Empowering e-fleets for business and private purposes in cities

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e-Mobility Fleet Schemes and Market Potentials in Germany

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1. Executive Summary

Electric mobility is a highly promising technology that can help address severe global challenges such as climate change and fossil fuel dependency; it can contribute to cutting local CO_2 emissions and noise pollution coming from transport and enable synergies with smart grids and so favour a greater percentage of renewable energies production.[1]

This is backed up in the Integrated Energy and Climate Programme of the German Federal Government launched in 2007, which gathers a package of measures focused in the expansion of renewable energies, electric mobility, and CO_2 emissions of passenger vehicles among its 29 topics.[2]

As a result of this, the National Development Plan for Electric Mobility was launched in 2009 with the aim of speeding research and development of electric vehicle technology and its market preparation and penetration in Germany.

This was followed by the creation of the Federal Joint Unit for Electric Mobility (GGEMO), in charge of coordinating the federal government tasks in the field and supporting the work of the National Platform for Electric Mobility to continue developing and implementing the national plan.

The federal government has placed high expectations on electric mobility and its opportunities. The new technology shall strength Germany's lead position as a competitive economy, research and technology site through systemic solutions and exploit the potential of new materials, products, services and business models of electric mobility, as well as the creation of new value chains in innovative production and manufacturing.

It shall also foster the use of renewable energy to contribute to achieve climate and energy goals and reduce the costs of electric mobility through innovation and cross sectoral collaboration, based on the development of education and training in the field.[3]

For this purpose numerous national-funded projects have been developed to test and validate electric mobility in different research and praxis sectors. The federal funding programme Showcase Electric Mobility is currently supporting 4 regions with EUR 180 million to move forward with electric mobility through research and demonstrative projects. In addition, the industry sector invested EUR 17 billion in the period 2011-2013, thereof 12 billion by the automobile industry. [4]

Germany is largest national economy in Europe. The German GDP (2011) was 2,593 EUR billion, representing the 20.52 % of EU 27 GDP[5].

With a population of 80 million (2012), Germany represents 16 % of total European population (500.35 million)[6]; 89.42 % of this population lives in cities that have between 50,000 and 300,000 inhabitants.

In 2012, the share of mobile persons was 92 % and the average person made 3.41 trips per day.

[1] Council of the European Union, 2010.

[2] Federal Ministry for Environment, Nature Conservation and Nuclear Safety, 2007.

[3] GGEMO, 2011.

[4] German National Platform Electric Mobility, 2011, page 5.

[5] Eurostat, (2013a). GDP at current market prices.

[6] Eurostat, (2013b). Population on 1 January.

In 2008, the average distance travelled was 11.50 km per day and the average daily travel time 80 minutes.

German trips were made mostly by car and motorbike (52.90 % total journeys, 2011), mainly to do shopping and errands (22.3% total journeys). Since 2008, trips made by private modes of transport fell while walking and cycling trips increased.

With a car fleet of 42.3 million vehicles in 2011, Germany has the largest European carpool representing 17.7 % of the total EU fleet. [7]

According to the McKinsey Electric Vehicle Index, by 2018 Germany could become the second largest electric vehicle producer, with an estimated 370,000 vehicles, overtaking the United States with 268,000 units and getting closer to Japan, the world's largest producer, with 950,000 vehicles.[8]

Even though, the market is developing slowly. From 3.08 million cars newly registered in 2012, only 21,438 were hybrid and 2,956 battery electric cars. The majority of these cars are registered by companies.

Market penetration scenarios of electric vehicles shape unalike landscapes. Positive assumptions state that even without monetary incentives the national goal of one million electric vehicles can be achieved. Under more realistic assumptions, only between 150,000 and 200,000 vehicles will be on the German roads by 2020.[9]

Besides this controversial debate, car sharing is developing as an important trend with more than 450,000 customers, 148 operators and 11,250 cars in 2012 (Bundesverband Carsharing 2013). Berlin, with about 3,400 car sharing vehicles, thereof 450 electric, has seen a huge development.

Electric car sharing can be thus considered a main driver for the broader adoption of electric vehicles in urban areas, both improving the market sales and increasing user acceptance.

[7] European Automobile Manufacturers' Association (ACEA). Pocket guide 2013.

[8] McKinsey&Company, 2013.

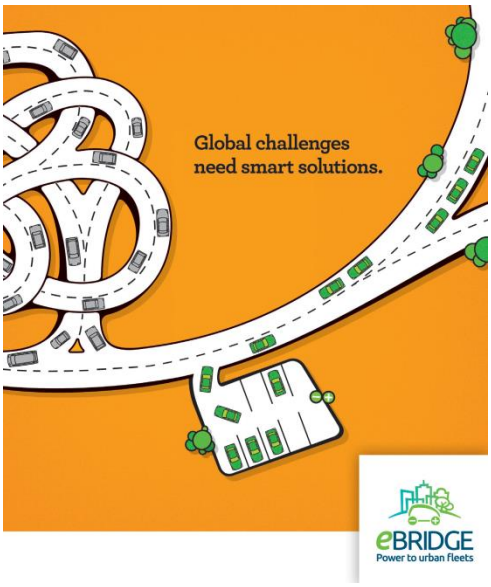
[9] Wietschel, M. et al, 2013.

2. Introduction

2.1 The eBRIDGE Project

eBRIDGE is a co-funded EU project to promote electric fleets for urban travel in European cities. The project aims to bring innovation and new technologies to make today's mobility cleaner, more efficient and sustainable.

During eBRIDGE, alternatives to current mobility patterns will be explored in order to analyze whether electric mobility is a feasible option to make cities cleaner and more sustainable.



Although electric vehicles fulfil all the requirements to be among the most important players in urban transport systems of the near future – they are clean, efficient, silent, and incur low running costs – significant barriers to a wider diffusion and use of electric vehicles remain to be addressed, including low user acceptance and higher purchase costs compared to conventional cars.

On this backdrop, eBRIDGE aims to demonstrate how the introduction of electric vehicles in fleets for business and private urban travel can efficiently contribute to the improvement of market conditions for the electric mobility sector.

Seven case studies with heterogeneous starting conditions assure a broad-spectrum outcome. Berlin (Germany), Milan (Italy), Lisbon (Portugal), Vigo (Spain), Valencia (Spain), a selection of Austrian municipalities and Carmarthen (Wales) are developing actions to optimise operational fleet performance, test and launch solutions to increase the convenience and ease of use of car sharing offers and finally, raise awareness among the target groups and further relevant stakeholders through engaging marketing approaches on the suitability of electric mobility for urban transport and commuting.

The eBRIDGE team involves technical experts, academics, associations, public administrations, mobility providers and public transport and car sharing operators:

- choice GmbH (Coord.), Germany
- DB FuhrparkService GmbH, Germany
- Allmenda Social Business e.G., Austria
- Forschungsgesellschaft Mobilität – Austrian Mobility Research gem. GmbH, Austria
- I Nova Consultores en Excelencia e Innovación Estratégica, S.L., Spain
- Galician Cluster of Automotive Companies, Spain
- Movilidad Urbana Sostenible S.L., Spain
- Comunitat Autònoma de les Illes Balears, Spain
- Fondazione Legambiente Innovazione, Italy
- Azienda Trasporti Milanesi S.p.A, Italy
- Occam, Portugal
- Câmara Municipal de Lisboa, Portugal
- Cardiff University, United Kingdom

2.2 Scope of the report

The goal of the "Work Package 2: Market Analysis", is to analyse the current situation and trends of electric fleets in the eBRIDGE targeted regions by assessing information about all context relevant issues such as market overview, best practice, legal framework, policy, and environmental impacts. The work package will also assess the market potential of electric mobility, mainly for fleets.

The present report "e-Mobility Fleet Schemes and Market Potentials – GERMANY" gathered this information Germany and particularly Berlin, the German case study site.

2.3 Methodology

In the course of this work package, data from Germany, Austria, Spain, Italy, Portugal and United Kingdom have been gathered and analysed for the period 2008-2012.

The overall goal has been to establish the current state of play on electric urban fleets for every participant country. A factsheet on transferability at a European scale will be based on this report series.

Relevant data regarding national carpools such as registrations, power train type, ownership, sales figures, car sharing hot spots, main charging operators, as well as main national policy and R&D aspects e.g. incentives and favouring policies have been collected and analysed.

Additionally, a brief assessment of the market potential of electric vehicles including identified national barriers and drivers and some figures on market projections are provided.

Finally, the assessment of the Berlin case study facilitates the comparison of the local and national levels, showing to what extent the German energy and climate targets are on track.

The methodology is based on four steps as shown in Figure 1. First, the relevant aspects of urban mobility and electric fleets were defined in the data collection template. The contents of the report were likewise defined and main timelines drafted. Finally, the results of the data analysis and complementary sources were added, and presented in the present report.

