking responsibility means driving the transformation process forward with a confidence-building approach centred on active partnership with employee representatives, politicians, and consumers.

From this overarching point of view, the imminent restructuring of the automotive industry must be understood as part of a transformation of the transport sector. This, in turn, is part of a fundamental transformation in Germany's approach to sustainability. The economic, social, and ecological aspects of sustainability should be balanced in such a way that they contribute to the greater resilience of Germany as a business location and of its value creating regions as a whole.

The negotiation processes that have occurred in automotive policy in recent decades have never questioned the well-balanced consensus of this established socio-economic field and were primarily aimed at stabilising and maintaining its structure. But now, this traditional regulatory regime is being called into question. It is in danger of falling victim both to its own success and to the enormous increase in complexity and acceleration of the mobility and automotive fields of action. As risky and uncertain as a real transformation of the transport sector may seem, in uncertain situations it is nevertheless a sensible alternative to the kind of slow and cautious approach that has been taken to date. That's because sustainability, urbanisation, digitisation and individualisation are joining forces in a transformation dynamic that can only be managed through early, goal-directed, but also experimental and courageous action. Watching and waiting, never mind trying to dodge the problem, will have negative consequences for the German automotive industry, especially in the long term.

It is clear that a change that is as comprehensive as this one can only be understood as a project for society as a whole. To leave the challenge of such large-scale restructuring to the industry alone would push it far beyond its capabilities and would also not be fair, given that the consumer side largely defines product preferences.

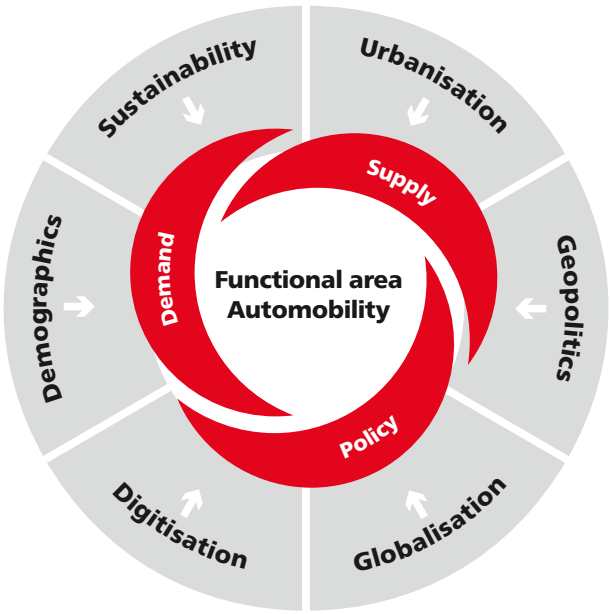
The central recommendation for action of this paper[1], which addresses companies, trade unions (e.g. IG Metall for the OEMs and suppliers, IGBCE for suppliers, Verdi for the mobility services sector), consumers, and politicians alike, is very simple, but at the same time very ambitious and will demand a lot from all those involved in the sector. Germany needs a pact for the future of mobility that unites private enterprise, trade unions, politicians, and consumers. One can argue about the details of strategies, time periods, and upper limits. Often, we don't know enough yet; we lack important insights and experience, especially with the new digital products and services, and thus we need to create real laboratory situations and socio-technical experimental spaces for new mobility in urban, suburban, and rural areas. But there will be no way out of the crisis other than to join forces.

The pact for the future of mobility is intended as a response to the current and future challenges of the German automotive industry that goes beyond the scope of established automobile policy mechanisms and familiar pact constellations between the automotive industry and politics. In the current situation, the restructuring of the automotive industry will not be a sure-fire success in the market economy, but rather one of the core projects of an ambitious political undertaking, which will in many ways clearly go against the short-term automotive interest constellations, as well as current lifestyles and consumer habits. This will demand something of us politically. We don't see any alternative to this.

The pact for the future of mobility requires a close look at the current situation in the automotive industry. Therefore, in the first part of this publication, we present the factors that are responsible for the upheavals in the transport and automotive market. To begin with, we will discuss the current significance and development of the automotive industry in Germany and Europe (Chapter 2). We then deal with the mega- and mobility trends that will interact to generate risks and the need for change, but will also create opportunities to sustainably transform the automotive industry for the future (Chapter 3). Before we draw an interim conclusion (Chapter 5), we first discuss the consequences of the previously outlined transformation dynamics for the German automotive industry (Chapter 4), with regard to cooperation, organisation, and employment. Finally, against this backdrop, the second main section (Chapter 6) discusses the entrepreneurial, political, and social strategies that have the potential to transform the emerging difficulties and distortions resulting from development by disaster into a lasting, sustainable development by design. The publication closes with a summary of the central recommendations for action addressed to the various players (Chapter 7).

The structure of our argumentation is illustrated in Figure 1. It identifies the relevant influences and actors to whom both the task and the opportunity to shape the future of the automobile falls, and lays out their relationship.

Figure 1
Multifaceted trends are changing the world of cars
Factors influencing the automobile industry



Source: FES.

1 Since the beginning of 2017, a group of experts from politics, trade unions, business and science have been discussing the transformation of the automotive industry in a series of expert discussions. The aim of the project was to describe and, if necessary, establish resilient new transformation networks consisting of the relevant automotive and transport policy actors beyond the classical structures and lobbying channels. The results of this project are presented here. They also include the findings of a joint excursion to China.

2

THE GERMAN CAR INDUSTRY TODAY

The importance of the automotive industry for Germany is undisputed. We want to take an empirical look here at the current situation in that sector. Above all, we are interested in the effects of global development on production, sales, and employment, the strengths the German automotive industry enjoys, and the weaknesses it faces.

In 2016, the German automotive industry had a total turnover of about 405 billion euros, roughly the same as in 2015 (VDA 2017a). This means that the automotive industry, which accounts for about one-fifth of total industrial sales, continues to be the industrial sector with the highest turnover in Germany. Vehicle manufacturers represent about three-quarters of that. The automotive industry is particularly relevant for the Germany's trade. In 2016, nearly 256 billion euros in sales, representing almost two-thirds of total sales, were generated outside of the domestic market (VDA 2017a). This corresponds to almost one-third of German industry's total overseas turnover.

2.1 THE INCREASING IMPORTANCE OF PRODUCTION AND SALES ABROAD

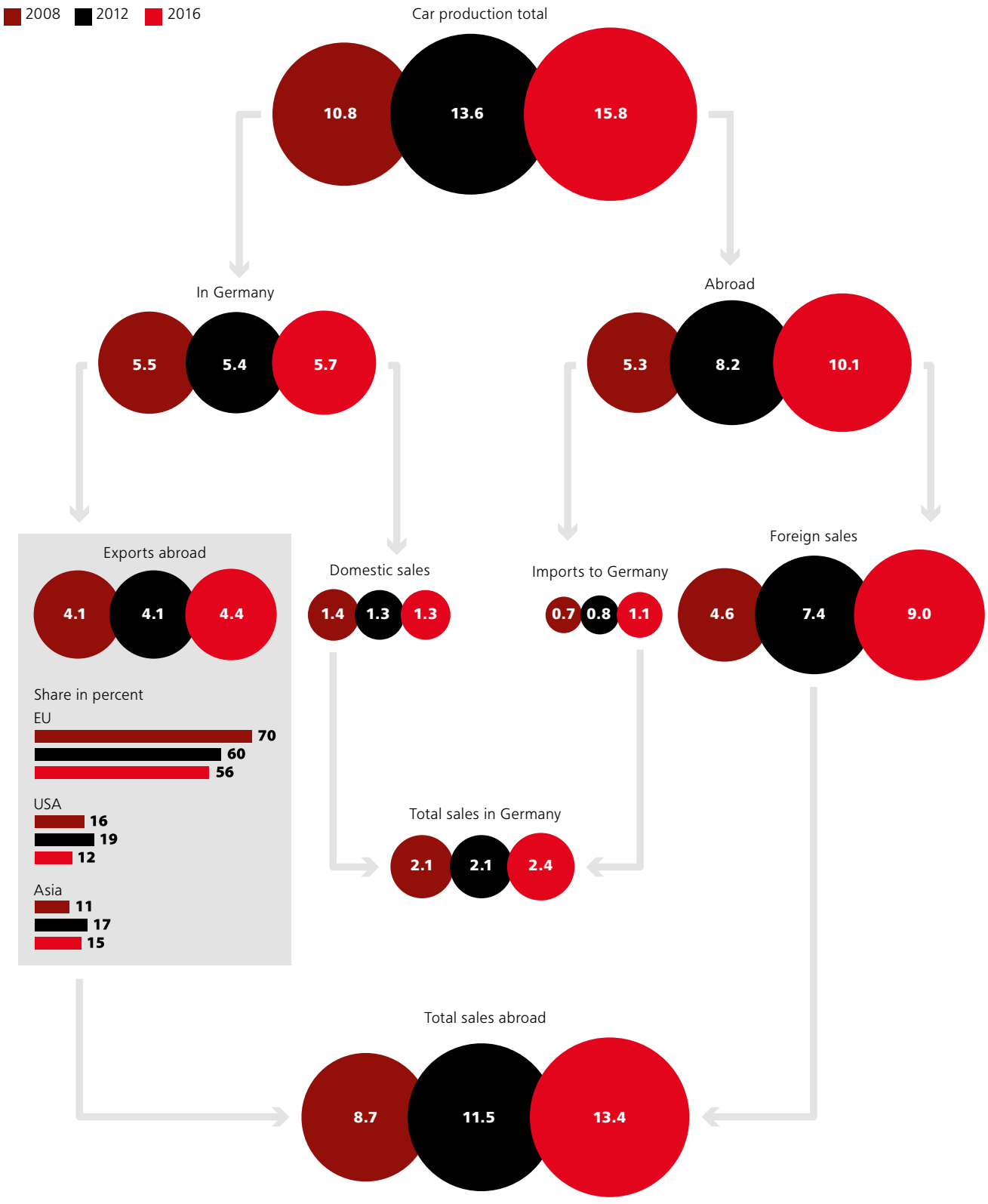
Differing market trends across the world means the geographical distribution of production and sales across the various regions of the globe is also changing. In the USA, demand for passenger cars reached a new peak in 2016. The same applies to the new vehicle market in China (BMWi 2017), which has experienced explosive growth in recent years. Since 2005, sales there have increased more than sevenfold to more than 23 million cars per year. Sales in Europe (EU plus EFTA) fell by 0.8 percent in the same period. China's influence on the world market is correspondingly great; worldwide passenger car sales have risen by 55 percent since 2005, but without sales in China, the increase would have been only about 11 percent (Ernst & Young 2017).

