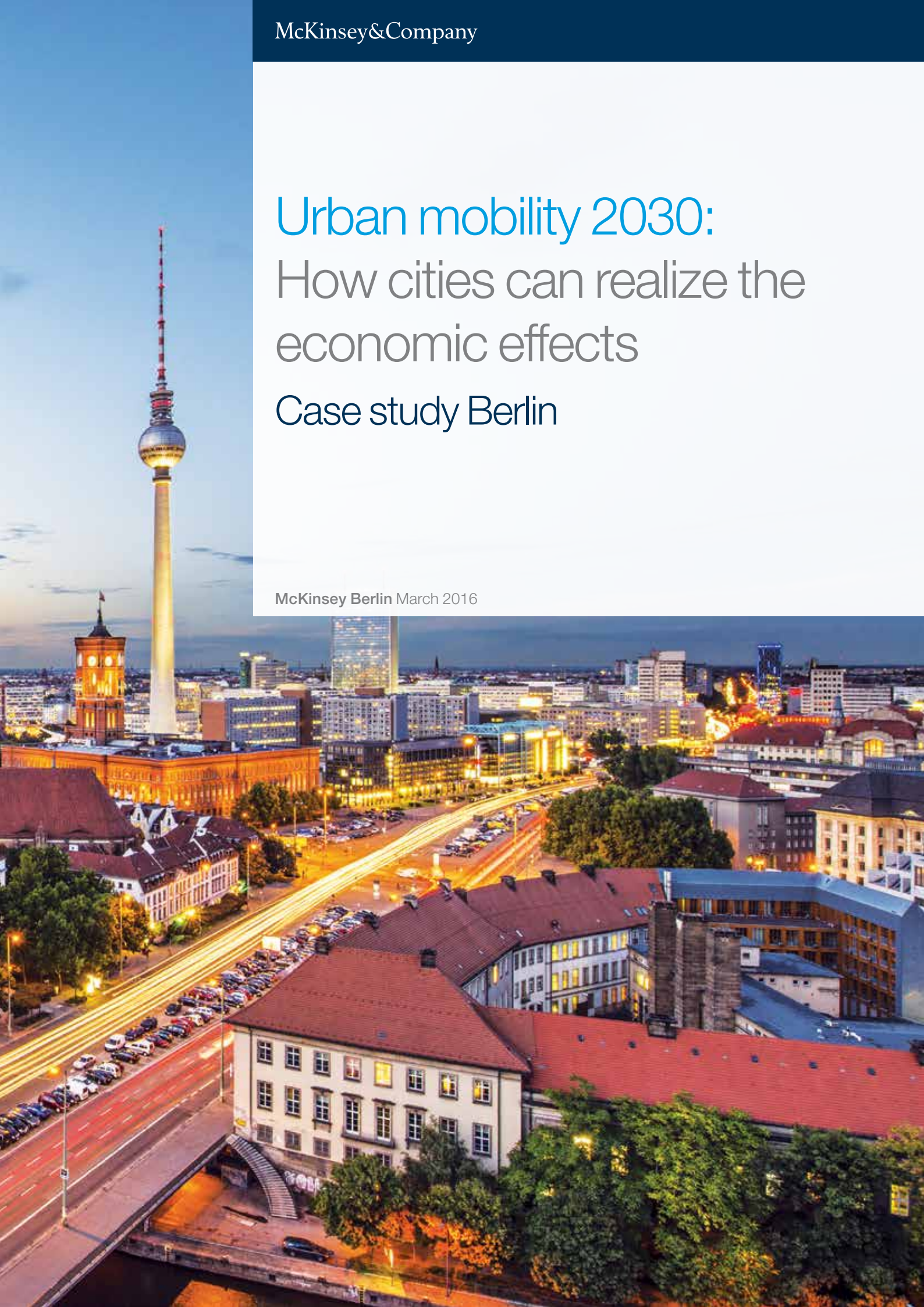


Urban mobility 2030: How cities can realize the economic effects Case study Berlin

McKinsey Berlin March 2016



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Berlin – a city on the move

Mobility is a basic requirement of modern society and a driver of innovation and growth. But in major cities, space is increasingly at a premium – and all forms of mobility make claims on it. New developments such as the spread of electric and connected vehicles and changes in user behavior now offer the opportunity to implement innovative mobility concepts. They have the potential to reduce congestions, noise, and pollution in urban spaces and improve the quality of life.

The new forms of mobility also offer the potential to create economic value. In the study presented here, McKinsey & Company examined how Berlin, Germany's largest city, can profit from intelligent mobility solutions. The key finding: by 2030, urban mobility can generate up to 14,000 jobs in Berlin. Urban mobility encompasses all modes of passenger transport within cities, a modal mix consisting of private cars, car sharing vehicles, public transportation, taxis, e-hailing (app-based taxi and transportation services), bicycles, and walking. Most new jobs will arise in mobility companies that address users' changing needs.

For Berlin to be able to tap this job potential, the city should concentrate in the next several years on three success factors: it should position itself as a lead market for urban multimodal solutions, promote the local start-up culture in this area, and attract and grow talent in the most important growth segments in the new mobility value chain. This focus could be complemented with attracting mobility companies to Berlin as a further way of positioning the city to benefit from urban mobility as a driver of growth and innovation.