Figure 1 Time Plan Methodology

Source: Own diagram

3. Electric Mobility in Germany

3.1 Starting point

Germany aims to become world's leading supplier and market for electric mobility by 2020. The opportunities and challenges embedded in this vision are worthwhile: developing the leadership position in the industry, science and technology sectors can help to create up to 30,000 new jobs and contribute to achieving a climate-friendly and energy-efficient transport system.

The National Platform for Electric Mobility (Nationale Plattform Elektromobilität – NPE) was established by the federal government and brings together representatives of the industry, research, politics, civil society and other stakeholder, clue for the successful development of electric mobility plans of the German government.

The NPE follows a systemic, market-focused, and technological-neutral approach with the aim of making Germany lead market and achieving one million electric vehicles on the roads by 2020. For this purpose, 3 market development phases were defined:

1. Market preparation over the period to 2014, focusing on research and development and showcase projects.
2. Market ramp-up over the period to 2017, focusing on the commercialization of vehicles and infrastructure.
3. Launch of mass marketing over the period to 2020 with viable business models. [10]

Currently, Germany is still in the market preparation phase (foreseen until the end of 2014). Up to date, a large variety of R&D projects have been supported with national funding to move forward with electric mobility.

Between 2009 and 2011, the stimulus package Konjunkturpaket II dedicated EUR 500 million. Currently the federal government is supporting through the Electric Mobility Showcase Program four selected regions, among them Berlin, which will be promoting R&D activities in the field.[11]

The German industry is also investing across the whole electric mobility value chain. Up to EUR 17 billion have been dedicated in R&D related to electric mobility, being the automobile industry the leading sector with EUR 12 billion investment (NPE, 2011).

But although some progress has been achieved and the German automobile manufacturers are launching their first electric models, the market continues developing slowly. In 2012 3.08 million cars were newly registered in Germany, thereof 21,438 hybrid cars and 2,956 battery electric cars. This represents a market share of 0.79 % for electric vehicles.

Available figures for 2013 show that the trend continues: as of October 2013, 1.59 million new passenger vehicles have been registered, thereof 4,849 battery electric and 14,616 hybrids, with a market share of 1.22 %. [12]

A significant fact is that the majority of these cars were registered by companies, which shows the relevance of targeting business fleets to stimulate the wider dissemination of electric vehicles. This is also backed up by the NPE (2011) where fleets are identified as one of the pillars for the successful diffusion of electric vehicles.

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[10] National Platform for Electric Mobility, 2011.

[11] Berliner Agentur für Elektromobilität eMO, 2013.

[12] Federal Motor Transport Authority (KBA), 2013.

3.2 General Aspects of Mobility

DEMOGRAPHY

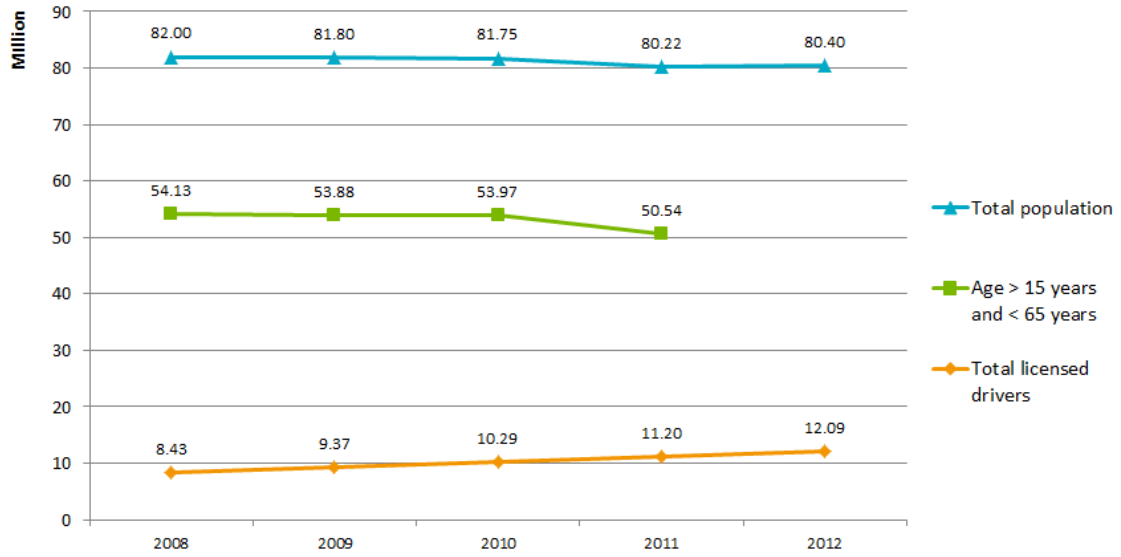
Germany recorded a total population of 80.40 million people in 2012. The median age of population has been steadily increasing in the last decades, being 45.0 in 2012 and so the oldest in EU-27, what confirms the relative old population structure.[13]

Figure 2 classifies Germany´s population for the period 2008-2012 in three categories: total population, working population (aged between 15 and 65 years) and total licensed drivers.

The number of driving licence holders has constantly increased being 12,090,280 holders in 2012. Of these, 6 million were women. For both genders, the groups aged 18-24 and 18-44 hold the majority of driving licences.

On the contrary, the total population has decreased by 1.95 % in the same period, being the working population the cohort reflecting the most significant decrease (6.65 %) from 2008 to 2011(no data available for 2012).

Figure 2 Demographic trends and driving licence holding



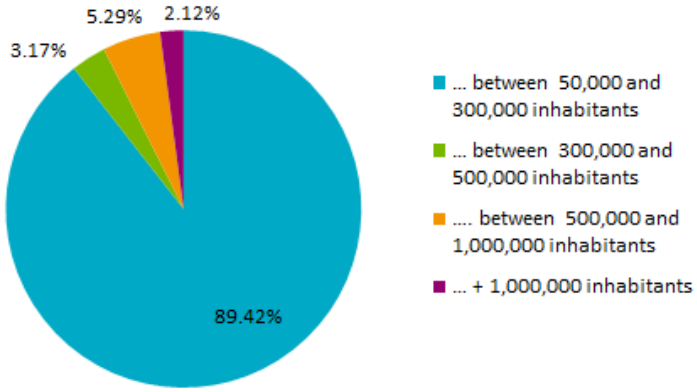
Source: Own graphic based on Zensus2011; Destatis and Federal Motor Transport Authority (KBA) (2013)

The next figure shows the population distribution by size class. German cities are mostly small-sized (50,000 - 500,000 inhabitants) and medium-sized (0.5 – 1 million inhabitants).

In addition, 39% of the population lived in metropolitan areas in 2008 (≥ 500,000 citizens in 50km, ≥ 1,000 inhabitants/km^2).

[13] Eurostat (2013c) Population structure and Age.

Figure 3 Share of cities by size class



Source: Own graphic based on figures from Destatis (2013)

MOBILITY PATTERNS

The share of mobile persons[14] in Germany has remained stable over the period 2002-2012, being in average 91.37 %.

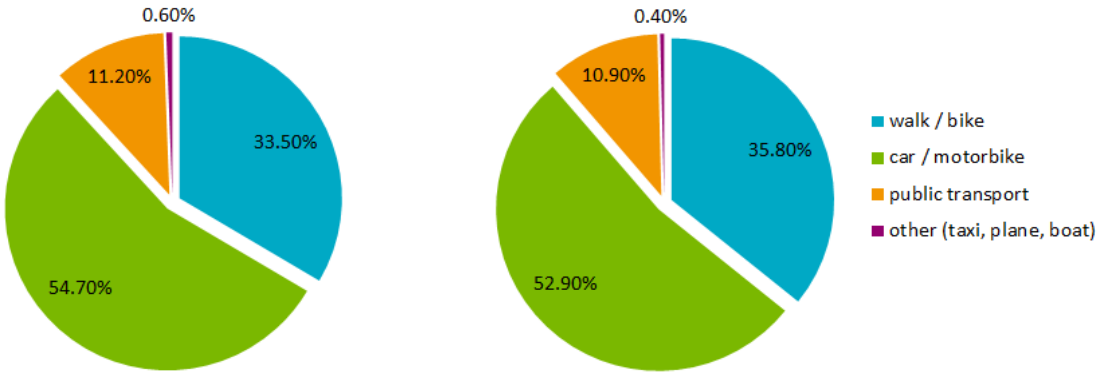
Overall in 2011, there was an average of 3.41 trips per person per day and an average trip length of 11.48 km. The average daily travel time was 1 hour and 20 minutes.

The number of cars per 1,000 inhabitants is on average 513 for the same period (2002-2012).

Cars and motorbikes remain the primary mode of transport. In 2011, 52.90 % of the trips were made by private modes of transport. Public transport accounted for 10.90 % of the trips done and soft modes (walking and cycling trips) for the remaining 35.80 %.

Compared to 2008, a slightly trend towards soft modes can be observed. The share of private transport has decreased by 1.80 %, while public transportation remained stable and the share of walking and cycling trips has increased by 2.80 %.