Figure 2 shows that, in 2008, of the 10.8 million German passenger cars produced, about half, 5.5 million, were actually manufactured in Germany. In 2016, the ratio of domestic to foreign production changed dramatically. German original equipment manufacturers (manufacturers of automobiles under their own brand name – OEMs) produced 5.7 million cars in Germany in 2016, almost the same number as in 2008. At the same time, they also doubled their foreign production by almost 5 million to about 10.1 million passenger cars (VDA 2017a).

China was by far the most important foreign manufacturing location for German OEMs in 2016, with about 4.7 million units produced. A total of 28.4 million vehicles were manufactured in the country, almost 30 percent of the world's passenger cars (ACEA 2017). The second most important overseas production site by far is the USA, with 110,000 employees (including suppliers) assembling about 852,000 vehicles on behalf of German OEMs in 2016. That means production in the USA has almost quadrupled since 2009 (Krause 2017). In Western Europe, on the other hand, German OEMs did not record any production growth in 2016 over 2015 – 1,565,192 vehicles were manufactured in Western Europe excluding Germany. German OEMs produced 1,888,000 vehicles in Eastern Europe, which represents an increase of five percent compared to 2015 (VDA 2017a: 12). Overall, as a result of this capacity expansion abroad, almost two-thirds of German OEM vehicles were produced outside the domestic market. The total of 15.8 million vehicles produced by German OEMs represents 19 percent of total global passenger car production (2016: 83.1 million units) (VDA 2017b). At the same time, global production figures have risen steadily since 2009, and by 2016, they had risen by almost 50 percent compared to 2009.

At just under 77 percent, more than three quarters of passenger cars are exported. The proportion of foreign sales rose from 82 percent in 2008 to just less than 85 percent in 2016. Germany exported 2.5 million passenger cars to the 28 EU states in 2016, accounting for about 56 percent of total sales (VDA 2017a); thus, sales of German-produced passenger cars still depend to a large extent on the European markets. German manufacturers produced every second car sold in Europe in 2016. In China, the German OEMs had a market share of just under one-fifth in 2016; the same applied in Russia. In the USA, the figure fell slightly below eight percent (VDA 2017a).

Figure 2
The German automotive industry is increasingly dependent on foreign countries
Regional distribution of the production and sale of vehicles made by German automotive companies, in millions of units



Source: VDA 2017a, KBA 2017, FES calculations.

2.2 STABLE AND HIGH EMPLOYMENT FIGURES

In the 16 German states, there are a total of 41 final assembly plants (ACEA 2017), with a production output that makes up more than 30 percent of the passenger cars produced in Europe. They are at the heart of the German automotive industry and are highly relevant to employment figures in Germany. Compared with 2015, the number of people employed in the German automotive industry rose by another two percent in 2016 and now stands at over 808,000. Employing a total of 13 percent of all industrial workers in Germany, the automotive industry is the biggest employer in the industrial sector after mechanical engineering (Federal Statistics Office 2016).

In addition, there are employees outside the automotive industry who manufacture up-stream and complementary products for the automotive industry (ifo 2017). Due to the sharp division of labour, about 70 percent of the German automotive industry's value creation is generated by mid-sized suppliers (BMWi 2017). In addition, there are many workers in Germany whose jobs are dependent on the automotive industry, even though these jobs may not at first glance seem linked to the automotive value chain (e g. workers in the chemical industry or the textiles industry). According to the Centre for European Economic Research (ZEW), a total of up to 1.5 million people are dependent on the automotive industry if the indirect employees are taken into account. The sector that comes closest to that significance for the German labour market is the mechanical engineering sector. To illustrate the European dimension: based on Eurostat data, the European industry association ACEA assumes that about 3.3 million employees in the EU are directly or indirectly dependent on automobile production (ACEA 2017). Despite temporary fluctuations, employment levels in the automotive sector have remained relatively stable for decades (ZEIT 2017). Employment has now been on an uninterrupted growth path for six years (VDA 2017a).

2.3 INNOVATION AS THE KEY TO SUCCESS SO FAR

In terms of research and development (R&D) expenditure, Germany's automotive industry ranks first in international comparison, ahead of OEMs from Japan and the USA. The German automotive industry spent almost 39 billion euros on R&D in 2016 (VDA Politikbrief 2017), 13 percent more than in the previous year. According to calculations by the European Commission, about one-third of global R&D expenditure in the automotive industry is spent by German companies.

In contrast to vehicle production, more than 60 percent of which now occurs at overseas locations, the German automotive industry spent the bulk of its global R&D budget in Germany, a sum of almost 32 billion euros. That is almost 40 percent of all German R&D expenditure (HELABA 2017).

That intensive research activity is also reflected in patent applications. In 2016, 32 percent of all patents granted worldwide in the automotive sector went to German companies, a total of 2,587 (ACEA 2017). A similar picture emerges when we look at the field of automobility that is most likely to be important in the medium term. Since 2010, a majority of patents in the field of automated driving have been awarded to German OEMs and suppliers worldwide. Overall, German industry has a 58 percent share of patents in this field (VDA 2017a).

2.4 PREMIUM SEGMENT DRIVEN BY SUV GROWTH

Research and development are of such great importance precisely because the success of the German automotive industry depends crucially on its innovation and technological leadership. This is particularly evident in the premium segment[2]. The German automotive industry produces by far the largest number of premium vehicles worldwide. Almost two-thirds (63 percent) of all premium passenger cars sold are made by a German OEM. Audi, BMW and Mercedes have a large lead over their international competitors in terms of sales. In 2016, about 40 percent of the passenger cars made in this high-margin category were manufactured in Germany (Statista 2017). The three major German premium manufacturers also grew faster than the market as a whole in 2016. With about 6 million premium vehicles sold, they achieved a global market share of 73 percent. In total, about 9.5 million premium vehicles were sold worldwide in 2016. This corresponds to a share of more than eleven percent of the total passenger car market.

The strong growth in the sports utility vehicle (SUV) subsegment is an important driver of this trend. In 2011, SUVs represented 13.3 percent of all vehicles manufactured in Germany; by 2016, every fifth car manufactured here was an SUV. A similar picture can be seen in foreign production, where the SUV segment also showed the largest growth rate by far (VDA 2017a).

2.5 INTERIM CONCLUSION

This statistical description of the situation underscores the enormous economic, employment, and innovation policy significance of the automotive industry in Germany and Europe. In view of the key export figures, it is evident that the German automotive industry is particularly dependent on foreign sales, in particular on the Chinese market, and this dependence has steadily increased in recent years. At this point, every third German new car is sold in China (Ernst & Young 2017).

With respect to the rapid transformation dynamics described in the following sections, it is clear that the risks associated with change in the global automotive market are hitting an industry at the peak of its success. On the one hand, such long-lasting and great success is strengthening the tendency to hold fast to what has been tried and tested. On the other hand, given this success, the industry also has room to manoeuvre in initiating necessary changes that it would not have initiated in a crisis.

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2 The term premium refers to high-quality vehicles with respect to technology and comfort. This includes both luxury sedans and similarly furnished smaller vehicles. Many new developments and innovations are first used in the premium segment and slowly spread into the mass-market segment.

3

MEGA AND MOBILITY TRENDS ARE TRANSFORMING MOBILITY

In order to be able to correctly understand the transformation dynamics currently confronting the mobility business, and to identify its challenges and opportunities, in this chapter we will discuss the global trends that are shaping our present. They are having a direct or indirect influence on the development of mobility.

A trend is a concept for describing changes in all areas of society that allows us to make statements about possible future developments. Trends are observable but difficult to measure accurately. We can assess their progression but only partially influence them. Futurologist John Naisbitt (1982) coined the term "megatrend" to describe particularly deep, persistent, and far-reaching trends. For the automotive industry, the interaction of the currently relevant megatrends is in turn resulting in concrete mobility trends. We would like to examine those trends here.

3.1 FOUR MEGATRENDS ARE CHANGING MOBILITY

It is the four megatrends of sustainability, urbanisation, individualisation, and digitisation that facilitate and require both technological and social mobility innovations on a large scale. In the following, we will discuss the risks and pressures of change, but also the opportunities it creates for a sustainable transformation of the automotive industry.

3.1.1 URBANISATION

Population growth over the next few years will be almost entirely concentrated in the urban regions of the world. Urbanisation is a global trend, but it is particularly pronounced in Asia. While about 165 million people lived in cities in the year 1900, it is predicted that it will be 70 to 80 percent of about 10 to 12 billion people in 2050. Thus, in the 21st century, living in densely populated urban areas will be the typical form of existence for the majority of the world's population. The more people find themselves having to take care of their varied needs and vital life functions in ever smaller spaces, the more scarce the functional space will become for the form of automobility that we know today. In the rapidly growing metropolitan regions of the world, but above all in Asia, there is simply not enough space for growing car fleets and their external effects. This is problematic for the German automotive industry, chiefly because those regions have established themselves as primary sales markets.

3.1.2 SUSTAINABILITY

Sustainability is understood here as a collective term describing all attempts to reduce the external effects of industrial and fossil fuel production and consumption methods and – in balance with socio-cultural and economic interests – to get a lasting grip on them. In view of the continued message in the "World Transport Outlook" of the OECD's International Transport Forum that traffic volumes will at least triple worldwide by 2050, good advice is desperately needed. While all other sectors are more or less successfully achieving efficiency increases, a decline in consumption, and reductions in environmental effects, the external effects of mobility are growing ever faster. Experts have not yet provided an answer to the question of how, under these circumstances, the mobility requirements of up to 12 billion people could be met in a truly sustainable way in the near future. The only consensus is that if development remains unregulated, fossil fuel consumption, emissions of greenhouse gases, air pollutants and particulate matter, noise pollution, accident costs and, above all, the materials and space needs of mobility will increase sharply. With regard to modern automobiles, vehicle emissions are particularly problematic. The diesel engine is currently facing particular criticism, and this technology line has given rise to a dilemma between climate protection and municipal health protection that is hardly likely to be resolved in the long term. The internationally agreed targets for climate protection – far-reaching decarbonisation by 2050 – will only be achievable in the mobility sector if, for example, combustion engines are no longer allowed from 2035 onwards (Öko-Institut 2016). At the same time, there are clearly defined emission reduction targets at the EU level for locally effective vehicle emissions, which are legal regulations that must be complied with. And compliance must not ignore the social

and economic dimension of sustainability. Social justice and public services, good jobs and the economic resilience of Germany as a business location need to be reconciled with strong environmental and health protection goals in a sustainable policy.

3.1.3 INDIVIDUALISATION

The term "individualisation" refers to the transition from the determination of individuals by their external social environment to internal self-determination. The rule of thumb in transport sociology is that the more developed a society, the higher the degree of individualisation, and the more specific, flexible, and spontaneous the transport behaviour, making demand less amenable to bundling. In addition, increased flexibility in the world of work has meant that more and more people are changing jobs more and more frequently and sometimes either have no work or need several jobs at the same time. For this reason, too, mobility patterns are changing faster and exhibiting less stable and therefore less predictable demand behaviour than before. So wherever individualisation maintains, the use of automobiles has become more pronounced. The passenger car became – with massive political support – optimally suited to this megatrend both functionally and symbolically, i.e. for the purpose of social distinction and self-styling through demonstrative consumption.

