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German Showcase Programme E-Mobility 2013 - 2017 – Results, Perspectives, Legal Framework

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Short Abstract

The implementation of e-mobility is a key instrument for achieving the European climate protection goals. In order to accelerate the evolution of mobility in Germany towards an emission-free transport system, the Federal Government has taken various measures. In this paper, we present the results of one of the biggest funding programmes – the "German Showcase Programme E-Mobility". More than 140 projects with a funding volume of EUR 400 million in four regional showcases demonstrate that: 1) Electric mobility is already suitable for everyday use. 2) An increasing number of application scenarios are already profitable. 3) Regulatory barriers were and are being dismantled. 4) The cars of the future will be electric.

Keywords: federal government, incentive, market development, regulation

1 The Showcase Programme

In 2011, the Federal Government of Germany made the decision to carry out measures to support electric mobility [1]. The objective was for Germany to be the leading market and leading provider of electric mobility. Therefore, the Federal Government implemented a promotional programme called the "Electric Mobility Showcase". Since then, through close cooperation between industry, science, and central government, innovative elements of electric mobility have been tested in more than 140 projects. The projects were located in four regional showcases and were supported from 2012 to 2016. The total amount of investment for the federally supported projects, including project involvement by states and other partners was almost EUR 400 million.

A total of 2,500 cars (90% BEV), 1,000 pedelecs, 8 light vehicles, 20 motorcycles, 65 buses, 71 commercial vehicles and 15 communal vehicles were utilised in the showcase regions. More than 2,000 charging points were installed. An outstanding characteristic of the German Showcase Programme is the number of stakeholders involved. Four federal and six state ministries funded the programme. Renowned representatives from science and industry, like OEMs or network operators, participated in the projects. In the meantime, a network of more than 1,500 experts has emerged, and this network is steadily growing.

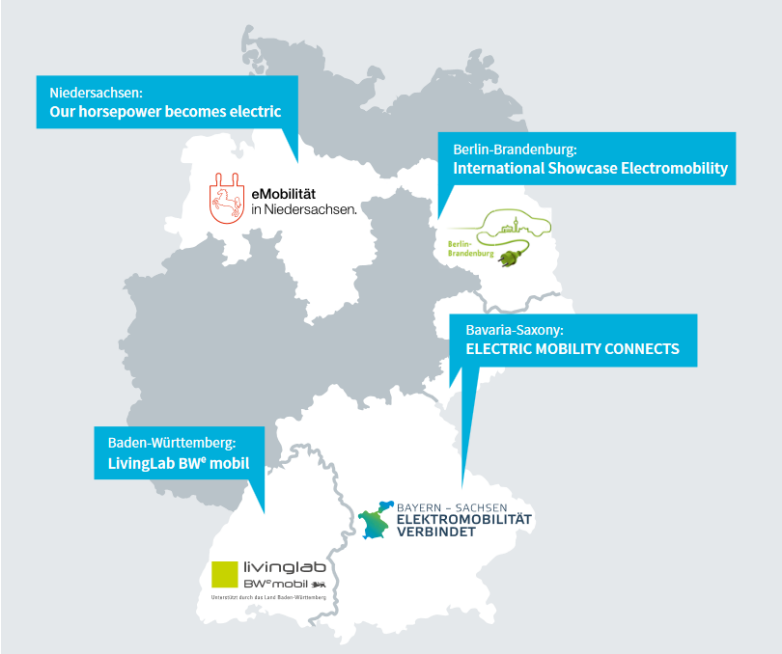

Figure 1: The Four Showcase Regions

In order to bundle knowledge and communicate results, the Federal Government commissioned parallel impact research. The main objective of the parallel impact research (BuW) was to enhance the leverage of the showcase programme in setting up a well-functioning comprehensive e-mobility system in Germany and to utilise its contributions in the best possible manner. It prepared the results of the showcase programme for both the professional and the general public. One focus of this programme was to provide different user groups with the ability to try out e-mobility in their everyday lives. This concept proved right. 75% of the people living in the regions of the showcase programme were aware of it or of one of its projects.