1

Urban mobility in transition

Mobility is an integral part of our society. Without a reliable transportation system, people would not get to work on time and could not enjoy their leisure time as flexibly as they do now. But the way we move around within our cities is about to undergo far-reaching changes. Four trends, recognizable worldwide, will change current mobility habits and conventions:

- **App-based mobility services.** For many years, the automobile was “everybody’s darling” in Germany, a central status symbol, despite the fact that privately owned cars spend 90% of their time parked in the garage or at the curb. Meanwhile, however, the desire to own a car has declined among young people and also among city dwellers. Cities offer any number of alternative ways of organizing mobility – besides public transportation, for example, people can make use of car sharing, which is advancing around the world. In 2015, there were already nearly 6 million users globally. In 2030, one car in ten sold could be a shared car – with potential consequences for taxis and e-hailing. At the same time, bicycle rental systems are also on the rise in many cities. The prime mover behind these changes is of course the smartphone and the expansion of information networks. Mobile devices provide quick access to timetables and pricing information, make the locations of available rental cars transparent, enable individuals to order a taxi with a simple app, and promote the creation of new services. App-based offerings also make it simpler to combine various modes of transport to complete a trip within a “mobility value chain.” If you want to go from A to B, you can already find the connections today for different modes of transport such as public mass transit, bicycle, or rental car. Deutsche Bahn and other passenger rail systems will soon offer travelers the option to book an electric car that awaits the traveler upon arrival at the destination station. This opens up new opportunities for travelers: if cars today are used mostly for the widest variety of applications – from the daily commute and short shopping trips in the city to longer vacation travel – people who live in big cities will be able to pick and choose from among tailored mobility solutions for any and every purpose.
- **Electrification of the powertrain.** More stringent emission regulations, better charging infrastructure, and lower battery prices are driving the sale of electric vehicles. Predicting how things will develop remains challenging, however, as the effects of the recent oil price drop make clear. In an optimistic scenario – assuming regulatory support and increasing interest on the part of customers – it is likely that, by 2030, every second new car worldwide will have an electric or hybrid powertrain. The world’s metropolitan areas will play a key role in the spread of electro mobility. Large cities are a particularly favorable seedbed for electro mobility for several reasons. First, a radius of 150 kilometers is sufficient to meet the mobility requirements of many city dwellers. Second, cities are home to the most “early adopters,” people who are the first to try new technologies and other innovations. This group also often tends to pursue a sustainable lifestyle and is thus also willing to spend more money on “green” mobility.

- **Connectivity.** In the future, cars will signal to one another when they detect traffic jams, construction sites will alert drivers not only with a “roadwork ahead” sign but also with a display on the dashboard, and real-time data will warn drivers about ice slicks – vehicles in the future will be mobile information centers. Even today, 37% of car buyers would switch brands if that would bring them better connectivity features. From the buyer’s perspective, what makes connected cars attractive are primarily the added safety and optimized routing. For cities, the benefits are improved traffic flows and, hence, reduced pollution and congestion. Connected cars, which will come on the market in the next few years, will pave the way to autonomous vehicles.
- **Automated driving.** It will take some years until large numbers of self-driving cars are a common sight on the road. In the best case, if the remaining regulatory hurdles are removed in parallel with technical advances, up to 15% of all new cars worldwide could be autonomous by 2030 (Stage 4). Many drivers are already open to and excited about this technology. Three-quarters of the car drivers surveyed in Germany say they are willing to switch to an autonomous vehicle – provided that it is no more expensive than a conventional car and the driver can take back control if desired. Autonomous driving has the potential to dramatically reduce the number of accidents and allow drivers to make better use of their time. With automated parking, cars can fit into tighter spaces, thereby freeing up part of cities’ already scarce parking space for other uses. Furthermore, cars that are completely controlled by computer could be suitable for segments of the population that were previously immobilized, such as the elderly or people with physical disabilities. Here, mini and micro vehicles as well as two-, three-, or four-wheeled vehicles might also be an option.

These four global trends will exert a strong influence on life in the city. The current system, based on individual vehicle ownership, will be increasingly augmented with alternative mobility offerings.