Figure 4 Modal share of journeys 2008 and 2011

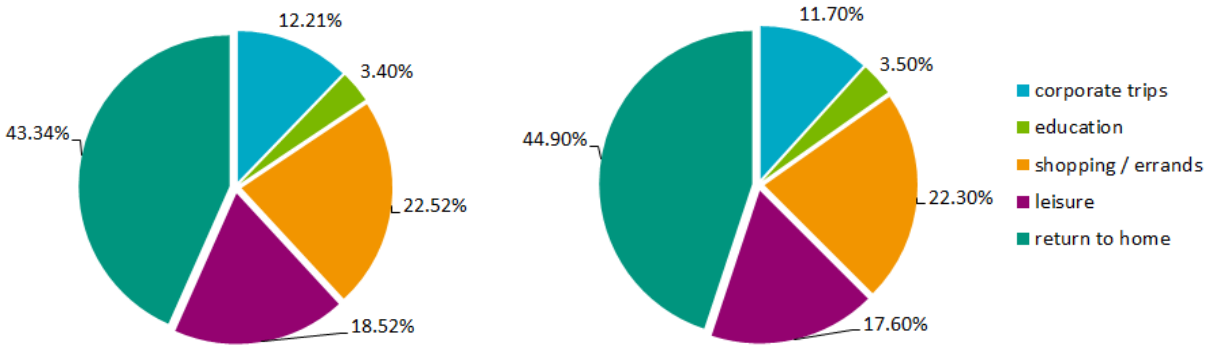


Source: Own graphic based on Deutsches Mobilitätspanel MOP Report 2012

[14] Mobile Person is any person who travelled within, to and/or from the surveyed area on the surveyed day.

Trip purpose in 2011 was mainly shopping and errands, representing 22.30 % of the journeys, followed by leisure 17.60 %, corporate and business trips 11.70 % and education 3.50 %. The remaing 44.90 % are trips back home and others (MOP especial category). This distribution has remained stable between 2008 and 2011.

Figure 5 Trip purpose share of journeys 2008 and 2011



Source: Own graphic based on MOP (2012)

CAR BUYER PROFILES

As described in previous paragraphs, the median age of the German population has increased in the last decade, being 45.0 in 2013.

Although there are no registered data of the average age of electric car buyers, results of academic support studies in the frame of electric mobility projects found that the profile of EV buyers was male (94.6 %) and in average 45 years-old.[15]

German new car buyers are today older than in past decades. In 2010 conventional car buyers were on average 50.9 years-old. Following this trend new car buyers are expected to be 55 years-old by 2020.This is especially remarkable among the customers of brands such as Mercedes, Opel, Audi, Porsche and VW. The youngest buyers preferred Smart and Mini.[16]

[15] Peters, A. et al, 2010.

[16] CAR Centre Automotive Research, 2010.

3.3 The German Carpool

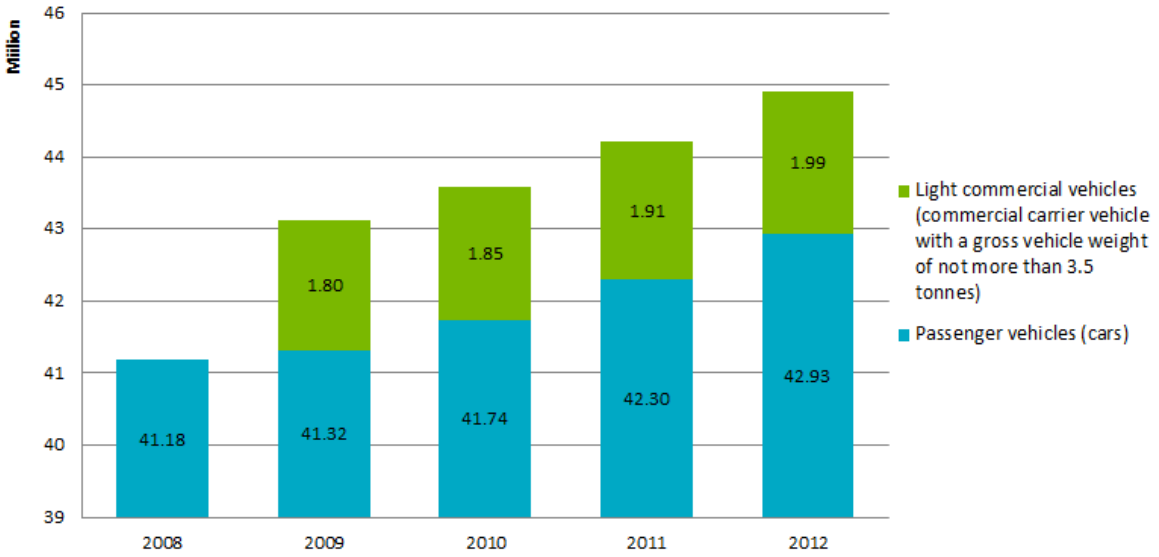
VEHICLE FIGURES

Total vehicles registered

The number of passenger cars and light transport vehicles has steadily increased from 41.32 million in 2009 to 42.93 million in 2012 (no data available for 2008). The 95.7% of all registered vehicles in the period were passenger cars.

The average age of the passenger carpool is 8.2 years.

Figure 6 Total vehicles registered 2008 - 2012



Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

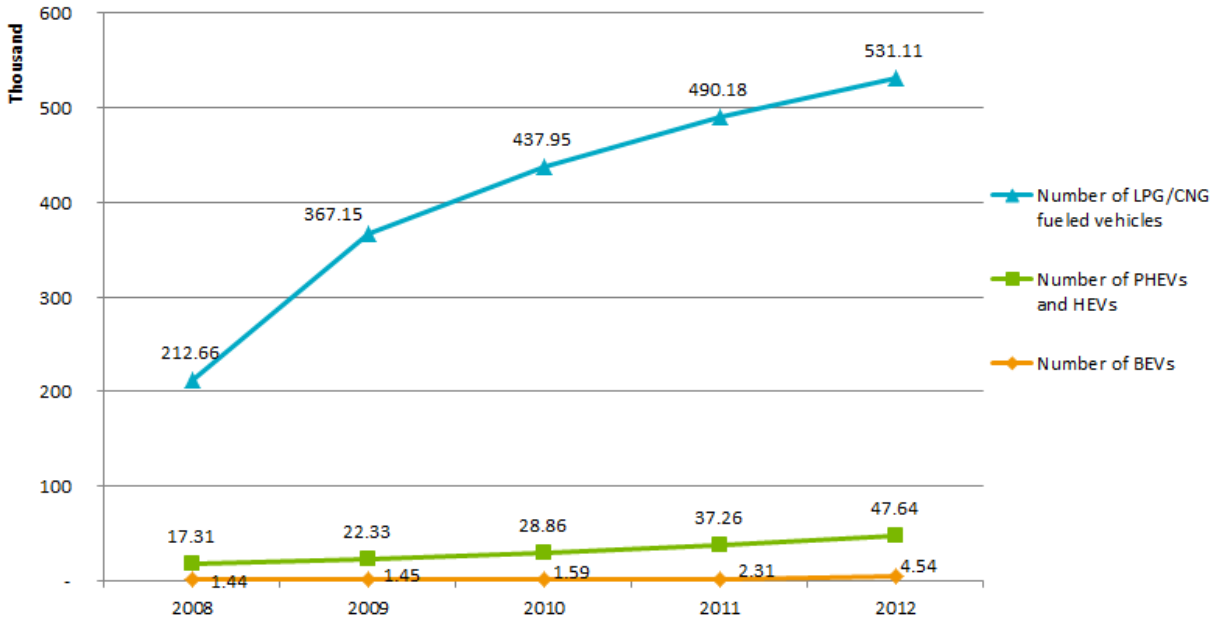
Vehicle power train type

Of the total number of passenger vehicles registered in 2012, alternative fuelled vehicles represented the 1.46 % (583,228 vehicles). Among them, a big percentage 91.05 % (1.24 % of the total registrations) were liquefied petroleum gas (LPG) or compressed natural gas (CNG) fuelled vehicles. Plug-in hybrid electric vehicles (PHEV) and hybrid electric vehicles (HEV) represented 8.17 % (0.11 % of the total). Battery electric vehicles (BEV) represented the 0.78 % (barely 0.01 % of the total).

The number of registered LPG and CNG vehicles has increased by 149.75 % between 2008 and 2012. In the same period, the number of registered PHEVs and HEVs has increased by 175.28 %, the number of registered and BEVs has increased by 216.23 %.

Despite the significant growth rates of EVs in the period considered, the absolute numbers of vehicles registered show that the national target of 1 million electric vehicles by 2020 is still far from being met.

Figure 7 Passenger vehicles per power train type 2008 - 2012



Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

Total ownership of passenger vehicles

Passenger vehicles in Germany are mainly privately-owned. In 2012, 89.97 % of the total passenger vehicles were privately owned. 10.03 % were registered by companies.