Along with these trends towards individualisation and flexibility, and shaped and promoted by them, the consumer trend towards a platform economy is slowly but surely developing in the urban cultures of the world. This is based on the enabling factors of digital technologies, but is also motivated by the higher complexity, flexibility, and variability of modern lifestyles as described above - where life becomes ever faster, less predictable, more geographically and temporally variable, ownership becomes an obstacle to flexibility. Conversely, interest grows in technologies that allow high flexibility and lower proportionate costs by easily allowing for a more use-based consumption of the product than was previously possible. Since the largest ownership-related economic misallocations to date have probably occurred in the mobility sector,[3] the dynamics spurring the development of shared products allowing for efficient usage are also strongest in that sector at the moment. The interaction of these sub-trends of individualisation is leading to changes in urban mobility markets, because this is where the degree of individualisation and flexibility is greatest. Consequently, the conditions for new services in the digital, start-up-based platform economy are also the most favourable here. Between two fields that have traditionally been separated by relatively stable demand patterns and political regulation – the less space efficient, less sustainable but strongly individual private transport sector (private cars, rental cars, taxis) on the one hand, and the highly efficient, more sustainable but not especially individualised mass transport sector (trams, commuter and underground trains, buses) on the other hand – a third new market segment is emerging, known as the collaborative transport market. Here, established urban mobility providers will face the challenge of adapting organisationally, technically, financially, commercially, and in terms of their brands to a landscape in which old and new players respond to individualised customer demands by developing flexible products and services.

3.1.4 DIGITISATION

Due to its inherent exponential development dynamics in the fields of digital networking, automation, artificial intelligence. and the predictive analysis of large amounts of data, digitisation may potentially have the strongest disruptive and therefore most dangerous innovation effects for established structures and players. Yet, digitisation offers a variety of approaches and opportunities to address the development challenges in the transport sector arising as a result of the other megatrends. Those opportunities are expected to arise due to three possible effects of digitisation: first, the enormous capacity to increase the usage efficiency of transport infrastructures and vehicle fleets; second, the automation and thus the optimisation of control functions previously performed by people; third, the very effective regulation of supply and demand through networking technology, smart end devices with software applications, and new platform-based service concepts. Each of these individual developments as a result of digitisation would on their own lead to enormous changes. But when they interact with each other and with the trends towards electric vehicles and "use, don't own", they generate the transformative development dynamics that can be observed right now in the automobile industry.

3.2 FOUR MOBILITY TRENDS ARE CHANGING THE AUTOMOTIVE INDUSTRY

Mobility trends are specific developments that can be even more clearly differentiated spatially and temporally than the megatrends mentioned above, but that at the same time are observably going in a similar direction globally. Their emergence can be interpreted as a result of the interaction of megatrends and the resulting change dynamics. In the scientific, transport, and automotive policy discourses, four mobility trends have become topics of discussion: electric vehicles, networking, automation, sharing mobility, and mobility services. They will play an important role in transforming automobility in the future and will reconfigure the automotive industry so comprehensively that we can legitimately speak of a new form of automobility. The precise form and combination of these mobility trends that will materialise in practice in the various regions of the world is still an open issue. Experts agree that diverse geographic-climatic, cultural, economic, technological, demographic, and political-regulatory conditions in different parts of the world will create varying market constellations, in which the car will play a distinctive role. There is also a consensus that dense, hybrid, and complex urban transport situations will lead to different market dynamics and concepts of future mobility than rural and suburban areas of residential and commercial spaces. All in all, this is a very clear departure from earlier concepts of a uniform world car construction with globally standardised vehicles.

3 In Germany, a car is used for an average of one to two hours a day, i.e. it remains unused for 22 to 23 hours.

3.2.1 ELECTRIC VEHICLES

Based on everything we know today, the electric motor is the most viable short-to-medium-term technological response to the challenge of minimising the external effects of automobiles, especially air and noise emissions. Gas propulsion may be an important transitional technology (especially in the commercial and HGV sector). Climate change and the corresponding CO_2 standards, local emission limits, and geopolitical and national economic interests in reducing dependence on oil imports are driving the development of electric vehicles in major European and Asian automobile markets. Apart from the electric car-sharing fleets of European car manufacturers, which have a marginal share in the current market, European manufacturers have so far essentially been following the path of continuing the established functionality of the privately owned, combustion-engine universal vehicle. For this reason, given the usual consumption patterns of car buyers, efforts to extend the capacity and range of electric vehicles are also a priority. This has given rise to various technological sub-concepts: hybrid motors, range extension (i.e. the use of a battery in combination with a small combustion engine), and approaches that seek to increase the range of purely electric vehicles with innovations in cell and battery technology.

In North America and in China, technology companies have been considering two other strategies with regard to the gradual optimisation of the vehicle and drive train. First, the idea of "leap-frogging" in electric mobility, i.e. skipping individual stages in a development process through a technological leap forward, overtaking established car manufacturers in terms of their expertise, and catching up to or overtaking established car manufacturers in terms of their competencies, thus integrating vehicle use into a new digital usage philosophy that focuses on operating large urban vehicle fleets with low specific performance per vehicle. In the future, autonomous and electrically powered urban car and ride sharing fleets[4] will operate as part of a diverse and intermodal networked transport environment. Second, building on this, there is the Chinese government's industrial policy interest in creating an independent automotive industry based on a mastery of the new engine technologies and thus releasing themselves from the constraints imposed by cooperation with the established manufacturers of vehicles with internal combustion engines, and the regulatory regimes of the countries in which they are based. It is possible that the requirement for foreign companies to enter into automotive joint ventures in China will be done away with, thus simplifying market entry for the European automotive industry. China's current activities show how quickly a change of model (see the following side-bar) could take place in automotive drive technology. The conditions for the development of transport in China underscore not only the necessity for the country to make an advance, but also its ability to do so. According to the experts, this technological transformation is likely to be successful. If this happens, it will mean great changes for the global automotive industry and especially for German car manufacturers. In the absence of risk awareness, the future of some European brands may only centre on their role as brand ambassadors, designers, and parts producers. For German manufacturers, the road to a stable future lies above all in cooperation (with each other, with technology companies, and with China).

Side-bar:
China as a game changer[5] in the global automotive market

The growth in car traffic in China has been driven primarily by the country's economic development. The enormously rapid "motorisation rates" are striking: Whereas there were only 1 million passenger cars in Beijing in 2000, there were already 5.6 million in 2010. Urbanisation and the associated functional and ecological problems of classic car mobility have created the context for the Chinese government's current industrial policy. About 300 million people are expected to move to the cities in the next ten years. In addition to the existing large metropolises, there are another 150 cities with more than 3 million inhabitants each. They will all grow considerably over the next ten years.

Regarding automobility, Chinese planners are currently concentrating on the three urban agglomerations most affected by traffic problems: Beijing, Shanghai, and Shenzhen. In each of these metropolitan areas, the plan is to establish an internationally competitive automobile manufacturer. The aim is, on the one hand, to combine the innovative power of the urban centres, the strong potential demand of technology-oriented populations, and the high pressure to resolve traffic problems, and to use them to create regional synergies. On the other hand, this is intended to consolidate production structures that were previously fragmented. So far, car production in China has suffered due to its division into 35 provinces. As a result, there are about 100 smaller companies that all have to deal with their specific problems: price pressure, low margins, low R&D investment, and local standards. The government's idea is to overcome this fragmentation via a strategic development plan "Made in China 2025", so that the automobile industry can develop into an important national economic sector in the coming decades.

All industrial policy-planning paradigms have been designed to make China a leading automotive nation, whose industries are technologically advancing beyond Western dominance in the field of internal combustion engines. The development plan scheduled to run until 2025 is based on clear technological innovation goals, the development of electric mobility in the context of a national fuel strategy, and finally the concept of integrating electric vehicles into digitised infrastructures and services. In addition, due to China's experience in the field of consumer electronics and electric scooters, it is gaining some important initial insights into the advantages and disadvantages of battery technology. Other – non-industrial-policy related – reasons for the technological change of direction include reducing the share of oil imports (two-thirds of imports are used for the mobility sector) and increasing economic resilience in view of price fluctuations on the world market. Air pollution control in the urban agglomerations and the congestion of urban road networks are also reasons for the realignment of China's industrial policy in the area of mobility.

The legal attempts to resolve the problems that have emerged so far (restriction of registration numbers, selective driving restrictions according to license plate number, and the high costs of vehicle registration) are now proving to be a viable means of promoting electric mobility. E-vehicles are subject to no or only minor restrictions, so there are massive benefits for the owners. Those consumer-driven approaches to market transformation are supported by financial incentives; it was possible to introduce subsidies of 10,000 to 14,000 euros per vehicle. Until 2014, these strong incentives were only partially successful because the functional framework for users was still insufficient (there was a lack of charging infrastructure). As early as 2013,

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4 In ridesharing, a driver picks up a passenger on his/her way to somewhere else – i.e. the driver would also be undertaking the journey without a passenger. Such carpooling can be offered by private individuals or companies. Transport companies would then pick up a passenger and take another passenger on the way to the destination, i.e. create car pools.

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however, a change of policy in favour of electric mobility was initiated, which aims to give greater consideration to the consumer perspective and to expand the charging infrastructure.

China also has a lot of catching up to do here, because the network infrastructure is not sufficient for the required charging column density. Although sales of electric cars are still increasing regionally, this is mainly due to the restrictions on the registration of vehicles with internal combustion engines introduced in megacities such as Shanghai and Beijing. If you want to register a vehicle with a petrol engine, you often have to wait for years and then pay 12,000 to 15,000 euros for the registration plate. Electric cars, on the other hand, can be registered in Shanghai without restriction and free of charge.

At the same time, the first major applications of market transformation are being created for fleet operations. That means state-owned fleets – e.g. increasing quotas for the procurement of electric buses for municipal public transport in Shanghai. But the private sector is also making progress in building up fleets of vehicles with electric drive systems. Taxis with internal combustion engines cannot be registered in China today. In terms of technology, the focus is on the BEV variant of electric mobility.

Despite all these efforts, experts note that China cannot yet be satisfied with electric vehicle sales. While sales volumes outside of the Chinese megacities were already sluggish, they slumped again at the beginning of 2017. The reason for this is likely the restriction of manufacturer's premiums. In 2020, this direct support for car manufacturers will cease completely because it has led to market distortions. Some of the premiums went to manufacturers who were not seriously interested in car production but only in the subsidies themselves.