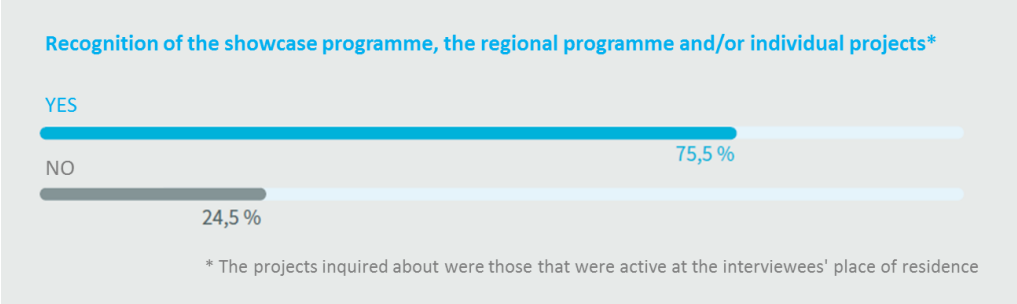

Figure 2: Recognition of the Showcase Programme.

Closely cooperating with the showcase projects, the parallel impact research has fulfilled the following tasks over the last three years:

- Identifying and communicating best practices,
- Evaluating economic leverage and efficiency of the showcase projects,
- Devising recommendations for action for the Federal Government, the National Platform Electromobility, and OEMs in order to effectively overcome existing obstacles for innovation.

At the onset of the programme, the ministries set up a list of questions which served BuW as a guideline for processing the programme contents in the following years. The work of the parallel impact research was guided by these 120 key questions. For instance, BuW dealt with questions like: What are the pitfalls in energy regulations or building and planning law that hamper the development of a public charging infrastructure across the entire country? Which steps have to be taken in fleet management to integrate a

large number of e-vehicles in company fleets? Which activities by government, science and industry are necessary to accelerate the market ramp-up?

The 120 questions set up by the ministries were divided into seven main topics like “legal framework” or “market” to ensure their adequate processing. The key results of these main topics will now be briefly presented, with a special focus on the legal framework.

2 Results of the Showcase Programme and the Parallel Impact Research

The programme provides a full range of positive outcomes. Numerous scientific results have been gained, the visibility of electric mobility has been increased and in political work, many changes have been initiated.

The showcase programme was able to demonstrate the following:

- Electric mobility is already suitable for everyday use.
- An increasing number of application scenarios are already profitable.
- Regulatory barriers were and are being dismantled.
- The cars of the future will be electric.

The scientific results of the parallel impact research were generated by different methods and from different data sources, e.g. evaluation of project results, workshops and expert interviews. The research process was adapted according to the particular research question. The answers to the questions were used to identify the following key results for each main topic.

1) Vehicles and Infrastructure

Overall, the range of electric models currently on the market does not completely satisfy the needs of potential customers. German manufacturers focus on plug-in hybrids and do not offer any purely electric model in the medium class. Setting up the visible public charging infrastructure is important in terms of perception and usability of the entire system although e-vehicles are currently charged mainly at home or at work. It is imperative to quickly install fast-charging stations along motorways and main roads. The charging infrastructure needed by 2020 is estimated at 36,000 regular charging points and 7,000 fast-charging points with public access. In 2016, however, there were only 5,836 regular and 153 fast-charging points. Sustainable business models for operating the charging infrastructure are still missing in Germany. In urban areas with fierce competition for space, privately operated semi-public charging points, e.g. at shopping centres or in multi-storey car parks, might play an important role. The development of convenient e-roaming platforms that are compatible all over Europe is swiftly advancing. Currently, financial incentives for controlled charging are almost irrelevant for private users.

2) Market

The plan to sell one million electric cars by 2020 has not picked up pace. The fastest market diffusion will presumably take place in the area of cost-efficient commercial e-vehicles and with new mobility concepts like car sharing using electric vehicles, if corresponding incentives and user information are provided. In 2015, almost 90% of the e-vehicles made in Germany are exported. Ona global scale, German manufacturers are way behind companies like BYD, Tesla, Mitsubishi, and Nissan. The world-wide share of e-vehicles is expected to increase from 9% to 31% between 2020 and 2030. It is to be expected that there will only be a few macroeconomic changes over the next few years of the market ramp-up. Mid-term, however, the automotive industry will probably undergo substantial restructuring. Potential job losses triggered by these processes cannot be exactly extrapolated yet. Established car manufacturers will probably have to reposition themselves as providers of mobility concepts. The disruptive nature of this transformation towards e-mobility may offer new opportunities for SMEs and start-ups, with presumably adverse effects on supplier from the metallurgical sector.