There have been no significant differences in ownership shares between 2009 and 2012 (no data available for 2008).

Figure 8 Total ownership of passenger vehicles 2009 - 2012

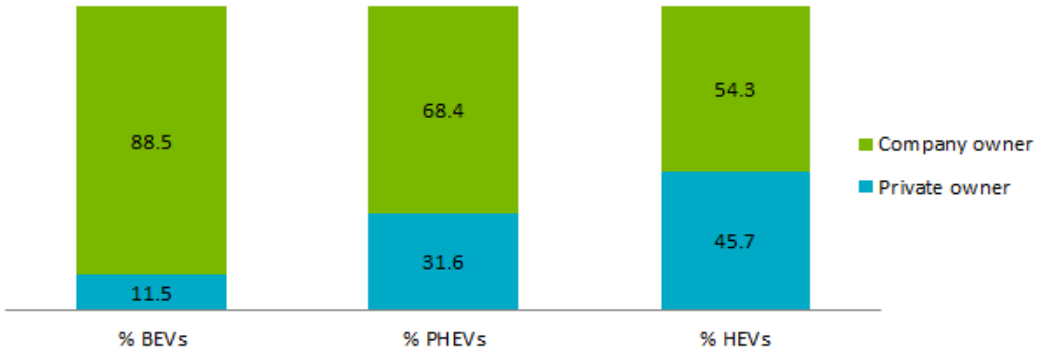
Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

EVs ownership

Contrary to the ownership of total passenger vehicles, companies registered the highest shares of new BEVs (88.5 %) and PHEVs (68.4 %) registrations in 2012. In the case of HEVs, the difference between company and private ownership shares is smaller, being company ownership 54.3 %.

Likely reasons for the unbalanced private/company shares of BEVs are mostly the higher purchase costs for the private user and range anxiety and lack of confidence in the new technology. In addition, it can be said that Germany companies played an important role in the R&D national funded projects, where an important number of BEVs were implemented in corporate fleets.

Figure 9 EVs ownership 2012

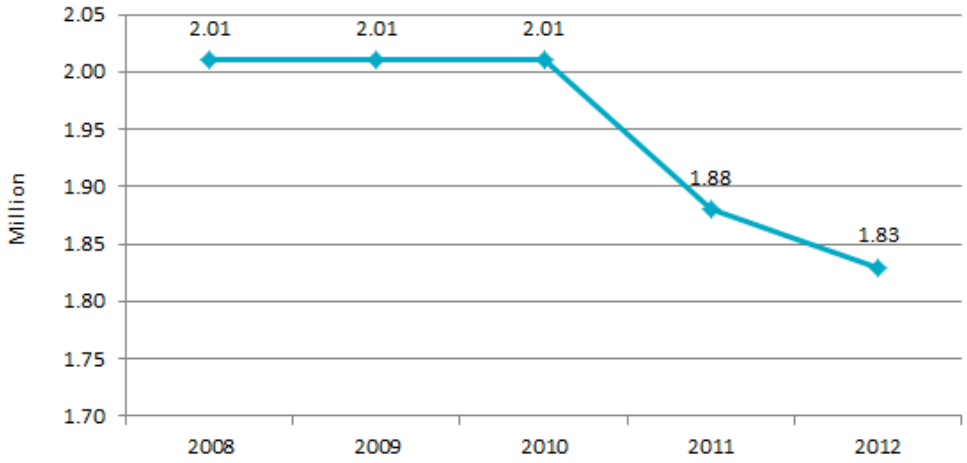


Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

Leasing market

The leasing market has experienced some regression. The number of leased passenger vehicles has dropped from 2.01 million in 2010 to 1.83 million in 2012, representing 8.96 % decrease.

Figure 10 Leasing market 2008 - 2012



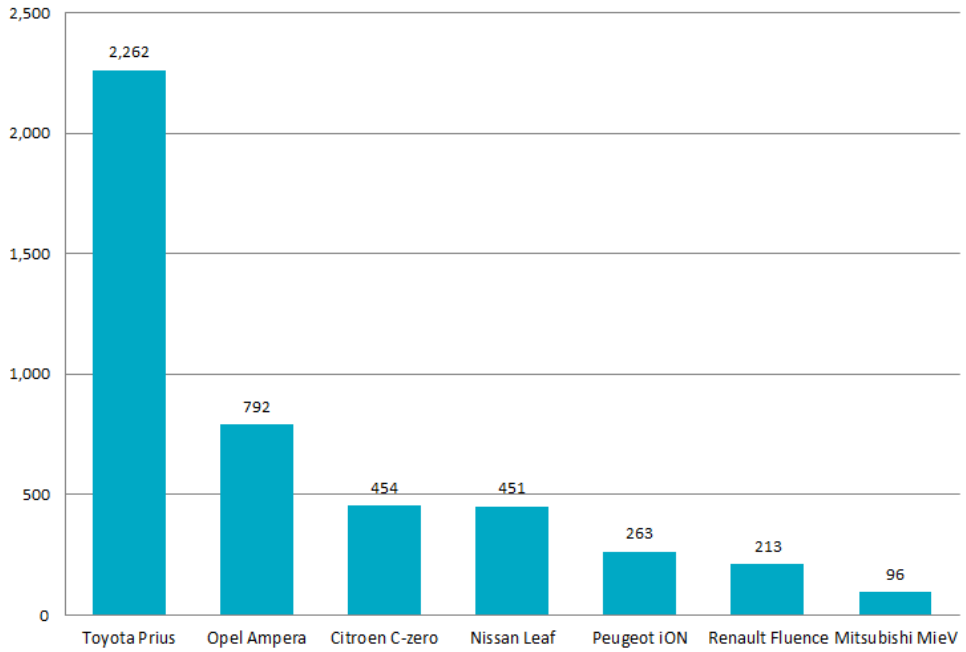
Source: Own graphic based on Statista (2013)

Selection of most registered EVs per supplier & model

Based on the new vehicle registrations 2012, Figure 11 shows a selection of the most registered EVs with Toyota leading by far the registrations market.

Among the PHEVs, Toyota Prius and two additional models (Yaris and Auris) lead the ranking of the registrations market. Opel follows with its REEV (range extended) model Ampera. Among the BEVs, the most registered is the Citroen C-Zero followed closely by the Nissan Leaf.

Figure 11 Selection of most registered EVs 2012



Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

ENVIRONMENT

The EU has called for the need to drastically reduce world greenhouse gas (GHG) emissions, with the goal of limiting climate change below 2 ºC. Overall, the EU needs to reduce emissions by 80-95 % below 1990 levels by 2050, in the context of the necessary reductions of the developed countries as a group, in order to reach this goal.

European Commission analysis shows that while deeper cuts can be achieved in other sectors of the economy, a reduction of at least 60% of GHGs by 2050 with respect to 1990 levels is required from the transport sector, which is a significant and still growing source of GHGs. By 2030, the goal for transport will be to reduce GHG emissions to around 20% below their 2008 level.

Accordingly, the White Paper on Transport (2011) establishes as first goal to halve the use of conventionally fuelled cars in urban transport by 2030; phase them out in cities by 2050 and achieve essentially CO_2-free city logistics in major urban centres by 2030.[17]

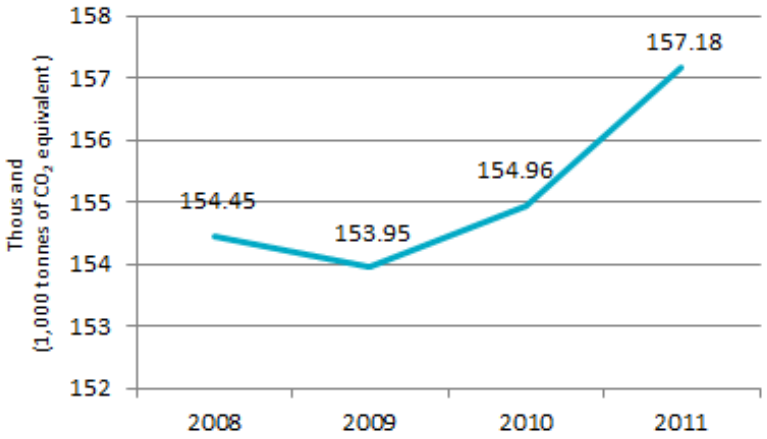
[17] European Commission, 2011a..

Moreover, the European Union's ten-year growth strategy, Europe 2020, established a set of targets including climate, energy and sustainability targets. The EU targets are translated into national targets in each EU country.