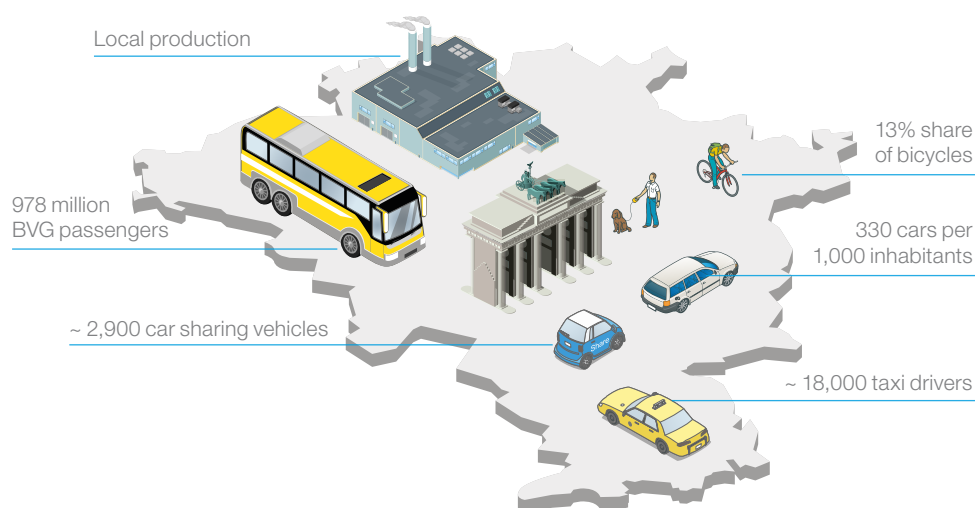


2

New jobs for Berlin

Because of its size, Berlin has very good prerequisites in place to use the new technologies to its advantage and implement innovative mobility concepts. With around 3.5 million inhabitants, Berlin already has a diverse mobility landscape. On average, people in Berlin make 3.5 trips per day and spend about 80 minutes in traffic. The share of pedestrian traffic in Berlin is nearly as large as the share that goes by car. More than 1 million inhabitants own their own car, and there are approximately another 2,900 car sharing vehicles and about 7,600 taxis operated by about 18,000 taxi drivers. In 2014, Berlin's public transportation system, the BVG, carried 978 million passengers. Around 13% of the routes traveled are covered by bicycle. Approximately one in six individuals gainfully employed in Berlin lives outside the city proper and, thus, has to find a reliable way to get into and out of the city (Exhibit 1).

Exhibit 1: **Urban mobility in Berlin is already characterized by multimodal diversity**

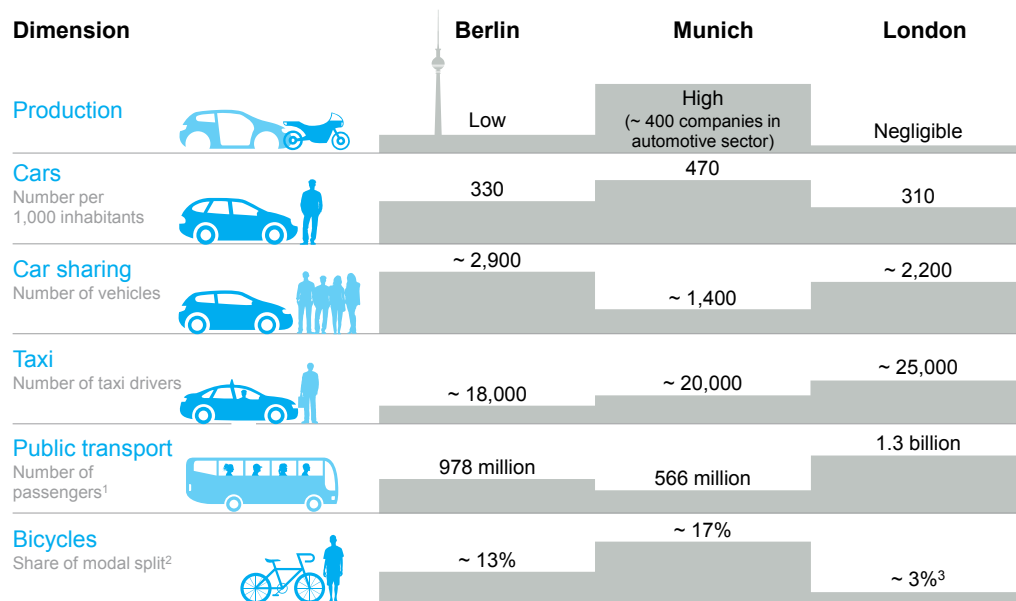


Modal split: Mobility options in metropolitan areas

In Berlin, millions of people are on the move from place to place every day. Compared with other major European cities, such as Munich (population 1.3 million) or London (population 8.5 million), the mobility options in Berlin have several distinctive features: despite recent declines in usage, owning and driving a car still plays a relatively big role in all three cities. This is especially true of Munich, which has 470 registered passenger cars per 1,000 inhabitants, whereas Berlin has only 330, and London merely 310. It seems likely that the fact that Munich is home to around 400 companies in the automotive sector accounts for its much higher share of private car ownership. All three cities have well-developed public transportation networks. In Berlin, the BVG transports 978 million passengers a year; Munich's MVG has 566 million passengers, while London takes first place with 1.3 billion users of the "Tube," reflecting its larger population and many tourists. When compared on a per inhabitant basis, Berlin is ahead of London, but behind Munich.

For car sharing, however, Berlin is the clear leader, with around 2,900 vehicles. Munich has around 1,400 car sharing vehicles, and London around 2,200. Another important part of the mobility mix are taxis. While Munich has about 20,000 taxi drivers and Berlin about 18,000 (50% of whom work in regular jobs, i.e., subject to paying social insurance contributions), London has 25,000 licensed taxi drivers. London is also the leader in e-hailing – in the British capital, there are more than 500,000 Uber users and 15,000 Uber drivers. In Berlin, the app can currently only be used by licensed taxi drivers as providers aiming to attract additional customers. Bicycles are also common in the two German cities: in Munich, 17% of the routes traveled are by bicycle, in Berlin 13%, in London only 3% (Exhibit 2).