3) Users

Currently, the main reasons for private people to buy an e-vehicle are driving pleasure and comfort, along with typical early adopter motives, whereas commercial users state efficiency and - to a lesser extent - image as reasons for buying electric cars. The fact that this efficiency can in part be already achieved was proven in the course of the showcase programme. Almost all the people who have bought an e-vehicle and used it for some time are so happy with it that they do not want to revert to an internal combustion engine. Therefore, it is recommended that e-vehicles are included in existing intermodal traffic schemes in order to encourage people to switch to this type of transportation. The opportunity to get hands-on experience of e-mobility, along with qualified information, is of major importance if potential users are to become excited about this technology. This was an area where the showcase regions with their respective regional centres have been particularly active and successful. It is important to continue and stabilize these activities after the end of the promotion programme.

4) Environment/Energy

Today, e-mobility actually contributes little to reducing pollutants, greenhouse gas, and noise emissions, given the low market penetration and the electricity mix in Germany. However, this will change as ever-growing amounts of electricity generated from renewables are being integrated in power or hybrid grids. The practical experience gained during the showcase projects clearly shows that structures designed to promote controlled charging must be tailored to different use cases and target groups. While fleet operators primarily look at financial incentives via variable load-related rates, private users might be driven by the opportunity to make a measurable contribution to grid stability and thus to the energy turnaround. Smartphone apps could be used to actually determine this individual contribution and thus foster motivation, as was shown in some of the projects.

5) Traffic Legislation and New Mobility Offers

In general, the experts from the showcase projects who were interviewed see a huge potential for innovative mobility - not least because of the burden put on the environment by motorised individual transport. They expect intermodal mobility offers to optimise the volume of traffic. In the near future, however, car-sharing fleets will not operate exclusively with electric drives. Nonetheless, both local authorities and electricity providers can give an impetus for switching to electric drives by installing a public charging infrastructure. An important aspect in this is the unified and unmistakable identification of the charging infrastructure. Particularly from a user's point of view, both signposting and identification of the charging zones are often still insufficient.

6) Safety

There is broad agreement among the experts that e-vehicles are not less safe than combustion cars. They are admitted for use on public roads based on the same standards, with specific test criteria for the drive train and energy storage system. They do not present greater safety risks than conventional vehicles, just other risks, especially with respect to the battery. In general, however, its inflammability is relatively low, even in a crash, because the battery is usually installed safely in the underbody. More dangerous is damage to the high-voltage system. Keeping the high-voltage system safe requires great care with maintenance, service, and repair as well as in the case of accidents. Nonetheless, there is a broad consensus among the experts from the showcase projects that e-vehicles will not lead to more accidents. Dealing with e-vehicles which are involved in a crash is not more dangerous than with comparable petrol or diesel engines, although a different approach is needed in some aspects. All manufacturers put type-specific emergency data sheets for rescue services into their vehicles.

7) Framework Conditions

In the course of the showcase programme, the framework conditions for the development of e-mobility in Germany were considerably altered, partially triggered by the projects and parallel impact research. The introduction of the Law on Electromobility was an important milestone for the implementation of e-mobility

in Germany. It granted local authorities more freedom to privilege e-mobility from 2015 onwards. The law enables privileged treatment of electric vehicles. Privileged vehicles are battery-electric vehicles, fuel-cell vehicles or plug-in hybrids, which meet certain requirements. These vehicles have a special licence plate to identify them in stationary and moving traffic. Municipalities in Germany can introduce different privileges: parking spaces for electric vehicles at charging stations, no fees for parking, use of designated bus lanes or exceptions from access and transit restrictions.