In the specific case of Germany, the national target related GHG for 2020 is to reduce the GHG 14% with respect to 2005. [18]

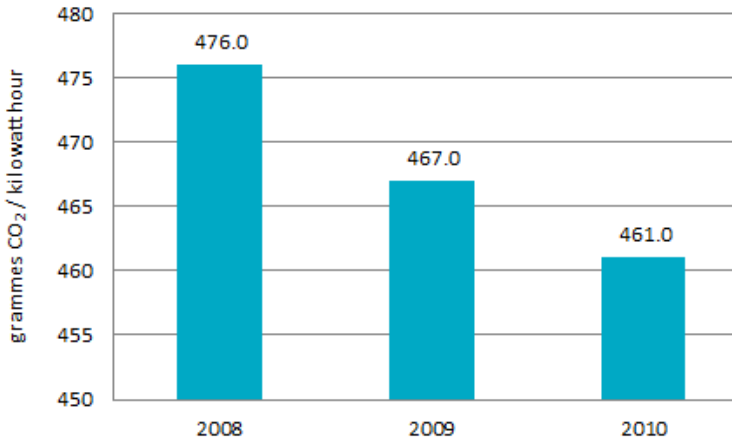
The total GHG emissions from transport [19] follow a growing trend with an average growth rate by 1.77%.

Figure 12 Greenhouse gas emissions from transport 2008 - 2011



Sources: Own graphic based on Eurostat (2013d) Indicators Theme 6 Climate Change and Energy

Figure 13 CO_2 emissions per kWh from electricity generation 2008 - 2010



Source: Own graphic based on CO_2 Emissions from Fuel Combustion Highlights, IEA (2012)

The power sector has improved its environmental performance. The CO_2 emissions associated to electricity production have decreased in average 3.15 % in the period 2008-2010. This can be considered a positive development with regards to electric mobility.

[18] European Commission, 2011b..

[19] This indicator shows trends in the emissions from transport (road, rail, inland navigation and domestic aviation) of the greenhouse gases regulated by the Kyoto Protocol.

3.4 Charging Infrastructure

MAIN OPERATORS

In 2012, the charging infrastructure is owned mainly by private companies with an electric utility profile. Four main operators installed approximately 855 stations and 2,133 charging points.

Table 1 Main charging operators

Operator	Stations	Charging Points	Profile
RWE MOBILITY	497	1,417	Electric utility
VATTENFALL	95	190	Electric utility
EnBW	68	136	Electric utility
BSM PARK & CHARGE	195	390	Industry

Source: Own table based on RWE; Vattenfall; EnBW; Park&Charge (2013)

BILLING

Currently charging infrastructure operators are joining platforms, for example HUBJECT or LADENETZ, network of municipal electric utilities, to improve the charging and billing process.

This enables the drivers of electric vehicles to access charging points of a wide range of suppliers as well as those operated by their own e-mobility provider.

The energy utility Energie Baden-Württemberg AG (EnBW), for instance, offers prepaid cards for “Elektronauten” similar to the mobile phone cards. Drivers of electric vehicles can purchase cards and so access the EnBW recharging network of around 300 charging points without becoming customer or registering in any way.

3.5 German Fleet Hot Spots

MAIN LOCATIONS FOR CAR SHARING

Car sharing in Germany operates mostly as station-based and free-floating systems. Station-based systems are the traditional short-term rental systems, with fixed pick-up and return stations; still, many operators have introduced the one-way service (the vehicle can be returned to any station).

Free-floating systems do not have a station network thus the customer can pick up and park the vehicle within the defined operational area.

Free-floating systems have seen a tremendous development in the last two years with a growth rate of number of vehicles of 250 % as of 1.1.2013. Automobile manufacturers such as Daimler, BMW and Citroën have entered the car sharing market with flexible and attractive offers – Car2Go, DriveNow and Multicity, respectively – in the main German capitals (Multicity only in Berlin).

A comparison of station-based and free floating systems is shown in Table 2. A noticeable fact is that although station-based systems have longer tradition and are broadly extended (343/8 locations and 145/3 operators), the difference between the number of station-based and free-floating customers is only 87,000 customers.

Table 2 Station-based vs. Free-floating

Station-based (started 1991)	Free-floating (started 2012)
270,000 customers 6,700 cars 145 operators 40 users/car 3,250 stations 343 locations	183,000 customers 4,550 cars 3 Operators 8 locations

Source: Own table based on Bundeverbad CarSharing e.V. (2013)

In addition, according to the same source, over a half of the car sharing customers got rid of their own car after joining car sharing.

As of 1st January 2013, the total number car sharing customers in Germany were 453,000 [20] and the top car sharing location – based on the number of car sharing operators and electric vehicles available – Berlin.

The next table shows the main German car sharing cities, both station-based and free-floating are included.

Table 3 Main locations for car sharing

Number of	Berlin	Munich	Hamburg	Dusseldorf	Stuttgart	Karlsruhe
Car sharing operators	10	6	5	5	3	2
CS vehicles per 1000 inhabitant	0,551	0,87	0,399	1	1,38	1,93
Charging stations	98	32	50	15	42	31
Demonstrative projects	70	10	8	11	40	40
EVs	450	-	4	-	400	-

Source: Own table based on Bundeverbad Carsharing (2013) and Berliner Agentur für Elektromobilität (2013)

Of particular note is that main cities such as Berlin, Munich, Düsseldorf, Stuttgart and Hamburg have increased the number of flexible, customer-friendly car sharing offers, especially since the market entrance of the automobile manufacturers.

[20] Bundesverband CarSharing e.V., 2013.

CORPORATE CAR SHARING FLEETS

Company and municipal fleets have made some progress towards electric mobility. Some examples arose from national funded projects and municipal initiatives. The following table shows a selection of company and municipal fleets operating with electric vehicles.

Table 4 Examples corporate car sharing fleets

Fleets	Type	Number of EVs	Location
SIEMENS AG	Private company	11	Berlin
POLICE DEPARTMENT INITIATIVE 120	Public body	11	Berlin
METROPOLITAN AREA OF HAMBURG	Public body	161	Metropolitan area of Hamburg
LUDWIGSBURG	Municipality of Ludwigsburg	4	Ludwigsburg
DHL POSTAL SERVICE	Private company	79	Bonn

Source: Own table based on Siemens AG, Police Department Initiative 120, Metropolitan Area of Hamburg, Ludwisburg; DHL Postal Service (2013), see links

BUSINESS CAR SHARING OPERATORS

Table 5 Main commercial car sharing operators

Operator	Fleet					Technological key aspects				Locations
	Operator private company	Total fleet	No. of EVs	No. of Stations	No. of customers	Booking	Access	System	Payment	
MULTICITY	Citroën/DB	350	350	Free-floating	3,400	on-line smartphone	RFID customer card	Free-floating	invoice	Berlin
FLINKSTER	DB FPS	2,800	100	780	215,000	on-line smartphone	RFID customer card	One-way Station-based	invoice	140 cities
DRIVENOW	BMW/Sixt	1,700	60	Free-floating	100,000	on-line smartphone phone	RFID customer card	Free-floating	invoice	Berlin, Munich, Cologne, Düsseldorf
CAR2GO	Daimler/ Europcar	3,400	450	Free-floating	170,000	on-line smartphone phone	RFID customer card	Free-floating	invoice	Hamburg, Ulm, Düsseldorf, Cologne, Stuttgart, Berlin, Munich
STADTMOBIL	Stadtmobil GmbH	3,500	-	1,000	30,000	on-line smartphone phone	RFID customer card	Station-based Partially free-floating	invoice	100 cities
CAMBIO	Cambio Mobilitäts service GmbH	1,000	8	270	38,000	on-line smartphone phone	RFID card Key box	Station-based	invoice	15 cities

Source: Own table based on Multicity, Flinkster, DriveNow, Car2Go, Stadtmobil, Cambio (2013, see links

3.6 Research & Development

In the market escalation phase through 2016, the focus of the German R&D funding, automotive OEMs, and suppliers will remain on field tests, demonstration, and serial mass production of lithium-ion batteries as well as plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs), and fuel cell vehicles (FCVs).