Exhibit 2: **The forms of mobility have specific distinguishing features**



¹ Berlin: BVG 2014; Munich: MVG 2015; London: Tube 2014
SOURCE: McKinsey

² German Federal Ministry of Transport

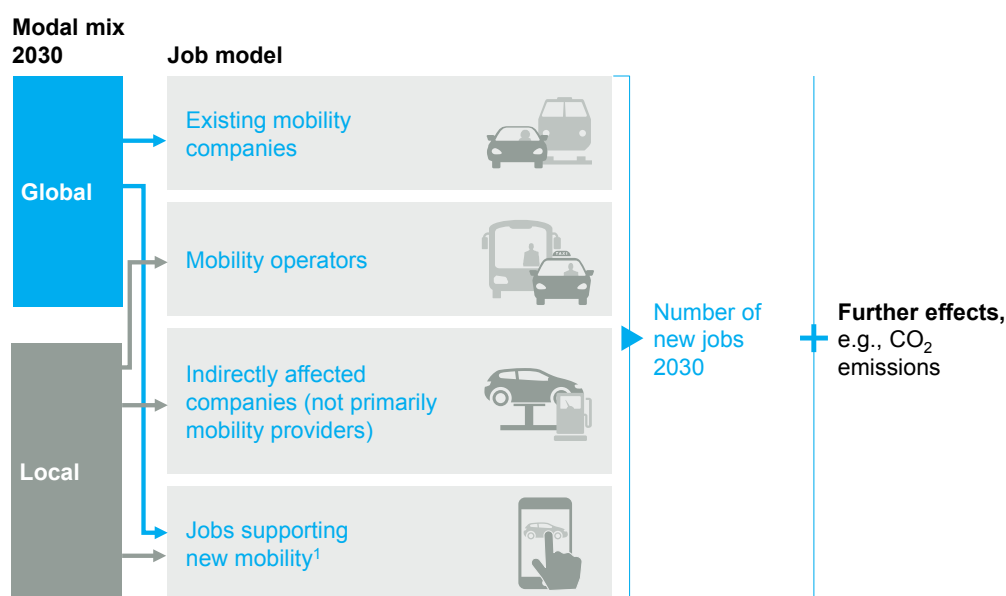
³ Estimate

Urban mobility also plays a role in Berlin as an employer. Currently, around 75,000 people are employed in this sector. That equals about 6% of Berlin's total employees in jobs that are subject to paying social insurance contributions. Nearly half of these jobs are in mobility companies (e.g., in production or at providers of card data) as well as in public transportation (mainly at the BVG). The remaining jobs will come in roughly equal measure from mobility operators (e.g., taxi companies) and from companies that contribute indirectly to mobility (e.g., car repair shops, fuel stations).

These emerging changes in the way in which urban mobility will be experienced in the future offers Berlin the opportunity to generate additional jobs. In the current study, a model was created to estimate how many additional jobs can be created by 2030 through intelligent urban mobility (Exhibit 3). The job potential calculated refers to jobs for which employer

and employee are required to pay social insurance contributions: these jobs encompass all employees who are required to make contributions to health, pension, and long-term care insurance and/or are required to contribute under Germany's Employment Promotion Act, or to contribute the employee share of contributions to the statutory pension system or are subject to the Employment Promotion Act.

Exhibit 3: **For the derivation of job creation potential, changes in the global and local mobility mix were considered**



¹ Jobs in existing companies, but part of new fields of business

SOURCE: McKinsey

Two scenarios were developed: the progressive scenario assumes that the four global trends – app-based mobility services, electrification of the powertrain, connectivity, and automated driving – will have a highly disruptive effect in the years ahead. The conservative scenario, on the other hand, assumes a more limited disruption effect (see box on page 17). At the same time, consideration was given to how urban mobility will develop up to 2030 in global terms and in Berlin itself – given that developments at both levels will exert an influence on the overall job creation potential. For example, if demand for private passenger cars continues to fall, this will also affect the mobility companies that already operate in Berlin. Changes to the local modal mix, in turn, affect others, e.g., taxi drivers or indirectly affected companies such as car dealerships, service/repair centers, and filling stations. How many jobs will be created in new mobility companies depends again, in turn, on the development of both the global and the local mobility mixes. If the share of autonomous vehicles worldwide increases, corresponding service providers in Berlin could profit, too.

The scenario model serves to arrive at an initial estimate of the job creation potential up to 2030. Because of the long time horizon and associated uncertainties, all figures are to be understood as approximations and not a detailed forecast.