After the end of direct producer subsidies, a quota system will be used to influence market development. From 2019 onwards, according to a statement by the Ministry of Industry and Information Technology in autumn 2017, domestic automakers will initially be obliged to set minimum targets for the share of alternative engines in production and sales in the Chinese market. That means manufacturers producing or importing more than 30,000 conventional vehicles per year will be required to hit certain targets by means of a point system. Manufacturers will receive more points for pure electric cars than for hybrid engines, and more points for longer ranges. In 2019, manufacturers are expected to meet a 10 percent quota in China, and then 12 percent from 2020 onwards[6]. If a manufacturer does not meet the targets, it will either have to buy points from other companies or pay penalties. Even though industrial policy efforts have not always met the targets, China is today what Germany once wanted to be from 2020 onwards: the lead market for electric vehicles. The country could therefore completely phase out combustion technology much earlier than expected.

Against the backdrop of this development, it seems advisable to at least assume in the interests of intelligently preparing for the future, that China will play a dynamic and strong role as a "game changer" in the global automobile market. This is all the more true because a similarly dynamic development and readiness to develop as is evident with e-mobility can also be observed in China in the area of networked and autonomous driving. It is strongly driven by the digital companies in southern China. Accordingly, experts believe it is possible that after entering the Western market via European brands, the first imports from China can be expected in about five years' time – possibly even earlier in the commercial vehicle and the city bus sectors. The Latin American, Arab, and African markets could also be accessed by China. The Silk Road Project can be seen as a vehicle for opening up the Asian market in particular.

3.2.2 NETWORKING AND NEW COMPETITORS

From our point of view, it will be above all digital networking capability that will set apart the automobile manufacturers of the future. As a basis for new services and mobility concepts such as automated driving, it guarantees that manufacturers will be able to benefit from the growing part of the automotive and automotive-related value generation related to this area, while the pure production of vehicles will bring in less and less money in the future. Here it can be noted that the IT industry – in particular Silicon Valley's global companies but also Chinese IT companies – has been crossing industry boundaries for some years now and is attacking the established automotive industry with new ideas for driving and using automobiles in a direct, visionary, well-financed, and aggressive manner, based on digital capability.

In addition, there are the diverse and quite aggressive activities of companies that also have a lot of venture capital, such as Lyft, Didi Chungxing, or Uber. With the chauffeur and ride sharing activities they offer, they do not rely on developing vehicles, but want to establish a new culture of use for the automobile on the basis of new digital networking and operating platforms (mobility services). Finally, in this context, it is important to mention the new Chinese IT and technology companies that are preparing to enter this market, such as the LeEco group of companies owned by billionaire Yueting, the search engine company Baidu, China's largest Internet company Tencent, or the trading platform Alibaba founded by Jack Ma. They are all investing in linking online user data, electric mobility, and automation technology for mobility services in Chinese urban areas. Individual data protection in China is generally subject to state-specified regulations, which in practice make it possible for the industry and the state to achieve a high degree of transparency on users

3.2.3 AUTOMATION

Encouraged above all by Google's initiatives in the past few years, the vision of fully automated driving has firmly established itself as an effective industrial policy and strategic model in the minds of the automobile industry, and some transport policy-makers. However, its feasibility and social acceptance are still highly controversial. This is because technological development is not an automatic process, but is socially shaped; it is accepted and used – or not. From a purely technical point of view, relatively uncomplicated, homogeneous, and standard driving situations, such as driving on primary roads without intersections or motorways, can in fact already be managed very well today and can even contribute to increasing road safety. Here, the automotive industry is already active in the field of highly automated driving and is continuously optimising it. It is also indisputable that one of the first major applications of autonomous driving will be in the field of road haulage.

What is more controversial is the vision of fully automated driving in densely populated urban areas. Here, the effects would be greatest, e.g. it would reduce space needs, allow for efficient infrastructure utilisation, improve the environment, and ultimately increase the feasibility of providing access and routing functions for public transport in fully automated

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5 The term "game changer" refers to a person or idea that fundamentally changes the accepted rules, processes, strategies, and management of business functions

6 At the same time, fleet fuel consumption in China is to be reduced to 5L/100KM by 2020

robot taxis and minibuses. However, it is precisely here that technical implementation is difficult. The reasons for this are the complex mixed traffic situations in the cities. Due to the defensive character of the control algorithms, automated driving has so far only really worked reliably and safely in a self-contained homogeneous system – the more homogeneous, the better. That starting point presupposes that a system can be created to which uncontrolled access is no longer possible and in which the digital connectivity of infrastructures is massively increased so that the autonomous vehicles involved can also benefit from the intelligence of the overall system. The related debates on urban planning, transport, and employment policy, as well as legal and ethical issues, have not even begun yet. If those concerns are put to one side for a moment, as well as fears of the "transparent" customers that are fed by the idea of automated driving, the 24/7 operation of an automated ride sharing vehicle fleet could really become, according to a study by the International Transport Forum of the OECD (2015), the starting point for a large-scale and sustainable redevelopment of urban areas (see the following side-bar).

Side-bar:
The potential of automation

In a study, the OECD World Transport Forum examined the potential of automation. Drawing on the example of Lisbon, the study shows that it would take only a vehicle fleet that is just less than 10 percent of today's fleet, in combination with a well-functioning and modernised public transport system, to achieve nearly identical levels of mobility to those achieved today. According to the World Transport Forum, this assessment can be applied to most central European cities. It would be the starting point for a far-reaching redevelopment of cities that would make use of the enormous free spaces. Since the new utilisation model means that vehicles, whether stationary or in motion, will not require much urban space due to the combination of automation and the platform economy, that space could then be reallocated to allow for the expansion of cycling infrastructure and to enhance the urban quality of life with large green spaces, areas for local mobility, children's recreational streets, and new residential properties (ITF/OECD 2017).

In sum, three key discourses and development options for autonomous driving can be identified. First, autonomous driving as a very serious, long-standing, and evolutionary project of the German auto industry; second, autonomous vehicles as a disruptive tech project of tech giants from California and increasingly from China, with the goal of connecting the technology with new usage and consumption forms and thus generating large amounts of data and high sales; and third, autonomous driving as a building block of an intermodal urban transport system with the aim of achieving an overall optimisation and transformation of transport.

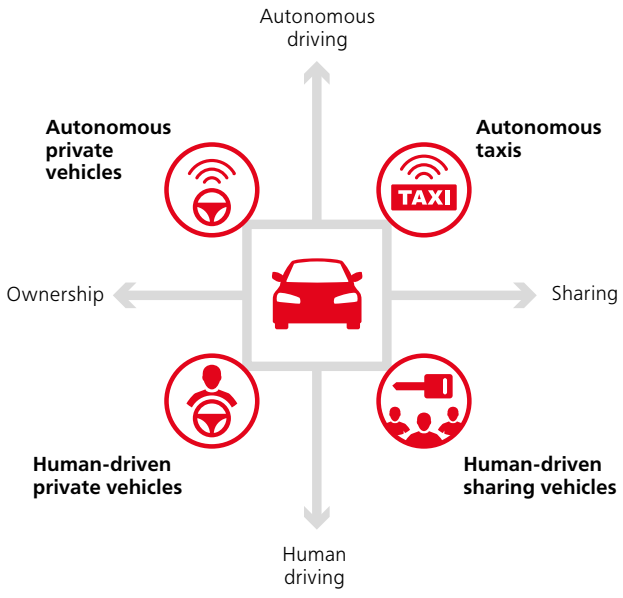
3.2.4 MOBILITY AS A SERVICE

The fourth mobility trend is the aforementioned erosion of the automotive ownership culture. A growing number of customers, especially younger urban residents, are increasingly focusing less and less on the inelegant, environmentally inefficient, and economically irrational ownership of vehicles in urban transport contexts. Instead, they expect reliable, flexible and, at the same time, cost-effective access to modern, combinable transport systems including automobile usage concepts. Historically, car sharing – pay per use instead of pay and use – was motivated by ecological and moral concerns. Today, by contrast, we can observe a very rational mix of cost concerns among younger market participants with tight budgets, along with sustainability motives and functional pragmatism (Deloitte 2017).

3.2.5 FUTURE PATHS OF THE AUTOMOTIVE INDUSTRY

"Networking, autonomous driving, ride sharing, and electric motors – each of these four trends has the potential to turn our industry upside down. But the real revolution lies in the intelligent combination of the four trends" (Dieter Zetsche, see Daimler 2017). The current situation could hardly be more succinctly described. For 100 years, automobility has been unequivocally linked to an individual's ability to own and drive a vehicle him or herself. Both are now open to change. The same applies to the internal combustion engine. The following chart, Figure 3, summarises the development paths that can be derived from the new setting. This diagram is helpful for mapping different future pathways for different regions of the world with different spatial and settlement conditions in the context of the three ideal-typical trajectories.

Figure 3
Sharing and automation will change individual transport
Possible future paths of the automobile industry



Source: Morgan Stanley 2015.

For example, robotic electric driving as a usage-efficient service in combination with public transport is an extremely realistic prospect in dense Asian urban regions – provided that the technological promises of feasibility are actually kept. It appears it will be particularly beneficial in China, because urban settlement structures are still being built there and the urban and traffic planning requirements governing automated driving can be used to fuel a leap in innovation.

By contrast, in rural regions all over the world, car ownership is likely to remain fairly stable in the future, but here too, there will be trends towards automation, as far as technol-

gical developments permit. At the same time, especially in rural and suburban regions, autonomous minibus fleets could form smart alliances with public transport – and thus modernise such services and make them more attractive. This is particularly useful where flexible supply formats offer great economic and environmental advantages over strictly scheduled and inflexibly routed large vehicles such as buses and trains. However, autonomous buses could face major acceptance problems. This is especially true given that attempts to attract people back to more collective forms of mobility with personalised services are likely to be more promising than that.

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CHALLENGES: COOPERATION, ORGANISATION, EMPLOYMENT

The German automotive industry is in danger of being squeezed out by the Californian and increasingly also the Chinese technology companies on the one hand, and by China on the other hand as a state-corporate player with definite planning horizons, goals, and strategic policy roadmaps for the development of a completely new automotive industry supported by industrial policy. Those developments coming from two sides are creating enormous challenges for the industry and policymakers.