KEY RUNNING R&D PROJECTS ON ELECTRIC VEHICLES

Table 6 Key running R&D projects on electric vehicles

R&D Program (2,000 million EUR)	Key areas covered	Funding Ministries
Flexible technologies for series production of electric drives for vehicles	Electric motors, mechatronic systems, contacting technologies, power electronics, system integration	Federal Ministry of Education and Research(BMBF)
Energy efficient and safe electric mobility	Energy and thermo management, safety concepts	BMBF
Elektro-Power: position of the new value chain	Integration of new value chain, integration and improvement of production lines	Federal Ministry of Economics and Technology (BMWi)
ICT for electric mobility	Smart car, smart grid, smart traffic, architectures, concepts, plug&play, integration in model regions	BMWi
Electric mobility show cases	Systems approach, critical mass	Federal Government

Source: Own table based on Hybrid & Electric Vehicle Implementing Agreement (2013)

DEMONSTRATIVE E-FLEET PROJECTS

Table 7 Demonstrative e-fleet projects

Project	Key areas covered	Period	Coordinator	Budget
eFleets Berlin and Brandenburg	Evaluation of usage cases for e- fleets, development and parallel testing of e-fleets from the perspective of a vehicle-independent mobility provider, fleet services, economic opportunities from a complementary evaluation of the fleet offers.	2012-2015	DB Fuhrpark Service (private company)	5.2 million EUR
BeMobility 2.0	Integration of EVs in urban transport and energy networks, development of sustainable business models, including flexible e-CS, through the integration of mobility plans, energy systems and urban charging infrastructure.	2012-2014	DB Fuhrpark Service (private company)	9.3 million EUR
Hamburg - Wirtschaft am Strom	Electric fleets of local administrations, companies, municipal fleets, charging infrastructure, business models.	2012-2016	Hysolutions (private company)	22.8 million EUR
Integriertes Flottenladen	Integration of EVs in fleets, intelligent management of fleets.	2013-2015	EnBW Energie (private company)	-

Source: Own table based on projects web page (2013)

3.7 Policy Framework

KEY REGULATIONS REGARDING ELECTRIC VEHICLES

Table 8 Key regulations regarding electric vehicles

Regulation	Key aspects being regulated	Date of release	Public body/ authority
EU Regulation CO_2 emissions passenger vehicles	CO_2 emissions	2009/2011	EU (European level)
Mandatory Labelling Vehicles	Fuel consumption, CO_2 efficiency, CO_2 emissions label	01/12/2011	Federal Ministry of Economics and Technology (National level)
Electric Mobility Strategy 2020 National Platform Electric Mobility	Industry and R&D funds, education, standardization, normative	May 2011	Federal Government (National level)
R&D Funding	ICT, electric power, system integration, energy efficiency and management, battery development, recycling, grid integration, energy storage, vehicle components, monitoring technology, standardization of vehicles and components, pilots in daily use, different transport modes	2011	Federal Government (National level)

Source: Own table based on Gnann, T.; Plötz, P. (2011)

FINANCIAL INCENTIVES

Table 9 Financial incentives

Sector	Key incentives	Date of release	Public body/ authority
Motor vehicle tax / road tax	Tax exemption of BEVs licensed before 31.12.2015 is extended to 10 years (previously 5 years). This exemption is extended to all BEV classes (pure). EVs licensed between 1.1.2016 and 31.12.2020 will be granted 5 years of tax exemption	25/10/2012	German Parliament (National level)
Company car taxation	Measures to compensate for disadvantages in company car taxation: A lump sum deduction from the taxable amount in order to compensate for the tax disadvantages of EVs compared to ICEs. A deduction of 500 EUR/kWh (capped at 20 kWh) to be applied based on the installed battery capacity.	2013	German Parliament (National level)

Public procurement for EVs	Evaluation of a public procurement programme for electric vehicles: In order to support the development of the market, a number of further, non-monetary incentives were recommended, such as priority parking for EVs and a feasibility study of priority bus lane use. Further incentives should also be assessed, such as the introduction of transferable number plates or incentive payments for connecting EVs to the power grid	On work	German Parliament (National level)
Electric Mobility in Pilot Regions Programme	Nearly 2,000 charging stations and charging points have been realised at the end of 2011.	2011	Federal Ministry of Transport, Building and Urban Development (national level)
Other	Special arrangements regarding depreciation of electric vehicles: A special depreciation allowance amounting to 50 % of the purchase price in the first year of use for EVs used for commercial purposes, in view of the rapid pace of innovation in this area.	-	-
	Low-interest loans from the Kreditanstalt für Wiederaufbau (KfW). At the moment there is no further information on rate or total amount.	2013	Federal Government Coalition Agreement

Source: Own table based on the recommendations of the 3rd Progress Report National Platform Electric Mobility (2012) and the Government Coalition Agreement "Shaping Germany's Future" (2013).

4. Market Potentials

4.1 Main Drivers and Constraints

In general terms and at European level, the main market barriers for the successful integration of electric mobility into European transport systems include technological, infrastructural and cost-related aspects. The electric mobility market depends on the development of external factors such as fossil fuels, electricity and battery prices. Further influencing factors are customer acceptance of and willingness to purchase the new technology.

Therefore, finding integrative solutions to overcoming the current challenges concerning battery technology, standardisation of the charging infrastructure, interaction with electricity generation systems and cost and business case of large scale introduction is crucial for the development of the electric mobility market in the short and long term.

Still, battery R&D continues to be one of the main issues from both cost and performance perspectives. In 2011, the battery price was 600 EUR/kWh[21]. Yet in its mid-term report, the National Platform for Electric Mobility expected the battery price to sink by 2020 to 250-300 EUR/kWh. Last figures on the topic are to find in the study "Market launch scenarios for electric vehicles" conducted by ISI Fraunhofer where the battery price ranges from 470-575 EUR/kWh by 2013 and 320-370 EUR/kWh by 2020 for the three scenarios considered [22].

But probably the most challenging barrier in Germany is the lack of charging infrastructure. Up to date, the existing charging network has been mainly developed through national-funded projects and therefore located in targeted regions and cities.

At the same time the lack of a consolidated charging infrastructure affect negatively behavioural aspects such as range anxiety, lack of confidence on and misperceptions about electric vehicles. This, together with the higher prices of electric vehicles, represents a too high risk for the end user.

In addition, the lack of leadership among German energy utilities to take over the infrastructure challenge continues slowing the market breakthrough.

Major German utilities could help overcome these barriers by offering business models for customer-friendly billing solutions.

Thus the subsequent question is whether the public administration shall take this leadership and continue funding the infrastructure. The debate is still open.

Even though, the Federal Government has placed high expectations on electric mobility and its opportunities. The new technology shall strength the lead position as a competitive economy, research and technology site through systemic solutions that go beyond the boundaries of the traditional industry branches and exploit the potential of new materials, products, services and business models of electric mobility, as well as the creation of new value chains in innovative production and manufacturing. Also, to foster the use of renewable energy to contribute to achieve climate and energy goals, to reduce the costs of electric mobility through innovation and cross sectoral collaboration and to safeguard jobs and create

[21] Mock, W., 2012.

[22] Wietschel, M., 2013, page 14.

new employment opportunities, based on the development of education and training to create top class scientists, engineers and specialists.[23]

Recently, the German Government Coalition has approved the agreement "Shaping Germany's Future (2013-2017)"[24]. A set of projects in the field of transport policy has been defined, reinforcing electric mobility and its goals, among others:

- Germany will continue striving to become world's market and supply leader;
- Promotion of eco-friendly vehicles, especially EVs, with soft purchase loans;
- to foster intelligent traffic infrastructure through ICTs and traffic telematics;
- to set 1 million electric vehicles onto German roads by 2020;
- the progressive electrification of federal fleets;
- parking spots for car sharing and electric vehicles should be legally-binding displayed by municipalities.

A summary of drivers and constraints is shown in the following table.

Table 10 Drivers and Constraints of Electric Mobility

Potential Drivers	Constraints
• Scarcity of fossil fuels and reduction of oil dependency • Energy and climate goals: energy efficiency, low local CO_2 emissions • Increased investment in renewable energy sources • New urban mobility concepts, vehicle-to-grid concepts • Innovative, strengthened automobile industry • Educational degrees in the field	• Purchase costs EVs vs. ICEs (mainly battery costs) • Battery R&D • Deficient charging infrastructure • Lack of business models charging&billing • Customer / User / Buyer acceptance • Effects on electricity grid: production and demand

Source: Own table based on Schill, W. (2010); GGEMO (2011); Federal Government Coalition Agreement (2013).

[23] GGEMO, 2011.

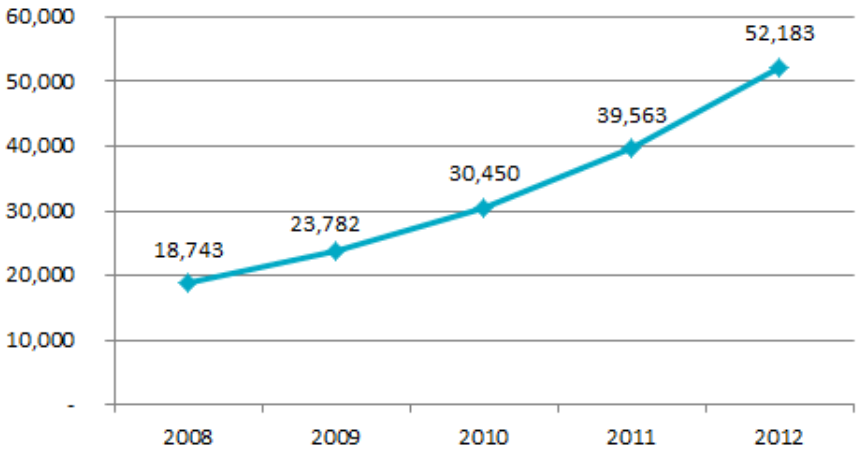
[24] Deutschlands Zukunft gestalten: Koalitionsvertrag zwischen CDU, CSU und SPD 18. Legislaturperiode (Dezember 2013)

4.2 German Market Scenarios and Projections

German car manufacturers such as BMW, VW, and Daimler presented at the IAA Frankfurt Motorshow in September 2013 their first electric models. Also, according to the McKinsey Electric Vehicle Index, by 2018 Germany could become the second largest electric vehicle producer, with an estimated 370,000 vehicles, overtaking the United States with 268,000 units and getting closer to Japan, the world's largest producer, with 950,000 vehicles.