Progressive and conservative scenarios

The progressive scenario assumes a high degree of disruption. That means: the four global trends – app-based mobility services, electrification of the powertrain, connectivity, and autonomous driving – will drive substantial changes in urban mobility by 2030. The progressive scenario assumes the following developments:

- **App-based mobility services.** New laws (e.g., restrictions on car travel in city centers) make it less attractive to use private passenger cars, hence new on-demand business models develop (e.g., e-hailing). Significant shifts occur – instead of relying on their own cars, people switch more and more to shared forms of mobility.
- **Electrification of the powertrain.** Prices for batteries decrease further, emission regulations are severely tightened. Consumer demand for electric powertrains increases substantially.
- **Connectivity.** In 2030, cars are linked in multiple ways; consumers regularly use paid services.
- **Automated driving.** Regulatory hurdles have been quickly overcome; secure and reliable technical solutions are developed. Customer acceptance and willingness to pay is high.

The conservative scenario, on the other hand, reflects less disruption; the influence of the four global trends spreads much more slowly:

- **App-based mobility services.** Regulators and legislators do not tighten restrictions on the use of private passenger cars; new on-demand business models and shared mobility attract only a limited share of the market.
- **Electrification of the powertrain.** Battery prices fall only slowly; there are no new regulations to reduce emissions. Consumer demand remains unchanged at a low level.
- **Connectivity.** Linking cars into networks proceeds only slowly; paid offerings meet with only limited acceptance by consumers.
- **Automated driving.** Overcoming regulatory hurdles is a slow process due to the slow development of secure and reliable technical solutions. Customer acceptance and willingness to pay remain limited.

The calculation of the scenarios is based on, among other things, comprehensive industry analyses, interviews with industry experts worldwide, and a quantitative market model (see McKinsey publication “Automotive revolution – perspective towards 2030”).

The results of the model calculation: by 2030, intelligent urban mobility can create up to 14,000 new jobs in Berlin. In the progressive scenario, the direct effect is 9,000 potential jobs, plus 5,000 more as a result of the multiplier effect, which assumes that the additional direct jobs will increase consumer spending in Berlin. In purely mathematical terms, the potential adds up to about 1,000 new jobs per year up to 2030. In addition, another 8,000 jobs could be created outside of Berlin, e.g., among suppliers. This potential gain in jobs is offset by the possible loss of jobs for car dealers and taxi drivers, as, in the progressive scenario, shifts in the modal mix exert increasing pressure on these jobs. For the various sources of employment, the modeling indicates the following effects:

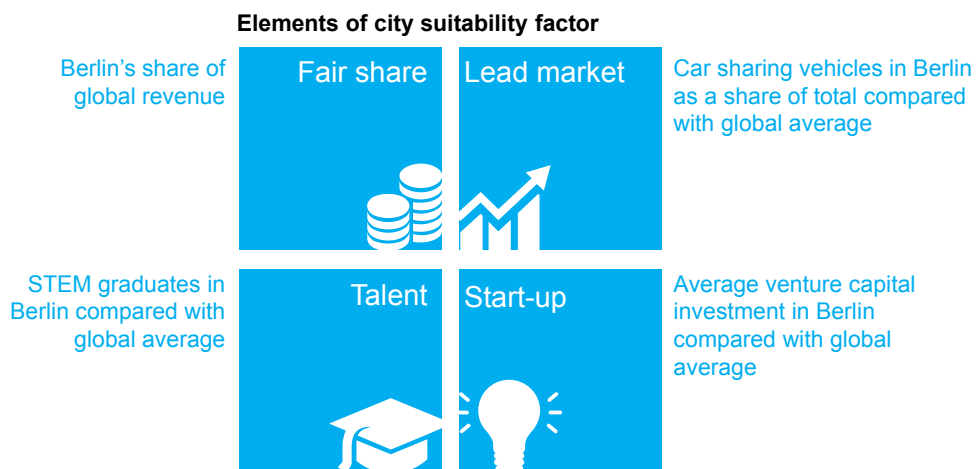
- **Existing mobility companies.** In these companies, the progressive scenario indicates that a slightly positive job effect can be expected. Global alignment, above all among automobile manufacturers, implies a high degree of dependence on the development of the global modal mix – the shift from privately owned cars to shared mobility offerings and, hence, higher utilization of cars makes significant job creation in Berlin unlikely. From the growth expected in Berlin of car sharing and e-hailing, the city is also unlikely to benefit much in terms of jobs, as the large car sharing providers are based in other cities. The head offices of the e-hailing providers are mainly in the US.

The conservative scenario assumes 400 new jobs will be created; this scenario is shaped by the lower substitution of privately owned cars, which has a slightly positive impact on employment subject to paying social insurance contributions.

- **Mobility operator companies.** If the share of car sharing and e-hailing in Berlin's modal mix increases, this could result in job losses among taxi drivers. In total, up to 3,700 jobs subject to paying social insurance contributions could be lost, as e-hailing drivers are typically not required to pay social insurance contributions. In the conservative scenario, on the other hand, up to 1,000 jobs can be created due to the increase in population and the assumption that shared mobility does not become very popular.
- **Indirectly affected companies.** In the progressive scenario, the indirectly affected businesses such as service centers, filling stations, and car rental firms can support the creation of up to 1,000 jobs. These types of companies benefit from an increase in person-kilometers traveled by car due to the increase in Berlin's population and from the more intense use of car sharing vehicles. Car dealers, on the other hand, could lose out, as car sharing vehicles are often sold directly to company fleets or the automobile manufacturers market their own car sharing offerings. In the conservative scenario, the number of new jobs rises to 1,400 due to the smaller share of car sharing and, hence, higher number of local vehicle sales.