In 2016, further legal changes like the adaptation of the Law on Weights and Measures, the Ordinance on Charging Columns, the revision of the Energy Economy Law and the Electricity Market Law stimulated e-mobility even more, in particular the installation of a need-based charging infrastructure. The lack of a monetary incentive by the state was identified as a major obstacle for the market ramp-up in some parts of Germany. This obstacle was removed. Since July 2016, private and commercial buyers can apply for an environmental bonus. The Law on Tax Incentives for Electromobility removed further barriers that existed: for example, charging at the workplace is no longer considered a non-cash benefit. Yet to be done are expedient changes in the Law of Tenancy and Home Ownership designed to facilitate the installation of charging infrastructure on private property. However, concrete proposals to this end have already been submitted to the parliaments.

3 Legal Framework as Market Incentive Programme

There are a number of incentives to stimulate the purchase of electric vehicles. They are based on different modes of action and can be divided into monetary and non-monetary incentives. Many countries already use legal provisions explicitly as market incentives. Comprehensive parallel impact research has been done into these incentives, including regulatory tools.

Table 1 shows the tools that are currently considered relevant. Several countries have already implemented and combined various market incentives and tested their efficiency.

Table1: Market incentives overview

type of incentive	incentive
monetary	buyer's premium reduction or exemption from car tax tax breaks for company cars exemption from VAT special amortization reduction or exemption from road toll low-cost or free parking
non-monetary	Privileged parking access to special lanes exemption from driving bans

There are different ways of applying monetary incentives. One way is to directly subsidize the acquisition of an e-vehicle. Such a "buyer's premium" represents a one-time incentive for buyers. Another option is to provide indirect subsidies of e-vehicles by means of tax breaks. This type of promotion may be designed as a single action, e.g. waivering VAT, or as a recurring incentive, e.g. car tax reduction. Surveys have shown that financial incentives have a positive influence on the number of e-vehicles sold [2] [3] [4] [5]. The highest sales figures for e-vehicles can be found on those markets where electric cars - thanks to incentives - are cheaper than their counterparts with an internal combustion engine. This can be seen in Norway, the

Netherlands, or Beijing [6]. The higher the additional costs for e-vehicles, the lower tend to be their sales figures. Monetary incentives can help reduce this price gap and strengthen the market ramp-up.

Most countries combine some of these tools. For example, in order to promote electric mobility in Germany, the Federal Government implemented a market-incentive programme, which consists of a buyer's premium, tax incentives and subsidies for public charging stations. Buyers of pure electric cars receive a premium of EUR 4,000, and for a plug-in-hybrid buyers receive funding in the amount of EUR 3,000. 50% of the premium is covered by the state, 50% by the industry. The Federal Government will be providing EUR 600 million by the end of 2019. An additional EUR 300 million is available for the installation of charging stations and for tax incentives. In Germany, there are different tax incentives for owners of an electric car, the most important is the exemption from vehicle tax. This tax exemption was extended in the course of the market-incentive programme.

The two main parameters to be taken into account when selecting the most suitable incentives are effectiveness (Will the desired effect be achieved?) and efficiency (What is the ratio between input and outcome?). Moreover, state-funded incentives must be considered temporary tools for the market ramp-up. Curtailing incentives too early, however, may also adversely affect the market. In Georgia, for instance, sales figures plummeted by 80% after tax breaks were abolished. Similarly, sales dropped sharply in the Netherlands in 2015 as a result of important incentives expiring in December 2014 [7] [6]. This is why Norway, for instance, has put a staged exit strategy in place that relates to incentives for buying e-vehicles: The exemption from VAT is to be phased out in stages after 2017. Exemption from import duties ends in 2010. Complete exemption from car tax lasts until 2018, a 50% reduction continues until 2020. The 50% exemption from company car tax is granted until 2018 [8]. Non-monetary incentives are supposed to grant owners of e-vehicles benefits in everyday traffic. This includes, for instance, time savings on the way to work or on business-related trips with special bus lanes like in Sweden or car pool lanes like in California. Also, bakeries, restaurants, and forwarders benefit from accessible environmental zones and extended delivery times for e-vehicles in inner cities which help them make their routes more efficient and cheaper.