4.1 NEW FORMS OF COOPERATION

It is still an open question how the American and Asian technology companies, especially those from China, and traditional car manufacturers will position themselves in the future in light of these developments; will they choose competitive or cooperation-based strategies? Based on the current situation, speculation about the future can be based on three theses. And all three of them underline the need for a greater willingness to cooperate on the part of the established automotive industry players in Germany:

1. The foreseeable further growth in mobility demand requires conceptual cooperation rather than competition. The challenges are so great that they can only be solved in an environmentally, economically, and socially viable way if all the players work together. The enormous competition in the transport markets to date is a particular obstacle here, as it structurally hinders synergetic cooperations aimed at creating an intermodal and multimodal transport system.
2. Due to their deteriorating situation with regard to environmentally friendly transport, municipalities in particular will have to develop into self-confident players that can advocate for quality of life and become new partners on an equal footing with hitherto unknown mobility economy players. Car manufacturers will have to get used to negotiating with local authorities about the makeup of their product portfolio of vehicles and services (business to authorities – B2A).
3. In view of the enormous success of its products in other areas of life, and the growing expectations of its customers regarding a comprehensively networked "smart" environment, the IT industry is already structurally at the forefront. Traditional car manufacturers are therefore well advised to seek new forms of cooperation, above all among themselves, rather than entering into potentially fruitless competition with other industries. As already mentioned, the latest announcements of the IT industry show that it is not so much aiming to build its own vehicles as to supply the digital platforms, both software and hardware, for autonomous driving and networked services. From the perspective of the IT sector, the established car manufacturers will at most be viewed as suppliers of vehicles or components in the future. The cooperation between Google and Fiat-Chrysler is going in this direction, although the balance of power is clear. The cooperation between Daimler AG and Uber in the use of autonomous premium sedans for passenger transport could, by contrast, prove to be an advantage for both companies. However, it is by no means certain that Daimler will not be downgraded to a supplier of vehicles within this cooperation at some point in time, while Uber will secure its position of dominance as a digital platform and thus as the important customer interface.

Is the German car industry as a whole too defensive and hesitant? Is it possibly missing the opportunity to enter into new advantageous cooperations at the right time? Is it not recognising its new growth potential? With "Mobility Asia", VW China has established a promising partnership strategy. As part of this, the first contracts with the Chinese mobility platform Didi have been signed. The cooperation between BMW and the Israeli software company Mobileye and recently Intel, along with the joint purchase by Daimler, BMW, and Audi of Here, a manufacturer of digital maps and navigation systems, show that some parts of the automotive industry have recognised the dangers. They want to enter the future of autonomous driving under their own steam, and with an independent business model for a self-contained digital ecosystem. Mazda, Ford, and Toyota are also cooperating and

have developed their own operating system, SmartDeviceLink, which is available free of charge as an open source platform. Hence, the players do not want to leave the field entirely to the tech sector, especially Google and Apple, and certainly not as far as the setting of technological standards is concerned. However, while European, American, and Japanese manufacturers still have not integrated digital ecosystems into their vehicles, the Chinese Internet giant Alibaba turned theory into practice in 2016: the Chinese smart SUV Roewe RX-5 from SAIC is equipped with YunOS, a proprietary operating system and application platform that has integrated the Alipay payment system in addition to navigation and entertainment. A recent study conducted by the consulting firm KPMG shows that such efforts could soon prove to be highly profitable. On the basis of a survey, the experts assume that an autonomous and digitally networked vehicle could generate ten times more sales in its lifetime than a conventional car due to possible auto-related business models (KPMG 2017:23).

In summary, we can conclude that the automotive industry is slowly opening up to a strategy of cooperating, both with partners from other sectors and more familiar ones. The former applies not only to cooperations with partners in the IT sector, but also with municipalities; the latter applies to national and international political players and political entities (e.g. federal government, EU, China). As part of this, a new balance needs to be struck between the regulatory power of the state and the innovative power of the private sector. However, a new partnership between industry and policy-makers is just as necessary as the strengthened partnership and cooperation between companies in the European automotive industry in order to create the resilient European ecosystems of the new digitalised mobility.

4.2 A NEW ORGANISATIONAL CULTURE

Against the backdrop of these developments, three ideal types of future corporate organisation in the automotive sector can currently be identified (Ramsauer et al. 2017):

- **B2C (business to consumer) vehicle manufacturers:** This is the established but moderately expanded organisational concept of today's manufacturers. The cornerstones of the business will still be the development, production, and sales of vehicles on the private and commercial fleet markets, supplemented by a range of services. By offering services, companies will be able to develop product and service packages complementing their own vehicles, thus creating their own ecosystem. The key customer benefit will be the brand experience and mobility package from a single source in the areas of automotive-related services (parking, refuelling, insurance, health, personal assistant systems).
- **B2B (Business to Business) vehicle manufacturers:** This area involves the production of vehicles for mobility service providers. A B2B manufacturer has no direct contact with the end customer. The company is at a one-step remove and becomes a subcontractor to the new, ideal type of mobility service providers. It can probably be assumed that the vehicles will be finished by the mobility service provider, which will have its own relationships with suppliers. This is because data collection by the mobility service provider in the context of their mobility services will give them a very precise knowledge of the necessary and desirable technical and functional features when designing their vehicles. In particular, the assumed increased market volume in the area of mobility services (ride and car sharing) will lead to a new vehicle market segment in the area of fleet-driven vehicles. This ideal type is embodied by the Italian-American company Fiat-Chrysler, for example, in its collaboration with Alphabet (Google).
- **Mobility service providers:** This ideal type focuses on the provision of mobility services. The main customer benefits are an integrated, intermodal range of mobility products with a high convenience factor (seamless mobility), and expanded flexibility in availability, processing, and payment. Organisationally, this ideal type will utilise software- and Internet-driven structures with a focus on operating digital networks. Direct digital customer access via smart phone applications and web portals will enable the retrieval of customer data and thus create the capability of delivering high customer value services.

The future transformation dynamics in the development of automotive companies can be described as existing in the field between these three ideal types. It remains to be seen to what extent German automobile companies will succeed in transforming from the B2C ideal type they have embodied to date into a mobility service provider. Withdrawing or downgrading themselves to a position as a supplier (B2B) does not correspond to either their self-image or their envisaged value creation.

A further option is to have at least two or all three ideal types under the umbrella of an organisation and to respond to actual structural changes in the demand for mobility by means of internal organisational restructuring in whatever direction is necessary. It is crucial to note that due to the differences in these ideal types' business models, completely different resources, processes, specialists, and sales channels will be required.

This raises the question of organisational culture: how do car manufacturers have to change internally in order to meet the new requirements? The established organisational culture, and the existing business model of the automotive industry, have hindered its ability to react to current market transformations in a rapid and agile manner. At present, these organisational cultures and institutional structures – with slight differences between the companies – are characterised by hierarchical decision-making processes, and a focus on the corporate goal of organising production processes, which link high quality with mass production. In addition, the business models of the German automotive industry have traditionally focused on the production and sale of vehicles with fossil fuel combustion engines for the individual transport market. Both lead to path dependence and prevent fast, agile reactions to market transformations.

To date, these companies have little experience with the organisation of non-material products such as mobility services and product service systems such as car and ride sharing. This applies both to confidently engaging with the possibili-

ties of digital transformation and dealing with partners who differ fundamentally in terms of mentality and speed as well as flexibility, capital strength, and risk affinity. In particular, the digital sector is gaining an increasingly sophisticated grasp of the customer experience, which will become more and more important in the future. Here, the automotive industry has a lot of catching up to do in terms of quality and speed. In addition to building up a core competence in data handling, a new organisational culture will be necessary in order to become ready for the future again. One thing that seems necessary is company restructuring away from the often inefficient and slow principle of hierarchical management towards more decentralised, flat, fast, experimental, and agile decision-making and work structures. Whether it is reasonable and possible to build up these new structures within the framework of the old, or to set up small "speedboats" with these attributes as trailblazers and test labs, whose experiences may form the basis for the classically managed core structures to quickly learn and scale within the classical corporate environment, is a question that can only be solved experimentally. From today's perspective, the foundations of the Daimler subsidiary Moovel or the Volkswagen subsidiary Moia can be regarded as positive examples of the speedboat variant. However, they should not be misused to circumvent established codetermination structures.

4.3 NEW EMPLOYMENT

The consequences of the transformation of the automotive industry for employment also depend on the change dynamics. On the one hand, a gradual, coordinated transition that allows time for new forms of cooperation and organisational culture can avoid structural distortions and the loss of jobs and skills. By contrast, an immediate reliance on electric mobility would endanger 600,000 jobs according to the VDA. In particular, many suppliers – who are currently responsible for a large part of the value creation – would be overwhelmed by an accelerated switchover within seven to ten years. On the other hand, sticking to currently functional business models, postponing system innovations, and failing to make necessary investments in infrastructure and personnel may also threaten jobs and mean that opportunities to create the jobs of the future are lost.

This is why the internal pressure to change is immense for all manufacturers. What is required is not only a high degree of innovation and willingness to invest, but also the ability to implement and finance new HR development concepts. Those must ensure that employees can acquire the necessary new qualifications and maintain their employment prospects. Essentially, two questions are at stake: where might new jobs arise? And what skills will employees need to work in the new areas? Three levels can be considered. First, there is the level of an intra-company transformation of employment: where in the company will employees who have previously worked in component manufacturing be needed in the future? Second, there is the level of internal sectoral transformations: where will employees be needed elsewhere in the automotive industry as a whole? These could be in electric vehicles, sensor technology, networking, or in the service segments of the new "mobility as a service" area. Third, there is the level of the induction of new employment potential in non-industry segments within or outside the mobility sector: the aim here would be to diversify the value chain, which has thus far been very exclusively oriented towards the automotive industry, by means of new companies and business models and thus new employment and skills requirements.

In any case, there is broad agreement that in parts of the production process there is a risk of job losses due to the far-reaching changes. Compared to today's highly complex internal combustion engine, the electric engine is a relatively easy-to-grasp technology. Other complex components of the engine architecture associated with combustion, such as the transmission and exhaust systems, will no longer be necessary in a future of electric motors. If employment levels come under pressure here, it will also be easier for new entrants to the automotive market – be they companies or entire countries such as China – to bring lighter, more competitive vehicles onto the market. The digitisation of mobility (sharing mobility and automation) and the digitisation of production (process automation) could also lead to noticeable increases in efficiency and thus to less demand for skilled work in the automotive and mobility industries. In addition, there are ongoing processes of relocation to the main sales areas, which will also lead to job cuts in the car manufacturers' home regions. One in three employees in the automotive industry is expected to take on a different job in the future.

At the same time, it is not yet possible to predict to what extent new jobs will be created in other areas of the mobility industry, and the economy as a whole, for example, through new digital business models. However, the decisive question is not only whether there will be sufficient new jobs in quantitative terms, but also what the quality of the jobs will be, and what retraining strategies will be needed to successfully transform employment. In other words, how can a mass devaluation of "good" work in the automotive industry in favour of "new" but precarious work, poor pay, and downgrading of job skills be prevented?