- Jobs supporting new mobility services.** By 2030, potential will arise for new revenues along the value chain for urban mobility. What will be interesting for Berlin is primarily the segment of the value chain devoted to research and development, while the current situation suggests that it is unlikely that the city will be able to gain additional production capacities, for example. With the help of a city suitability factor that measures the four criteria fair share, lead market, talent, and start-ups (Exhibit 4), it is possible to determine how Berlin can profit from the additional revenue potential. Overall, the progressive scenario indicates a potential of up to 7,000 jobs in mobility companies, 1,800 of which are related to electro mobility. In the conservative scenario, the potential is 5,100 jobs; the main contributor here is the global modal mix, which will change only slightly. The jobs supporting different aspects of the new mobility offerings can be created in new companies, but also in new business units within existing mobility companies.

Exhibit 4: **The city suitability factor measures 4 criteria along the mobility value chain**



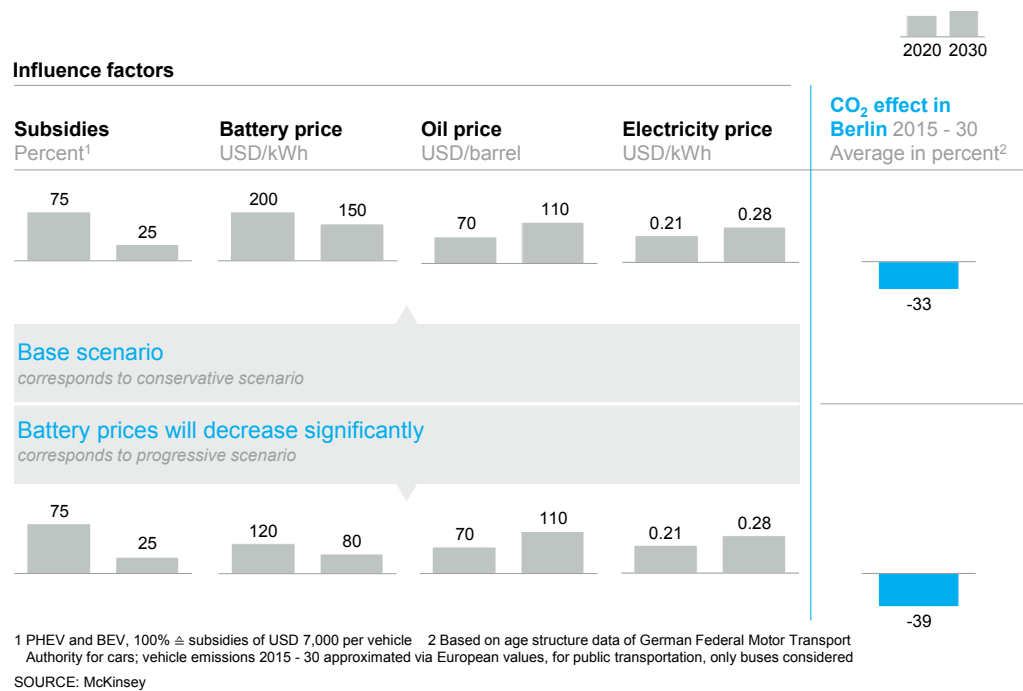
These are examples. Different parameters were developed for each step in the value chain

SOURCE: McKinsey

More jobs is a very important gain but not the only one. Intelligent urban mobility also has further positive effects for the city. For example, in the progressive scenario, Berlin's value creation can increase as a result of the shift towards higher-productivity jobs. Furthermore, the technical improvements to the powertrain can have a positive impact on Berlin's CO₂ balance and could reduce emissions by more than 30% (Exhibit 5).

Exhibit 5:

CO₂ scenarios – depending on oil and battery prices, CO₂ savings of 33 - 39% are possible



How fast new technologies and offerings will penetrate the market depends not least on the scope of regulatory interventions. For example, by implementing a city center toll, London was able to reduce traffic by about 30%; in Singapore, congestion at rush hour was reduced by 13%. Cities such as New Delhi or Beijing impose temporary driving bans for certain license plate numbers, primarily to improve air quality. In other cities, authorities are considering the implementation of zones in which cars may no longer drive at all. Oslo is planning such an initiative for 2019, Helsinki for 2025. The current study therefore also examined the question of how such regulatory interventions affect aspects of urban mobility, e.g., job creation potential and CO₂ emissions in Berlin. The basis for comparison in each case is the progressive scenario:

- **Blocking part of the city center to cars** (including taxis, car sharing, and e-hailing). A ban covering 3% of the total area would have a negative effect of up to 600 jobs, as more people would switch, for example, to public transportation, which needs fewer employees per person-kilometer. At the same time, the emissions would decrease by about 16,000 t CO₂.
- **City center tolls for privately owned cars.** The effects here would be similar to those of a ban. The number of additional jobs would drop by up to 200; at the same time, emissions would decrease by about 10,000 t CO₂.