Unlike monetary incentives, most of which are not visible for drivers, non-monetary incentives can often be clearly noted in the streetscape. This goes for marked e-parking spaces, special lanes for e-vehicles, or access privileges for e-vehicles in environmental zones. Thus, non-monetary incentives have an additional effect on the entire society since they change the streetscape and become tangible for the public at large, while monetary incentives affect rather the decision of individual buyers [9].

A detailed description of the market incentives which are based on legislation follows next.

1) Reduction or Exemption from Car Tax

Some countries have tried to stimulate the purchase of e-vehicles by a reduction of or exemption from the car tax for those vehicles. The tax may be assessed according to various factors such as weight, CO_2 emissions, or displacement (for combustion cars). The tax reduction or exemption for e-vehicles is usually limited in time. Assignment of a more favourable tax category, on the other hand, based on CO_2 emissions, is often a long-term benefit. In principle, this tool is also well-suited for accelerating the market ramp-up since experts consider a tax reduction or exemption an attractive incentive, especially for companies operating large fleets. This tool could become the driver for boosting e-mobility, particularly in the segment of company car fleets, which constitute the majority of new registrations in most countries. In addition, this mechanism entails much less paperwork than a buyer’s premium. Another benefit is the high visibility of this tool with car drivers. Finally, it provides a permanent benefit in terms of operating costs. Critics, however, point out that this tool may fail to bring about the desired results. [10]. This may particularly apply to countries like Germany, where a low car tax is levied on zero-emission vehicles. In this case, users of e-vehicles save hardly any money. In addition, a reliable strategy for phasing out the measure - possibly using a degressive scheme - must be put in place to prevent the market from plummeting when the incentive ends, similar to the buyer’s premium.

Depending on its design, a car tax exemption scheme may have variable effects. In Germany and Sweden, tax exemption results in insignificant cost savings for the owners of e-vehicles due to the relatively low car tax rate. In the Netherlands, on the other hand, users profit substantially from tax exemption. The differences become clear when comparing various models. In Germany, savings vary from EUR 110 to maximum EUR 950 over five years, depending on the model. In Sweden, savings fluctuate between EUR 185 and EUR 1,150, whereas Dutch users can save from EUR 1,480 up to EUR 6,560. In general, experts consider this a high-

efficiency incentive provided the car tax is at such a high level that a reduction or exemption relieves the burden significantly. But even if tax cuts do not result in substantial savings for the user, the measure can still have the effect of a positive signal. Particularly with regard to its appeal for companies with a large car fleet, this measure can be a promising incentive.

2) Tax Breaks for Company Cars

Company cars that are used for private purposes by employees are usually taxed as a non-cash benefit. In Germany, the tax is based on the gross list price of a vehicle plus the price for extra equipment if applicable [11]. The average price for e-vehicles is still much higher than for a comparable combustion car. Consequently, the income tax payable is also higher, which means that users of e-vehicles are at a tax disadvantage. It depends on the tax rate, however, whether a tax break for company cars will actually have the desired effect: If the rate is low, tax reduction or exemption does not constitute a buying incentive. In addition, it is not clear if companies really regard this tool as an incentive because it is the company which has to buy the - usually more expensive e-vehicle, whereas the benefit goes mainly to the tax-paying user of the car. The tool of a tax break is appreciated as the elimination of the tax disadvantage of e-vehicle owners. This makes it possible to significantly increase the share of electric cars via the company car segment, which accounted for 66% of newly registered cars in 2015 [12]. Thanks to lower taxation, owners will not have any disadvantages in terms of total cost of ownership. Moreover, operating electric fleets may have a positive influence on the image of the company. Another benefit stems from the experience with e-vehicles that employees gain through their company. This provides access to the new technology even for users who do not have an affinity for e-mobility.
The higher the tax rate in a country, the greater the incentive provided by reducing the tax on company cars. The broad impact of this incentive also depends on the share of company cars in the respective country. In the Netherlands, for instance, unexpected results were observed: In this country, more than 90% of the e-vehicles are registered with companies [2]. Since companies tend to procure large company cars, tax breaks enhance the trend towards large vehicles. In a situation where a large portion of the e-vehicle market is served via company cars, the market is filled primarily by large e-vehicles [2]. In general, experts think that this measure will have a rather minor effect. Given a favourable situation in specific countries, however, it may still become an additional attractive incentive. Overall, however, the interviewees consider both the buyer's premium and the car tax reduction or exemption more beneficial.