This development is likely to take place at different times throughout the world. There will be different vehicles and business models for the important lead markets in Asia, North America, and Europe as well as for their downstream markets, which will at times diverge greatly in terms of their geographic and settlement structures, demand patterns, and political regulation. The consequences for business and employment could vary widely across regions. Very different demands would emerge from the respective regions, which have to be met at the same time despite an enormous differentiation.

In the next few years, a parallel further development of combustion technology and e-mobility or hydrogen technology is expected in Germany. The time must be used to establish new value-added chains, especially in the automotive producing regions. For this reason, the automotive industry needs an industrial and service policy concept that safeguards and expands the industrial value chains, ensures its link to digital business models, and secures innovation potential and jobs in the long term.

A concerted effort by the local car manufacturers and system suppliers to promote battery cell production in Europe

is crucial. Nevertheless, the question arises as to how the restructuring of employment via national and regional economic programmes could lead to alternative employment potential in other sectors. In particular, regional automotive clusters face the challenge of diversifying their economic structures, and reducing their dependence on automobile production. This, in turn, prompts the question of training programmes and suitable regional economic innovation and conversion strategies.

The employment policy challenges of transforming the current system into a carbon-neutral transport system are therefore considerable. A balance must be struck between meeting demanding climate targets and the necessary transformation process in the automotive industry, without sacrificing jobs.

5

INTERIM CONCLUSION: POLITICS NEEDS TO TAKE CHARGE

We are currently experiencing the beginning of the end of the form of automobility that we have known for almost 100 years, and which we have been perfecting ever since – that is the first conclusion of our study. All over the world, the established functional models of the automotive industry of the 20th century – the private ownership of vehicles, the operation of cars by a human driver and, finally, the concept of the fossil fuel internal combustion engine – are being questioned in different ways, based on different interests, and with different strategies, but more or less simultaneously. In place of fossil fuel combustion engines, a number of variants of electromotive generators and storage concepts are emerging; instead of human-driven cars there are concepts of assisted, automated, and autonomous driving, and instead of ownership there is the utilisation innovation of the automobile within the digital platform economy, with its new business models and distribution modes, i.e. mobility services.

5.1 SQUEEZED BY CALIFORNIA AND CHINA

What is also new in this context is the fact that the industry, which – despite continued strong competition between the individual companies – has been able to rely on internal unity and a sense of mutual commitment to the established functional model of automobility for many decades, is now being put under pressure by non-industry players. The technology companies from California, and increasingly from China, have not only mastered the new disruptive technologies of digitisation much better. They are, above all, characterised by an innovation and organisational culture that is very compatible with the exponential development dynamics and complexity of these technologies; a culture that is as flexible and agile as it is risk-oriented. They feel only conditionally, if at all, committed to the old consensus and goals of automotive culture. By and large, however, they take on the explicit goal of doing everything differently and much better, and showing little consideration for existing players

5.2 CHINA'S TECHNOLOGICAL ADVANCE

In addition, there is another powerful political player, the Chinese state. In its threefold industrial-political endeavours, it has sought to develop its own automotive industry, to become a leader in sustainable technology, and to mitigate the ecological and economic growing pains resulting from the mobilisation of Chinese society, yet it has paid little attention to the current regulatory and technological consensus of the Western industrial nations. This is especially true when it comes to implementing China's own regulatory goals and strategies. This is key for two reasons. First, Chinese society is not trapped in the golden cage of an established fossil fuel automobility and automobile industry. Chinese policymakers do not have to oppose an established socio-economic regime with their industrial policy design concepts and technological decisions; they do not have to implement this policy in the face of a fully established fossil fuel technology context, with its functional infrastructure space and the associated industry interests. Moreover, there is little resistance to be expected from a population that does not drive private combustion engine cars en masse. The Chinese state can therefore act with a high degree of freedom in the field of transport and innovation policy, and can use electric mobility together with digital systems and networking technologies as a comprehensive system innovation in transport policy. Finally, due to its basic non-democratic outlook, China's government can force political and technological innovation by means of a strong and rapidly effective system of regulatory and top-down fiscal policy instruments, while democratic societies have to implement their calls for change on the laborious and slower path of pluralistic opinion formation and decision-making.

5.3 PATH DEPENDENCE IS IMPEDING INNOVATION

By comparison, Western automotive policy remains strongly rooted in the established usage structures and values. So far, it has at most managed to develop a purely product-techno-

logical innovation approach that attempts to meet the demands for range and availability within the given structures and requirements. The intention is to implement the new engine technology using traditional usage patterns. Yet this could be doomed to failure, a suspicion that is demonstrated by the debate over resource usage in an electric vehicle. If it is used within the usual usage concepts and patterns, it would be almost impossible to amortise the primary energy and resources used over the entire life cycle in terms of energy or emissions alone, or only if we assume very high mileage.

There are, of course, reasons for this path dependence. The transformation dynamics described here are confronting an industry that has been extraordinarily successful within the established automotive culture. Product competence plus production competence plus high-quality standardised mass production was the formula that until recently not only supported the German automotive industry, but also contributed significantly to prosperity and employment in the four major automotive regions and to Germany as an industrial location. However, the dynamics of transformation are also encountering consumers who, having come of age with the technological and cultural model of the universal, combustion-engine, privately owned car, accept or have had to accept increasingly distant residential and commercial areas. And it is confronted with a political sphere that has to date viewed its central duty as regulating this key industry for economic and employment policy reasons in a largely benevolent manner, and that has chosen to support it in its interests. On the other hand, it pursues a consumer-friendly, supportive automotive policy, since consumers are always also employees and voters. Finally, there is also the socio-psychological effect of a broad societal self-conception of Germany as one of the economically most successful nations for automobility from the beginning of its history. All of these factors can be a hindrance if the current technological, scientific, and entrepreneurial competencies are devalued very quickly, and if the aim is to develop a transformation perspective.

In other words: the flip side of economic success and the expansion of the automotive opportunities for the consumer over the past decades is now an equally strong path dependence on the part of companies, consumers, politicians, and trade unions – resulting in strong resistance to change. The negotiation processes in automotive policy in recent decades have never called into question the well-balanced basic consensus of this established socio-economic field, and were primarily aimed at stabilising and maintaining existing structures.

To a certain extent, this traditional regulatory regime is threatened with failure because of its own success and also because of the enormous increase in complexity, and simultaneous acceleration in the field of mobility and automotive policy. In social theoretical terms and observed over longer periods of time, social systems or functional subsystems, such as the mobility subsystem, develop linearly and evolutionally only to a limited extent. Whenever clear limits of further development cannot be overcome with established technological, economic, political, and social strategies, it can lead to sudden crises and change dynamics. Once such a situation has arisen, sticking to current thinking and procedures can become a great danger. Taking the bull by the horns, however risky it may seem, can be a wise alternative to sticking to your guns in uncertain situations. In the mobility field, as described above, the demands of sustainability, urbanisation, digitisation, and individualisation have consolidated into a transformation dynamic that can be mastered only by early, purposeful, experimental, and courageous action and not by waiting, avoidance, and watching.

All this is happening at a time when the German automotive industry is still at the peak of its economic success, but is being weakened by the reappraisal of its dirty and likely criminal business practices, while at the same time displaying enormous resistance to new ways of thinking. The same applies to the political sphere. So far, politicians have had no more of an idea of how to restructure this core sector of the economy than the enterprises themselves. Finally, this is also reflected in the consumers of the established automotive culture, and their functional and emotional dependencies. Their purchasing decisions and their choices of means of transport, are evidence that their readiness for transformation is very limited.

5.4 TRANSFORMING A SYSTEM IN OPERATION

Politically, there's a lot coming our way. If the future of one of the most important industries in Germany and Europe is not to be jeopardised by a largely unplanned transformation process in the face of a global conflict between different players and interests; if the transformation is instead to be carefully planned, guided, and cushioned by socio-political measures, a new regulatory regime and new forms of interest aggregation and articulation in an expanded field of mobility policy are required. As was also the case for the German energy transition, historically speaking, there are no examples or models for how the overhauling of such an enormous and networked mobility and logistics machinery can occur while carrying a full load. That is new political territory in a democratically governed system. However, the successful transformation of the mobility economy could be the test ground for new procedures and political approaches for the transformation of society as a whole, which needs to socially tame digitisation and create a sustainable economy in the coming decades.

5.5 POLITICS TAKING CHARGE

To cope with this upheaval, there are, in simplified terms, two options for action: a traditional, politically feasible but insufficient option or, on the other hand, an unknown, politically difficult option that would be suitable to the problem. The former would be an evolutionary automotive policy scenario. It would focus on supporting industry and mitigating the employment effects of market-driven change. The aim would be not to fundamentally restructure the sector in light of a new overall concept of mobility and transport policy; it would be to alleviate the worst problems directly. Constellations of this kind are well known in automotive history and could be successful in the short to medium term. They do not call into question the interests and procedures of the well-balanced field of automotive policy.

By contrast, a comprehensive medium to long-term change in mobility would aim to develop a sustainable and integrated transport system that incorporates the automobile as a building block in intermodal chains of action and transport. Constellations of this kind are unknown in transport and car history. They massively call into question the interests and procedures of the existing automotive political power field. The political sphere is the only player who can, on the one hand, be considered as a moderator of the discourses on the way to a kind of new social treaty and, on the other hand, who can carry out its political implementation as a legitimate controlling body; policy-makers have the capacity for different levels of action, access to political institutions, and established negotiating arenas.

5.6 A WAY OUT: A FUTURE PACT FOR MOBILITY

Germany needs a future pact for mobility involving industry, trade unions, politicians, and society. This demand is central to the next chapter. Current automotive and transport policy is still largely limited to managing the challenges of a highly complex and highly automotive-dominated transport system in developed industrial societies. There are no clear visions for transport and automotive goals that reconcile economic, social, and environmental requirements in a long-term and sustainable manner. There is also little willingness to take clear measures aimed at changing goals and ideal images on the demand side in order to support the market transformation among consumers, and shift them towards new technologies and business models – and thus towards new product strategies for the industry. Similarly, there is still a lack of courage to take such measures, which clearly contradict the short-term interests of the industry, to ensure the medium and long-term protection of economic, environmental, and social interests.

The following, second main part of our study serves to elaborate on these considerations, in which the transformation of the automotive industry is a central element. The political model for this future pact for mobility is the programmatic consensus of all the players involved, the redevelopment of the industry on the basis of the clear vision of a sustainable and integrated overall transport system, and the inclusion of the automobile as an automotive component in intermodal logistic chains of action and transport. The pact for the future follows the tradition of coping with economic, social, and societal change in a cooperative manner. Germany has had good experiences with this so far.