The Figure below shows the evolution of the number of total EVs (HEV, PHEV, BEV) of the German carpool.

Figure 14 Evolution of the total number of electric vehicles 2008 - 2012



Source: Own graphic based on Federal Motor Transport Authority (2008-2012)

Despite the positive trend, the market keeps developing slowly. Taking into account the number of new passenger vehicles registered, from 3.08 million cars newly registered in 2012, only 21,438 were hybrid and 2,956 battery electric cars (0.79% of market share).

This upward trend continues in 2013, according to data October 2013, 1.59 million new passenger vehicles have been registered, thereof 4,849 battery electric and 14,616 hybrids, with a market share of 1.22%.

Finally, three different studies on market launch scenarios for electric vehicles have been consulted. The results are shown in the following table.

Table 11 Market launch Scenarios

Study, Scope	Horizon	Scenario 1	Scenario 2	Scenario 3
ISI Fraunhofer 2013, Germany	**2020**	**Contra-EV**	**Mid-EV**	**Pro-EV**
		50,000-300,000	400,000-700,000	1,000,000-1,400,000
CE Delft, ICF and Ecologic 2011, EU wide	**2020**	**Realistic**	**Pessimistic**	**Optimistic**
		3,300,000	2,000,000	5,500,000
	2030	+50,000,000	20,000,000	93,000,000
DLR 2009, Germany	**2020**	650,000	1,000,000	-
	2030	4,500,000	8,000,000	-

Source: Own table based on Wietschel, M. (2013); van Essen, H. (2011) and Mock, P. (2009)

In 2012, the German carpool had a total of 52,183 electric vehicles (HEV, PHEV and BEVs). This figure represents the 5.22% of the national target of 1 million electric vehicles until 2020.

The scenarios developed by ISI Fraunhofer conclude that under optimistic assumptions the 1 million goal can be met even without monetary incentives and measures. In its pessimistic scenario, a maximum of 30% of the 2020 target could be reached. [25]

In 2010 an EU-wide study on impacts of electric vehicles was conducted by CE Delft, ICF and Ecologic Institute. Three scenarios were developed to assess the market uptake and environmental impacts of electric vehicles (BEVs, PHEVs, REEVs). The most realistic scenario, based on cost and performance of EVs and ICEs and considering governmet incentives and fiscal policies, led to 3.3 million EVs throughout the EU by 2020 and more than 50 million by 2030. In an scenario where EVs gain some market share, but still remain a relatively small part of the car fleet, 2 million vehicles could be reached by 2020 and 20 millions by 2030. If a technological breakthrough in battery technology occurs in the next decade (mostly fast cost reductions and market uptake after 2020) 5.5 million EVs could be reached by 2020, and 93 million by 2030.

In 2009, the Institute of Vehicle Concepts of the German Aerospace Center (DLR) developed a model to assess future market propospects and environmental impacts of EVs in Germany[26].

Two scenarios were developed: Scenario 1, business-as-usual (among other assumptions, fossil fuel price increases moderately and electricity generation as the usual power mix with a moderate increase of renewable energies share by 2030), showed that only 650,000 EVs would be reached by 2020. The national target of 1 million EVs would only be achieved by 2030.

Scenario 2 considers a strong governmental intervention with a high share of renewable energies of energy for transport and higher electricity prices. Under these assumptions, 1 million EVs could be reached by 2020, followed by a fast market uptake, achieveing 8 million EVs by 2030.

[25] Wietschel, M., 2013

[26] Mock, P. 2009.

5. Local Assessment

5.1 Starting Point

Berlin has been an important location for several research and development projects[27] within the Economic Stimulus Package II 2009-2010 (Konjunkturpaket II). A local demonstration on the EUREF Campus served as first pilot area to test technical solutions for charging infrastructure, smart grid and different vehicles.

In the near future the cities of Berlin and Potsdam will expand their project activities and become e-mobility showcase (Schaufenster Elektromobilität). Around 50 million EUR of funding will support a variety of activities to foster electric mobility in the next years.

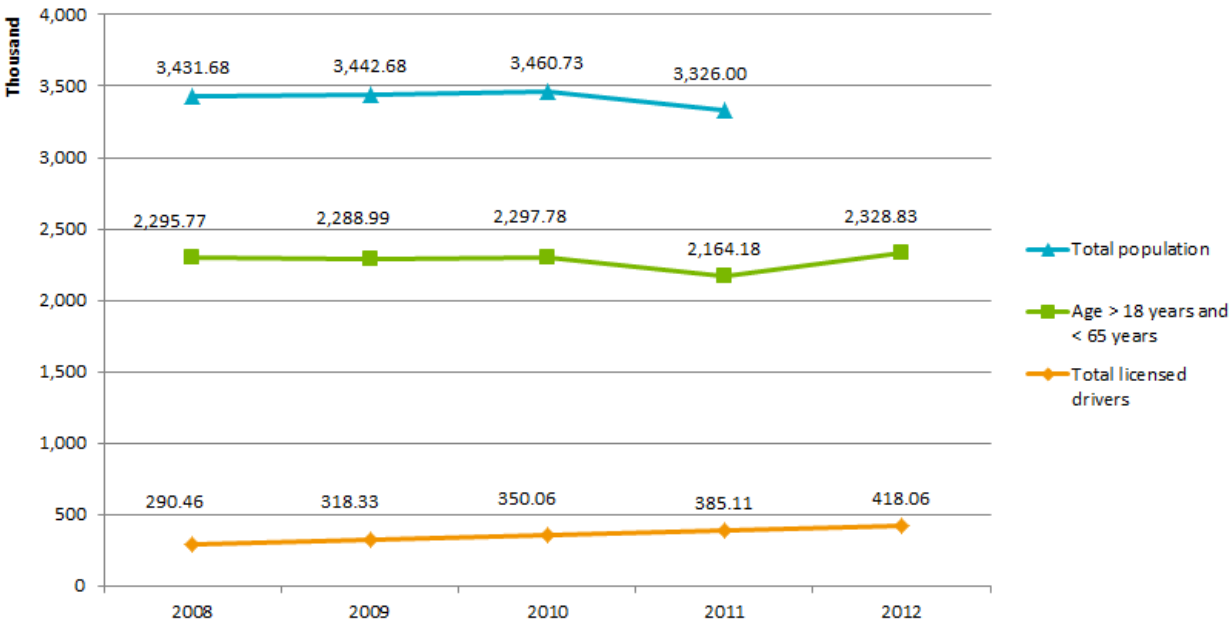
5.2 General aspects of Mobility

DEMOGRAPHY

Since 2008, the number of driving licenced holders in Berlin has increased by 43.9 %.

Total population fall by 3.08 % from 2008 to 2011(no data available for 2012), while working population (aged 18 - 65) increased by 1.44 %.

Figure 15 Demographic trends and driver's license



Source: Own graphic based on Zensus2011; Destatis; Federal Motor Transport Authority (KBA) (2013)

[27] BeMobility project

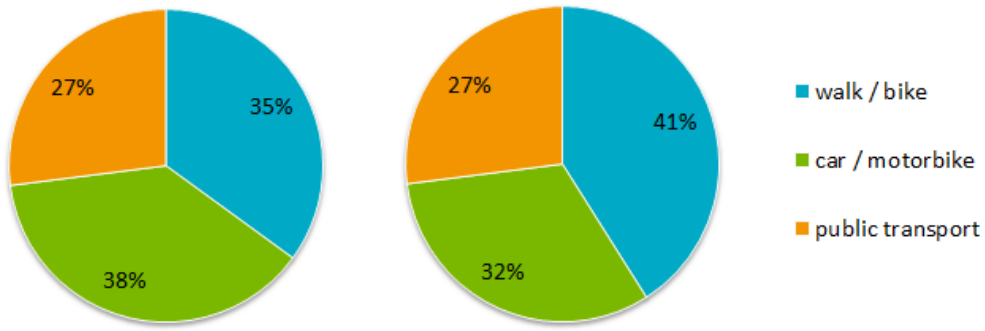
MOBILITY PATTERNS

In 2008, 41% of the journeys were made by car/motorbike, 32% by public transport and 27% by soft modes (walking and/or cycling).

Compared to 1998, a trend towards soft modes can be observed, with an increase of 6% resulting from a lower share of private transport modes, which accounted 38% in 1998. Public transport trips remained stable over the period.