3) Privileges for Users of E-vehicles

Along with numerous incentives, owners of e-vehicles are granted privileges for using their cars in a number of countries. These privileges can often increase the visibility of e-mobility [2]. There are various types of privileges, often adapted to the situation in the respective countries. Usually, their objective is to lower the operating costs of e-vehicles, e.g. by means of lower parking fees or the exemption from motorway toll (monetary privileges). Another type of privilege provides users of electric cars with more flexibility and benefits (non-monetary privileges). An example for this is access to bus lanes for e-vehicles. The different user privileges will now be discussed, followed by an overall assessment of their respective effects.

Some countries have introduced privileges for parking to make e-vehicles more attractive. A monetary incentive in this respect is the elimination or reduction of parking fees for e-vehicles. In Norway, for instance, e-vehicles can park free of charge on any municipal parking space. [13]. In the US, some cities and states have also adopted similar rules [14]. Another approach, apart from free parking, is the special designation of car parks for e-vehicles, which are usually equipped with charging columns. The Netherlands, Norway, Great Britain, Denmark and the US are among the countries that have put this type of car park in place [15] [14]. In Germany, the Law on Privileged Use of Electric Vehicles (Law on Electromobility – EmoG) forms the basis for parking privileges. To prevent problems with parking offenders, clearly identifiable signposting is recommended. Coloured markings on the ground have also proven to be effective in stopping parking offenders. The effect of this incentive depends largely on the framework conditions. An extensive offer of low-cost or free parking increases the appeal of this incentive considerably. However, if each city takes a different approach, users become anxious. For customers in Norway, where free public parking is provided across the entire country, this incentive seems to be having a positive effect on their decision to buy e-vehicles [16], whereas in Germany, this incentive apparently did not play any role for buyers of electric cars [17]. Most probably, there will be a clear distinction between urban and rural users. Motorists who live in the city

and often need a long time to find a parking spot, see parking privileges as a far greater incentive than their counterparts in small towns.

In some countries, owners of e-vehicles do not pay any or very low toll fees, for instance in Norway, where this rule was adopted as early as 1997 [18]. Oslo has also introduced a road toll, from which e-vehicles are exempt [19]. Commuters and long-distance lorry drivers in particular can thus save a lot of money when driving e-vehicles. This is why 41% of the interviewees who own an e-vehicle stated the exemption from the motorway toll as a major argument for buying their cars [20]. Depending on the toll amount, this tool can be an attractive incentive for buying an e-vehicle.

In order to provide positive effects for users of electric vehicles, some countries have opened special lanes, which had previously been reserved for selected groups, for e-vehicles. This includes bus lanes and high-occupancy vehicle lanes, also called car-pool lanes. Some cities in Europe permitted e-vehicles on bus lanes some time ago, which can substantially reduce travel time, depending on the traffic situation. The Norwegian city of Oslo was a pioneer in this respect. Cities in the UK [21], Barcelona [22], and other big cities followed suit. The US and Canada still have other special lanes: high-occupancy vehicle lanes, also called car-pool lanes [14]. These lanes are reserved for cars with a certain minimum number of occupants. Since these lanes often provide more space and in some cases even have a higher speed limit than the other lanes, e-vehicles can significantly reduce travel time. The use of special lanes is an incentive with high visibility. People driving conventional cars actively perceive the advantage of their electric peers and are thus encouraged to think about buying an e-vehicle as well. Another benefit for users is that they reach their destination faster, especially in big cities. If, however, the incentive meets with too much interest, its benefit turns into a drawback. In Oslo, the incentive was suspended because the permission to use bus lanes was so successful that it partly led to congestion on these lanes [23]. Moreover, many local authorities are concerned that opening bus lanes might impair the processes and punctuality of municipal public transport and therefore do not use this incentive. Experts claim that in the US the use of high-occupancy vehicle lanes play a major role for buying e-vehicles and may in some cases be even more decisive than monetary incentives [24]. A survey carried out by ICCT in various US states confirmed these assumptions. The survey shows that users perceive access to high-occupancy vehicle lanes as a greater benefit than other subsidies and incentives [2]. A possible reason for this impression might be that this privilege, unlike one-time or annually recurring financial benefits, is available all the time and is actively used by drivers.