6

A FUTURE PACT FOR MOBILITY TO TRANSFORM THE AUTOMOTIVE INDUSTRY

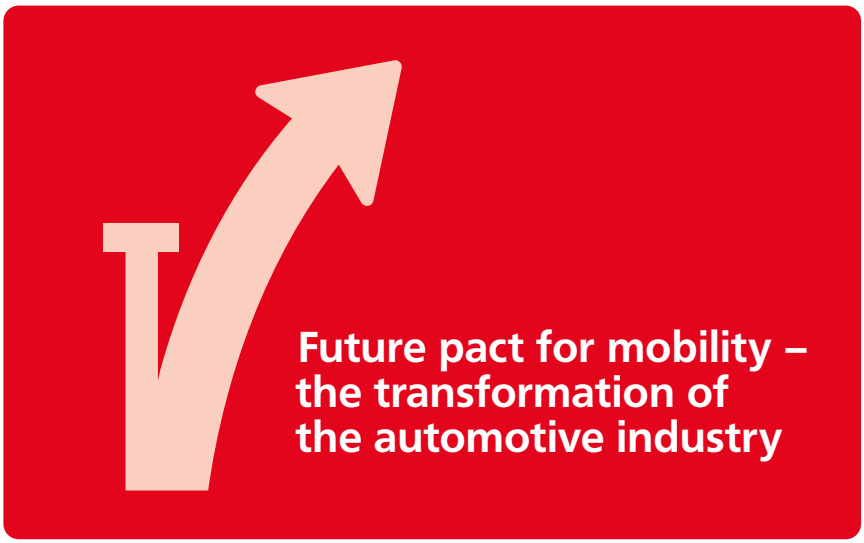
In order for the transformation of the automobile industry to succeed, and to secure the important role of this sector for Germany and Europe, we must now begin to influence the ever more dynamic transformation. Instead of experiencing and enduring the transformation by disaster as we have done recently, we have to switch to a transformation by design mode. A future pact for mobility is needed. However, it is equally important to emphasise that the current situation is not only characterised by challenges, but also opens up valuable opportunities to take bold steps, test and implement innovations, and develop sustainable mobility jointly with all the stakeholders. This is not an easy task. Which is why it primarily depends on the political sphere. The policy outlook on mobility must take the entire social transformation into account. For that reason, we must focus on the policy areas that are crucial to that. We want to designate concrete proposals and instruments for the direction and specification of the future pact for mobility, in order to steer the transformation of the automobile onto the right track. Figure 4 summarises our recommendations for an initial overview.

A central mechanism of the future mobility pact proposed here is a binding agreement between the industry and politicians on phasing out the registration of vehicles with fossil fuel combustion technology in the medium-term. The exact timeline remains to be discussed, but current debates suggest a target date range between 2035 and 2040. This target is a logical consequence of the CO_2 reduction targets agreed in Paris. For only if combustion engines are no longer permitted from, for instance, 2035/2040 will the internationally agreed target of extensive carbon emissions reduction by 2050 be achievable in the mobility sector. In this constellation, the companies will provide assurances regarding their planned exit from the combustion engine market, their willingness to fully deal with current fraud allegations and cartel law ambiguities, and their future abstinence from non-compliant lobbying in Berlin and Brussels.

The German government, as the central state actor, will coordinate and moderate the processes, working with the federal states and the municipalities. Those bodies will establish the regulatory and fiscal framework for action at those levels in order to be able to act in accordance with the future mobility pact. Those frameworks must include sufficient financial resources for investments in infrastructure and public procurement, the fair management of the consequences for labour and social policies (see the trade union position on the "just transition"), and the willingness to adopt a strongly user-centred regulatory policy for the targeted market transformation of consumer behaviour towards electric mobility and multimodal transport choices. Finally, the government must reach agreements for a Europe-wide concerted initiative.

In addition, it should be the joint task of politics and industry to use public discussions of the mobility policy as a political model for a consultation mechanism to be further specified, to clarify it, and finally to agree on rapid implementation steps within the framework of a future pact for mobility. This may be based on experience gained in other sectors, such as the phasing out of nuclear power in 2012. On the other hand, important institutions have already been established that could take on the role of a discourse arena, such as the Agora transport transition in Berlin, or the activities of the Baden-Wuerttemberg state government to transform the south-western automotive region around the OEMs Daimler, Porsche, Audi, and important suppliers such as Bosch and ZF Friedrichshafen. Clear and transparent public positioning, persuasion, and the government's function as a role model and overseer of the transition will help to win over the population's political and societal support.

Figure 4
Future pact for mobility – the transformation of the automotive industry



1. Programme to restructure the market for electric mobility

- Implement a market transformation programme moderated and regulated by policy-makers
- Establish long-term mobility and structural policy objectives to guide action
- Initiate an electric mobility public procurement pact
- Revise fiscal regulation
- Secure market transformation through regulatory policy frameworks
- Realign the legal framework for vehicles with internal combustion engines

2. Europe's technological advance

- Reallocate and pool research and research funds
- Develop European battery production capacity
- European coordination of procurement initiatives for electric vehicles
- Harmonise regulation of the automotive industry and consumers

3. Municipal laboratories for new mobility

- Enable time-limited and locally limited setting of divergent rules
- Support laboratories through advice from interested citizens and experts
- Communicate results at state and federal level
- Revise fiscal regulation
- Use findings to further develop the legal framework at the federal level

4. Reorientation of infrastructure policy

- Include social and environmental criteria in cost-benefit analyses
- Expand truck tolls for the entire road network
- Provide additional funds for cycling and public transport
- Expand the charging infrastructure for electric vehicles

5. Research funding

- More funding for basic research
- Strengthen applied research on digital technologies in urban transport markets
- Encourage the testing of digital links between individual mobility services

6. Initiative for employment and skills

- Create a collective bargaining agreement framework for the introduction of digital business sectors
- Involve works councils and affected persons at an early stage
- Ensure further education and training courses
- Further develop labour market policy and social security systems

7. Structural policy initiatives

- Strengthen and refine existing structural policy instruments
- Develop key structural policy objectives for the transport industry
- Support the achievement of objectives with funding programmes and public contracts
- Adjust European state subsidy laws
- Provide structural policy instruments for established automotive regions as well

6.1 MARKET TRANSFORMATION PROGRAMME FOR ELECTRIC MOBILITY

Only by generating a strong consumer demand dynamic can the full scope of action for industry be initiated and, with it, the willingness to change technological paths. As a first step, a politically moderated and regulated consumer-based market transformation programme for electric mobility should be set up and implemented. Associated regulatory reinforcement can later be created at the European level by setting standards, e.g. by continuously tightening emission reduction targets. A key factor in all decisions is that the short-term political measures should not be inconsistent with the long-term and overriding mobility policy objectives of a sustainable transport future, or contravene agreements on an equitable structural change ("just transition").

In order to strengthen demand, we are proposing a procurement pact for electric mobility, which provides for coordinated purchasing of vehicles and mobility services by all government agencies. If necessary, changes and simplifications of the legal acquisition basis can be made in order to achieve the desired goal of increasing the proportion of electric vehicles in state fleets. Coordinated procurement in cooperation with semi-public or private fleet operators such as churches, church welfare organisations, and social service providers would be desirable. This procurement pact would also include operators of public utility vehicles. The starting points are municipal maintenance and waste disposal fleets, local public bus companies, as well as authorised taxi and passenger transport companies.

Another important starting point is the restructuring of fiscal regulations governing car purchase and operation via the alignment of relevant taxes and levies. This can be done, for example, by means of purchase bonuses for electric vehicles or even by the use of bonus-surcharge systems and taxation linked to emission levels. At the same time, it is important to get rid of established incentives that will likely be counterproductive in view of the need to provide relief in the local emissions sector in the future. This will primarily involve phasing out all tax benefits for diesel vehicles, and commercial and private tax write-offs for the acquisition and operation of vehicles with internal combustion engines.

Regulatory frameworks should be set up to enable urban congestion charge concepts or other approaches to emission-based regulation of infrastructure use (e.g. blue stickers, parking regulations). These approaches should create legal stability during the transition phase and, above all, allow local players to regulate the actual situation in their locations.

All transport, environmental, tax, and financial laws aimed at promoting and stabilising the automobile with internal combustion engines should be reviewed and fundamentally realigned. The aim must be to end decades of preferential treatment and promotion of the combustion engine while at the same time ensuring maximum increases in efficiency. These include:

- In the light of the Paris decisions, updated CO_2 limits for passenger cars and the introduction of CO_2 limits for trucks;
- Reform of the identification requirements for all vehicle classes according to pollutant classes (update of the 35th federal emissions identification ordinance with blue stickers) with the aim of creating emission-free environmental zones in city centres.

At the same time, the social and economic participation of consumers and retailers must not be inhibited. This is why it is important to enable transitional technologies and, if necessary to financially support them on a temporary basis. In the short term, it would be conceivable, for example, to increase financial support for gas combustion engines until the market transformation programme for electric mobility becomes effective, in order to be able to meet the CO_2 limits despite the phasing out of diesel technology.

6.2 EUROPE'S TECHNOLOGICAL ADVANCE

Measured in terms of the size, innovative power, and development dynamics of the Asian and North American mobility markets, meaningful prospects for Germany as an automotive location can only lie in a pan-European innovation and transformation project. In the future, there will be few chances of success for nation states that choose to go it alone. The retention of technological competence, industrial systemic capability, and the jobs that go with it, must also be politically anchored at the European level. Together with the French government, the German government should therefore take the lead in a joint pan-European project to take a technology leap into the future.

Even though the European automotive industry is not without prospects in the race for electric mobility innovation, the Californian and Chinese players are much more dynamic and agile. Unrestricted by previous technological decisions – such as diesel technology – and endowed with great financial strength for innovations (in California through the venture capital market and in China through strong industrial policy support), the entrepreneurial conditions for entering the electric mobility sector in the USA and China are much better than in Europe. However, a pan-European alliance for electric mobility at EU level, and a coordination and alignment of national policies, would be able to counter the competition from the USA and China with an independent European innovation project. Elements of such a European project for the technology leap could be:

- The reallocation and pooling of research funds in order to create an effective funding policy lever in the short term;
- Pooling of top-up company funds from the European OEM and supplier industry;
- Basic research into battery technology and battery production, especially with a view to achieving higher resource efficiency and with the idea of developing a regenerative resource strategy for storage technology;

- Development of a sufficient pan-European battery production capacity. The issue here – and this must be examined further – is not so much of independent cell production as of further developing the capacity to design a high-performance battery architecture;
- Further development of energy re-charging systems;
- Europe-wide coordination of procurement policy initiatives to promote market entry for electric vehicles;
- Europe-wide harmonisation of exit targets from combustion-engine technology, and of automotive political regulatory approaches to the industry and consumers.

Particularly with respect to the expansion of renewable energy sources for the operation of electric vehicles, it is clear how energy and transport are directly linked. From this perspective, too, a decision on European energy industry objectives for the qualified modification of the energy mix in favour of renewable electricity generation and storage at the national levels is therefore desirable.