- **Ban on autonomous driving.** If driverless cars are denied registration for regulatory or legal reasons, the effect would be a positive one of up to 1,000 jobs due to the retention of drivers in taxi companies and public transportation.

From the regulatory perspective, it will be essential to carefully weigh up the extent and purpose of such interventions.





3

Mobility in the future:
Successful implementation

Intelligent mobility offers Berlin and its inhabitants many positive effects. Now is the time to create the necessary general conditions so that the city can participate in developments at the global level and tap the job creation potential identified. One focus should be to attract new mobility companies to Berlin – through offensive positioning of the city as a lead market for urban multimodality and relevant technologies, support for the existing start-up culture in these fields, and making use of existing talent. A policy specifically aimed at attracting mobility companies to Berlin can create new opportunities for Berlin.

Lead market for urban multimodality

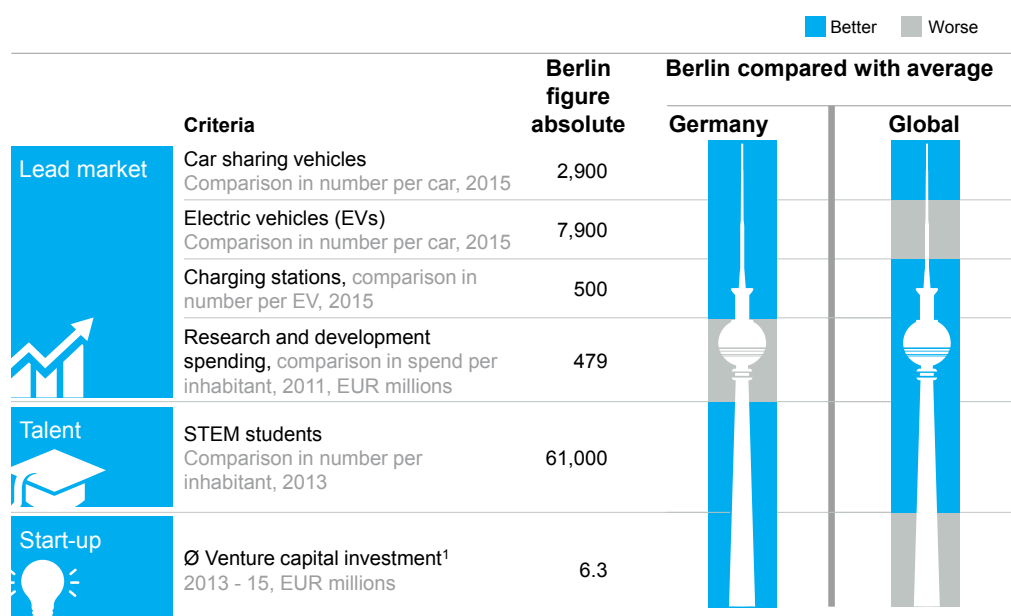
The more successfully innovations and future-oriented technologies can be established in Berlin, the more attractive the city will be for new mobility companies. The initial pre-requisites for assuming leadership in urban mobility are in place. Since 2012, Berlin (together with Brandenburg) has been one of four showcases for electro mobility, supported by the federal government and the states Berlin and Brandenburg. The goal is to explore electro mobility in regional demo and pilot projects, in particular at the interfaces of the power system, vehicle, and transportation system. Various projects and numerous partners will make it possible for citizens to experience electro mobility. Currently, Berlin has about 7,900 electric vehicles (including hybrids) – or 0.7% of all registered vehicles. That is higher than the average for Germany as a whole (0.3%), but less than for the fleet worldwide (1.3%). At about 500, Berlin is also well equipped with public charging stations; that means there are 63 public charging stations per 1,000 electric vehicles, whereas the average for Germany as a whole is only 42.

The intensity with which the mobility ecosystem beyond electro mobility in Berlin is currently being developed can be seen, for example, in the growing number of car sharing vehicles (a plus of more than 50% since 2012). In other areas, Berlin is not yet in the top group. While it is true that R&D spending on mobility, at about EUR 135 per inhabitant, is higher than the average for other developed economies of about EUR 100, the figure is nevertheless markedly lower than the Germany-wide average of EUR 395 (in 2011) (Exhibit 6).

To make Berlin more attractive as a lead market for urban multimodality, the city can, for example, take the following initiatives:

- **Promote intermodality.** Mobility offerings that are already in place can be more closely linked, e.g., when public transportation stations rent out bicycles for the last leg of the trip to the destination. It would also be conceivable to promote car sharing centers at hubs for commuters to simplify the route to work and back.
- **Implement innovative reservation and payment systems.** The easier it is to access and combine the different mobility offerings, the greater the acceptance they will garner among users. In urban transportation especially, it is particularly important to offer options to make reservations at short notice in order to meet customers' spontaneous needs for mobility.