This trend is in line with the targets set by the city of Berlin in its "Urban Development Plan – Traffic" (StEP)[28] for the reduction of individual motorised transport (MIV) shares by 2025, where MIV represents the 25% of the modal choice; public transport 29% and walking and cycling 28% and 18% respectively.

Figure 16 Modal share 1998 - 2008 (journey-based)



Source: Own graphic based on figures from Mobilität in Städten SrV (2008)

EVS USER PROFILES

Results from the project MiniE-Berlin 1.0 (2010) showed that 80% of the electric car buyers were male. The average age was for the 61% under 50.

The project BeMobility 2.0 (2012) showed that 95% electric car buyers are male. The average age was 39 years.

5.3 The Berlin Carpool

TOTAL VEHICLES

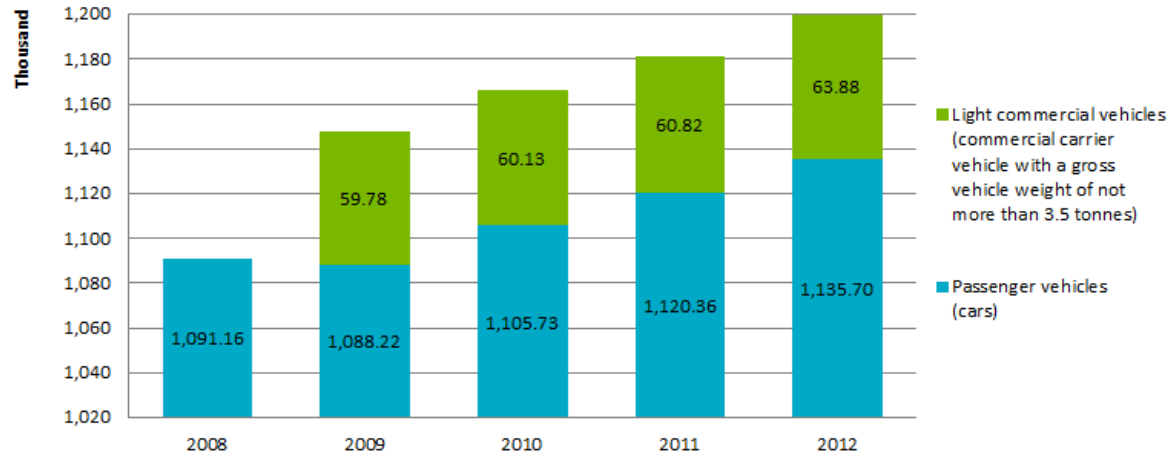
Since 2009, the number of passenger cars and light transport vehicles has increased steadily from 1.148 million to 1.199 million in 2012 (no data available for 2008).

Of all registered vehicles in this period, 95.8% were passenger cars.

The average age for these cars was 8.5 years.

[28] SenSTADT, 2011.

Figure 17 Total vehicles registered 2008 - 2012



Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

VEHICLE POWER TRAIN TYPE

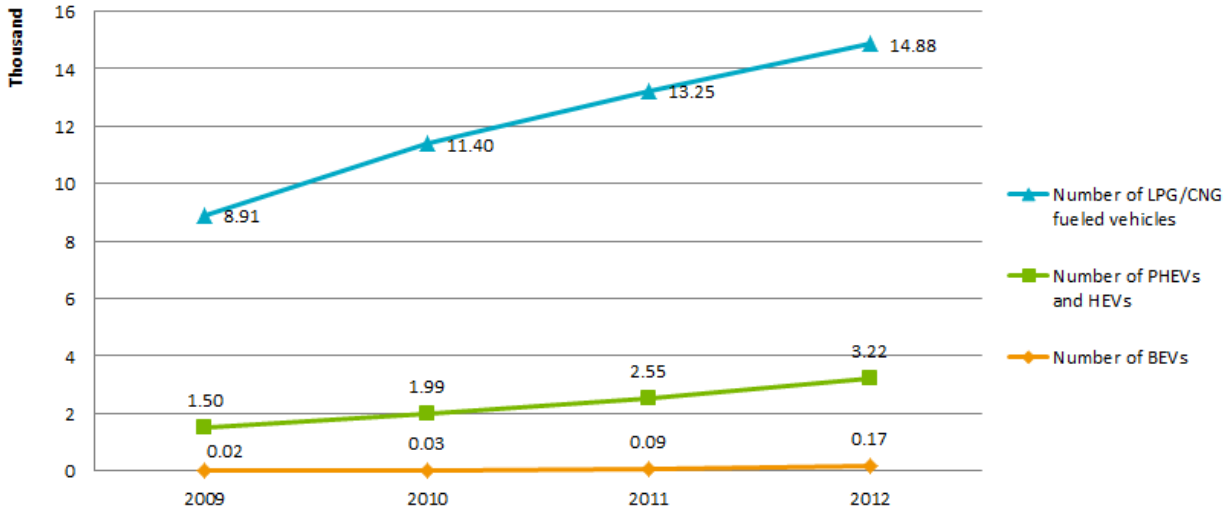
Alternative fuelled vehicles represented a 1.61 % of the total passenger vehicles in 2012 (15,041 units).

Among the alternative fuelled vehicles a big percentage, 81.45% (1.31% of the total registrations, 14,876 units), were LPG/CNG fuelled vehicles. 17.64% (0.28% of the total, 3,222 units) were PHEVs and HEVs. BEVs represented 0.90% (0.01% of the total, 165 units).

LPG and CNG registered vehicles increased by 66.96% between 2009 and 2012 (no data available for 2008).

In the same period, PHEVs and HEVs registrations increased by 114.37% and BEVs registrations by 650%.

Figure 18 Passenger vehicles power train type 2009 - 2012

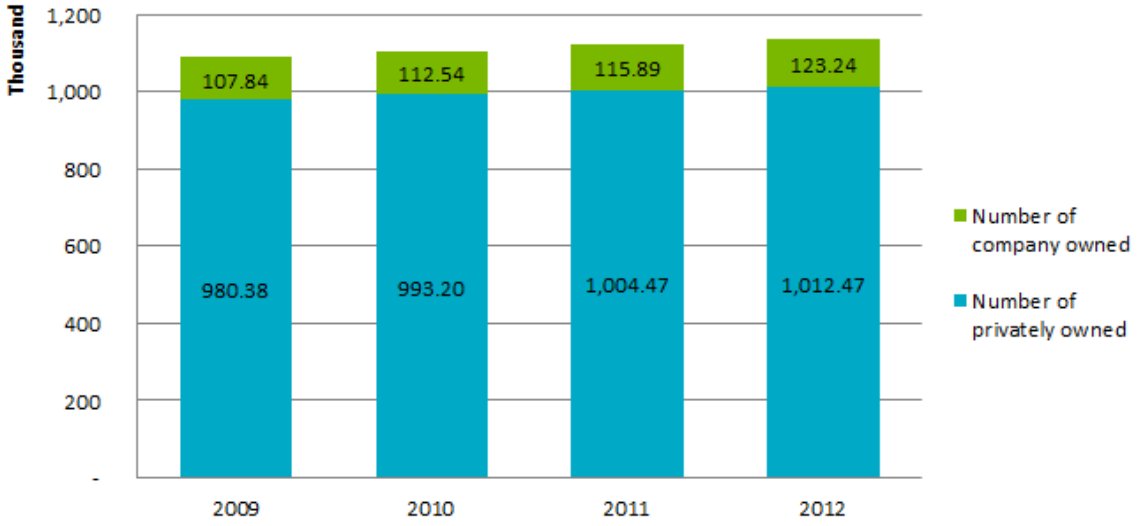


Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

TOTAL OWNERSHIP OF PASSENGER AND COMMERCIAL VEHICLES

Ownership of passenger vehicles has been mainly private in the period (89.15%). There have been no significant differences in ownership shares between 2009 and 2012 (no data available for 2008).

Figure 19 Total ownership of passenger vehicles 2009 - 2012



Source: Own graphic based on Federal Motor Transport Authority (KBA) (2013)

5.4 R&D State of the Art

Since April 2012, the Model Region Berlin-Brandenburg has been one of four regions selected to participate in the Electric Mobility Showcase Program funded by the Federal Government (180 million EUR budget) and the federal states of Berlin and Brandenburg.

The overall goal is to integrate electric mobility into the energy, transport and traffic systems, testing multimodality, vehicle-to-grid (V2G) and renewable energies generation approaches. Several initiatives will run until 2015. The themes and priorities are:

- Driving (CO_2 emissions-free passenger and goods transport).
- Recharging and parking (sustainable extension of Recharging Infrastructure).
- Storage (e-mobility as part of the Smart Grid Berlin-Brandenburg).
- Connecting (ICTs, Qualification & Services, Education).
- Public Relations (access and experience electric mobility, etc.).
- Cooperation (political, economic and scientifical at local, national and international level).[29]

[29] 3rd Progress Report National Platform Electric Mobility, NPE (2012)

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