6.3 MUNICIPAL/LOCAL LABORATORIES FOR NEW MOBILITY

Municipalities should be able to independently change rules more radically and more comprehensively than has been the case to date. This is because municipal laboratories of this kind can allow both the car industry and public transport operators to come up with new forms of cooperation in view of the new mobility (digital networking, autonomous driving, and mobility services).

- In a pilot phase the parking management system could be changed, the environmental zones could be redefined, and parts of the Passenger Transport Act could be suspended under the experimentation clause, so that (municipal and private) ride sharing could be made possible and tested, for example, via digital platforms (also, and particularly, in rural and suburban regions).
- The aim of the municipal laboratories could be to make better use of the vehicle fleet and strengthen public transport, and to develop forward-looking, digitally supported capacity planning based on the motto "citizens drive citizens" – organised by the local public transport company. Other options that could be tried out in such laboratories are the introduction of mandatory citizens' public transport tickets, bicycle rental systems on an appropriate scale, extensive 30 kph zones, etc.
- These facilitating laboratories would be limited in time and space, and would be guided by and commented on by a council of interested citizens and experts.
- In addition to the cities, rural areas or small localities should also be allowed to temporarily suspend parts of the existing laws in order to facilitate multimodal transport projects.

The knowledge and experience gained in this way can serve as building blocks for the development of new regulations at the federal level (an omnibus act, i.e. a legislative technique, is just one of many options). This is precisely why the municipal facilitating laboratories are so decisive for the future mobility pact. They should allow a moderate change in the rules for a limited period of time, offer immediate insights into new business options that could further a sustainable mobility culture, and could quickly contribute to cultivating a supportive opinion environment for upcoming modifications to the existing transport policy framework.

6.4 THE REORIENTATION OF INFRASTRUCTURE POLICY

Infrastructure financing has already been the subject of several commissions. As a result, there are more financial resources, but the political and economic approach remains aimed at specific clients. A reorientation of infrastructure policy should aim to intelligently dovetail federal, state, and municipal authority with clear responsibilities that transcend the previous approach. The following measures are necessary for this:

- The establishment of an efficient agency for mobility infrastructure planning, financing, and operation that carries out planning, construction, and maintenance tasks for all transport carriers based on parliamentary investment decisions and demand levels.
- Expansion of the traditional cost-benefit assessments of transport infrastructure projects (CBA) to include social and environmental criteria relevant to decision-making, e.g. inclusion of healthcare costs (as in Denmark), instead of focusing only on economic viability and (minor) travel time gains;
- The extension of the truck toll to the overall network, and consistent off-setting of external costs.
- Additional federal funds to promote cycling and increase the safety of cyclists.
- A significant increase in federal financial resources to promote the attractiveness of public transport systems;
- Restructuring of the sectoral federal traffic route planning programme into an integrated traffic planning programme.
- Comprehensive expansion of charging infrastructure for electric vehicles.

6.5 PROMOTING RESEARCH

The pact for the future of mobility also requires the promotion of basic and applied research at pre-competitive European level. This applies, for example, to battery research and automation technology. Further application-oriented research funding is particularly necessary with regard to the applicability of new digital technologies to urban transport markets. What would be particularly desirable here are temporary real-world laboratories to test digitally linking user-

efficient individual mobility services (car and bike sharing, ride sharing, public "mobility on demand", autonomous vehicle and service offers) within the framework of integrated, intermodal and multimodal overall transport concepts.

6.6 INITIATIVE FOR EMPLOYMENT AND SKILLS

The coming structural change in the automotive industry requires the active intervention of policymakers. They must work with the social partners to ensure that jobs of equal value are created in the event of structural change. The burden of adapting to structural change must not be imposed only on employees; it must be distributed fairly (see here the corresponding trade union discourse on the “just transition”). In addition, employees, social partners, consumers, and civil society must be fully involved in making joint decisions.

Germany’s characteristic diversified quality production is closely linked to co-determination systems and collective bargaining agreements, especially in the case of structural and operational changes. Building on this tradition of social partnership, employers and trade unions can and must create a collective bargaining framework that sets out, for example, the rules for the introduction of digital business fields. Works councils and the affected parties must be involved at an early stage in the coming changes. This is because further education and training are prerequisites for vocational changes. Our society has the political will and the necessary experience to shape digitisation so that it will not be detrimental to employees, but instead can be used to create good work and new freedoms. The pact for the future of mobility must implement this.

Labour market policies should contribute to this. The social security system needs to make it possible for employees affected by restructuring and transformation processes to cope with this without drastic loss of income.

6.7 STRUCTURAL POLICY INITIATIVES

In order to prevent regional rejection caused by an uncoordinated transformation process, it is necessary to anticipate upheavals in the automotive regions at an earlier stage, in order to be able to react more precisely with an integrated approach to industrial, service sector, and structural policies.

In addition to strengthening and tightening up existing structural policy instruments, it is therefore necessary to develop key governmental structural policy objectives for the transport industry that benefit employment and industrial locations. Sector-specific support programmes and public contracts should be derived from those objectives in order to support the future viability of the automotive industry in Germany and Europe.

For this reason, the federal government must make every effort over the next few years to ensure that European subsidy laws meet those requirements. In addition, industrial and innovation policy measures that also focus on the seemingly economically sound automotive regions are needed. This could be done with new funds and financing instruments, and support programmes, with the expansion of existing innovation funds or with the investment activities of the KfW and the European Investment Bank.

7

OVERALL CONCLUSIONS AND RECOMMENDATIONS FOR ACTION: TRANSFORMATION BY DESIGN IS DIFFICULT BUT FEASIBLE

The German automotive industry is experiencing a period of transformation without precedent. Strong and globally effective megatrends, new mobility demands in the urbanising transport markets, and unprecedented competition are unsettling the industry in many respects – both due to the digital upswing in the IT sector, and to China's industrial policy objectives, its international leadership aspirations, its global investment strategy, and its domestic market, which is crucial for all exporting nations.

This upheaval can no longer be managed with the familiar methods of automotive policy regulation and internal corporate self-transformation. In recent decades, politicians, private enterprise, trade unions, and consumers have configured and equipped the functional arena of today's automobile industry, with its well-known barriers. Only together will it be possible to rebuild it.

With this goal in mind, politics will inevitably have to adopt a social perspective on the transformation on mobility. Above all, it is important to courageously regulate customer behaviour in a way that creates demand for new and forward-looking products. A transformation of the industry towards electric mobility can only succeed if it is accompanied by a rapid and strong market transformation on the consumer side towards the new energy technology. Industry alone will not be able to undertake this comprehensive market transformation. It can only be brought about by political players. However, all policy approaches will come to nothing as long as the regulatory framework is not in place to govern conditions in the public transport sector, the infrastructure, and the geographic conditions for alternative mobility behaviour. At the same time, it is the duty of policy-makers to develop cooperative strategies jointly with enterprise and trade unions to ensure an absolutely socially-acceptable transformation of employment and training.

Our pact for the future between the state, industry, trade unions, and mobility players is a first conceptual proposal, which should be fleshed out and modified in further discussions with the parties involved. The automotive value-added regions around the major automotive companies in Germany appear to be the appropriate places for these discussions. The consequences of an uncontrolled transformation would first be seen here in the form of precarious employment and social risk. That is also where the greatest resistance can be expected to any form of change that is detrimental to employees. However, that is also is where the greatest capacity for innovation is found. If we succeed in mobilising the potential for solutions in the major automotive regions of Germany, and in gaining acceptance for a new (automotive) mobility, they can become cutting-edge and exemplary laboratories and experimental spaces for sustainable mobility. A redeveloped version of automobility can and will guarantee Germany and Europe a significant share in future-proof automotive value creation.

Against this backdrop, what are the recommendations for action to the major groups of players in the automotive transformation?

Politics: Take on a central role. Adopt a leading role in moderating and coordinating the transformation of the automotive industry in the context of a comprehensive transformation of transport, rather than managing the status quo. Strengthen corporate co-determination and create social arenas of participation. Moderate the discourses on defining common goals, implement the corresponding political strategies and measures at national level, cooperate at the European level. That means sending an industrial and socio-political signal both internally and externally to the important markets of the USA and China. Europe has the historic opportunity to become a pioneer if it sets the right course.

Companies: Recognise the central role of politics. Understand the absolute need for transformation in the industry. Be willing to cooperate with old and new automotive industry players (other OEMs, digital technology companies and start-ups, politics, and local government). Be willing to implement organisational restructuring. Develop a new, more collaborative form of lobbying. Develop a new concept of the industry as a provider of mobility services.

Trade unions: Grasp the need for transformation in the sector as an opportunity to shape the future. Use co-determination instruments for a future-oriented strategy. Become key players in structural and regional economic initiatives for new employment, especially in automotive regions.

Municipal and local governments: Implement the urban transport transformation towards emission-free and post-fossil-fuel automobility as an integrated component of intermodal transport strategies in urban areas. Review and modify existing urban and development planning according to the new objectives of the transport transformation. Strengthen civic participation. Develop a cross-community procurement policy (e.g. with a view to municipal utility vehicles and emission-free bus fleets). Promote the electric charging infrastructure (e.g. at government buildings). Grant traffic-related and, if applicable, financial benefits for the use of electric vehicles. Be open to experimentation with a view to emission-free and post-fossil-fuel automobility in rural and suburban communities as well, keeping in mind that due to on the more decentralised geographic and settlement structure of these communities, a higher proportion of electro-mobile hybrid concepts with a greater range will be necessary (for example, dominant electric driving with range extender) in order to master the initially structurally deficient starting point for rapid changes in user behaviour. Simultaneously develop alternative means of transport (structurally flexible public transport concepts, express bike routes). Use rural and urban communities as laboratory and application areas for the concepts of new mobility (sharing mobility), including the rapid creation of infrastructure, and firm regulation of the external effects of private fossil fuel cars.

Consumers: Utilise participation instruments. Support government players in pursuing an ambitious policy of change in the transport sector, including a new regulatory framework for automotive policy. Be willing to experiment, and be open towards new digitised product and service concepts.

From today's perspective, the transformation by design appears difficult and likely to result in conflict. Yet it is the right way. Instead of shying away from these conflicts, we should seize the opportunity they offer to shape this societal transformation. Only in this way can we secure the automobile industry's important long-term role for Germany, and therefore also employment in the form of good work. We hope that our proposals will trigger the necessary discussions.

List of figures

List of abbreviations

B2A	Business to authorities
B2B	Business to business
B2C	Business to consumer
EFTA	European Free Trade Association
R&D	Research and development
KfW	German government-owned development bank
CBA	Cost-benefit analysis of transport infrastructure projects
OEM	Original equipment manufacturer
SUV	Sport utility vehicle
ZEW	Centre for European Economic Research

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