Exhibit 6: Comparison for Germany and global averages with Berlin



¹ Cumulative average value of seed and financing rounds A - C

SOURCE: OECD; German Federal Office for Statistics; S&P Capital IQ; press research; McKinsey

- **Create a culture for innovation and test environments.** New mobility solutions could be tested locally in individual districts of the city (e.g., by creating preferential parking places for electric vehicles). Alternatively, within the legal framework, Berlin could position itself as a trailblazer for autonomous driving.
- **Increase attractiveness of technologies and modalities.** By setting specific requirements, Berlin can steer the deployment and use of innovative mobility solutions. Taxi operators could, for example, be given incentives to use electric vehicles or, in public transportation, certain lines could be made free of charge or tied to a specific bonus program, such as free trips or reduced-price admissions.

Start-up culture

Berlin has seen a considerable number of initiatives to promote a start-up culture – and the city has succeeded in becoming an internationally admired location for young companies. The McKinsey studies *Berlin 2020*, published in 2010, and *Berlin gründet*, published in 2013, presented many approaches to continuing to promote Berlin’s start-up culture. In addition to the scarcity of capital for follow-on financing (A/B), there were too few start-ups by students and graduates of technical course of study, a lack of central places to gather and work, and insufficient coordination between the various start-up types and activities. Today, Berlin

can justifiably claim to be a top start-up metropolis in comparison with the rest of Germany and Europe. Many initiatives were undertaken, including creating a central hub for founders. Another positive impact was achieved by increasing the space available for start-ups. The fact that 41% of the start-ups founded in 2014 were related to technology (e.g., in software development or ICT services) can also be counted a success. With an average venture capital investment (measured as the average value of the seed and financing rounds A to C) of EUR 6.3 million in the 2013 to 2015 period, Berlin is above both the German average and the average for London (EUR 5.6 million), but remains significantly behind Silicon Valley (EUR 10.4 million). Still, individual success stories continue to happen in Berlin; e.g., one Berlin start-up company succeeded in the first half of 2015 in securing an investment of nearly EUR 500 million, the largest single financing package of recent years.

The focus of the start-up scene currently, however, is on e-commerce. To extend the active and vibrant start-up culture to urban mobility, Berlin should start by focusing on networks and financing – the two key factors to attract new, mobility-oriented companies to Berlin:

- **Provide infrastructure.** One approach would be to set up a start-up campus dedicated to mobility and also create the environment for testing new technologies there. The location would ideally be close to research facilities and companies that already have something to do with mobility to stabilize and expand interconnectedness and the exchange of knowledge.
- **Facilitate financing.** Here, Berlin could create a mobility-focused start-up fund that is jointly financed by Berlin's city-state government and the business community. Another possibility are incubators or accelerators dedicated to mobility to make it easier to establish new businesses in this field. With venture capital as well, there could be a sharper focus on technical start-ups. In addition, a focus for follow-on financing could be to support start-ups on growing and expanding. Finally, holding an international mobility summit with partner cities and existing mobility start-ups could help develop new ideas for intelligent urban mobility.

Talent

To establish a profile as a lead market, Berlin needs qualified specialists in the strongest fields of growth in the value chain, in particular IT developers, electrical engineers, and data scientists. The attractiveness of the city is an important location advantage – many highly talented workers move to Berlin because of its good quality of life. In terms of the relative number of STEM graduates (science, technology, engineering, and mathematics), Berlin, with about 61,000 (1.7% of the total number of inhabitants), ranks well above the Germany-wide average (1.2%) and other developed countries (1.0%). The number of employees in public and private non-profit research institutes, at 20,000, is prodigious. But Berlin can do even better. One way to increase the number of STEM graduates even further would be to implement bachelor degree curricula in English. This could make the city even more attractive for foreign students. For German students, it would also become

easier to gather international experience and get “fit” for the global market. It would also be conceivable to anchor the topic of entrepreneurship more strongly in the curriculum of STEM students, intensify the exchange of start-up ideas with students in other disciplines, develop dedicated support programs for internships or research in the field of mobility, and provide more business support for founders with a technical background. Foreign founders of start-ups with a focus on mobility could also benefit from specific offerings and their own contact people.

Finally, when seeking to attract businesses to Berlin, it will also be important to direct more attention to mobility companies. The more companies decide to set up operations in Berlin in the field of mobility, the more attractive the city-state will become for still more transplant companies. Here, it is not only about bringing big companies to Berlin, but also medium-sized enterprises. Favorable factor costs and the availability of talented workers are two arguments in Berlin’s favor. In the immediate surroundings of Berlin, there are already some companies active in mobility. These companies could serve as a crystallization point for new firms with a similar focus on mobility. The crucial prerequisite for a successful effort to bring mobility companies to Berlin is close collaboration between the city-state of Berlin, the industry associations, industry, and the state of Brandenburg.



The way in which people get around in urban spaces will change dramatically in the years ahead. For Berlin, intelligent mobility solutions offer attractive growth opportunities – including up to 14,000 new jobs. Now it is time for the actors in the city to link together in order to jointly realize the potential identified. By taking this approach, Berlin can become a worldwide center of intelligent urban mobility.

Urban mobility in Berlin – sketch of a possible future



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Note for the English edition: As this case study of urban mobility in Berlin draws primarily on German sources, German alphabetization and date conventions (dd.mm.yyyy) have been retained. The English translations of publication titles and organizational names are provided as a convenience.

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