Some cities ban driving at specific times or in specific areas. These bans are usually provoked by excessive air pollution or extremely heavy traffic and high noise exposure by residents. Exempting e-vehicles from these bans is a non-monetary tool and a major incentive. China already uses this incentive: In Beijing, combustion cars were banned from the inner city on one day of the week [25]. Since February 2017, cars which do not comply with a specified emission standard are completely banned from the city centre [26]. E-vehicles are exempt from this rule. This incentive has a high visibility and signal effect. One benefit of this tool, along with the expected boost in e-vehicle sales, particularly due to commercial users, is the improved quality of life in inner cities. Critics, however, fear that this measure will adversely affect the economy.

Overall, experts consider the above-mentioned privileges as reasonable additional incentives. On an international level, particularly exemptions from bans and the access to special lanes are considered to be successful tools, whereas free or low-cost parking is deemed the least effective. When looking at all these tools, however, the specific situation in each country needs to be taken into account in order to make a realistic assessment of their effectiveness.

Table 2: Overview of relevant incentive mechanisms and their application by country.

	Nether-lands	Norway	France	China	South Korea	Japan	USA
car tax exemption or reduction related to CO_2 emissions	●	●	●	●		●	●
reduced taxation of company fleet cars	●	●	●				
exemption from VAT		●		●		●	
buyer's premium			●	● (regional)	●	●	●
access privileges for EVs (environmental zone, extended delivery times, toll cuts …)	●	●	●	●			
privileged parking (free of charge, EV exclu-sive parking		●		●			●
access to privileged lanes		●			●		●

4 Outlook - Recommendations for Action

Today, there is no doubt that e-mobility - driven by renewable sources of energy - is the most important path towards a consistent and sustainable decrease of CO_2 emissions caused by traffic, while at the same time retaining the requested mobility worldwide. Statements by politicians as well as representatives of businesses and associations on this issue have changed drastically in the course of the showcase programme. Today, the boards of every car manufacturer express their conviction that a transformation towards electric drives will take place and that the market will undergo major changes.

Despite these statements, there are still not enough models on offer. The product portfolio offered by OEMs has a large impact on the success of e-mobility. This becomes clear when looking at Norway. Figure 3 shows that, despite considerable incentives, sales of e-vehicles in Norway increased only marginally between 1990 and 2010. Only after a certain variety of models had been reached did sales figures skyrocket. This was also supported by intense sales activities by manufacturers and dealers.

Consequently, there is still a lot of catching-up to do in terms of the manufacturers' portfolio of electric cars, to which the diagram relates. The e-models offered and their availability do not meet the needs of the customers and need to be expanded urgently.
Although the range of series e-vehicles has been considerably expanded over the last three years, there are still many segments where interested customers cannot find a suitable model. And there are still target groups for which no suitable electric cars are available, such as families with comfort and space requirements. Therefore, car manufacturers should continue to extend their range of e-vehicles if they take e-mobility seriously. Based on these findings, BuW recommends the following: The variety of models and the availability of electric vehicles currently do not meet the needs of the customers and must be extended urgently.

A much larger gap, however, exists for light commercial vehicles and lorries. In a poll conducted among people using or planning to use e-mobility for commercial purposes, the majority of the interviewees said that the narrow model range of lorries presented a very great or a rather great obstacle. Almost half of the people questioned made the same statement with respect to light commercial vehicles and buses. Practical examples show that some companies are not waiting for initiatives any longer, but are getting involved in the production of suitable e-vehicles themselves. Currently, German manufacturers are not active in these important segments. Consequently, the following two recommendations are directed explicitly towards the OEMs:

- The production and market launch of electric buses should be accelerated.
- German OEMs should not leave the market gap in light electric utility vehicles to other players in the market.

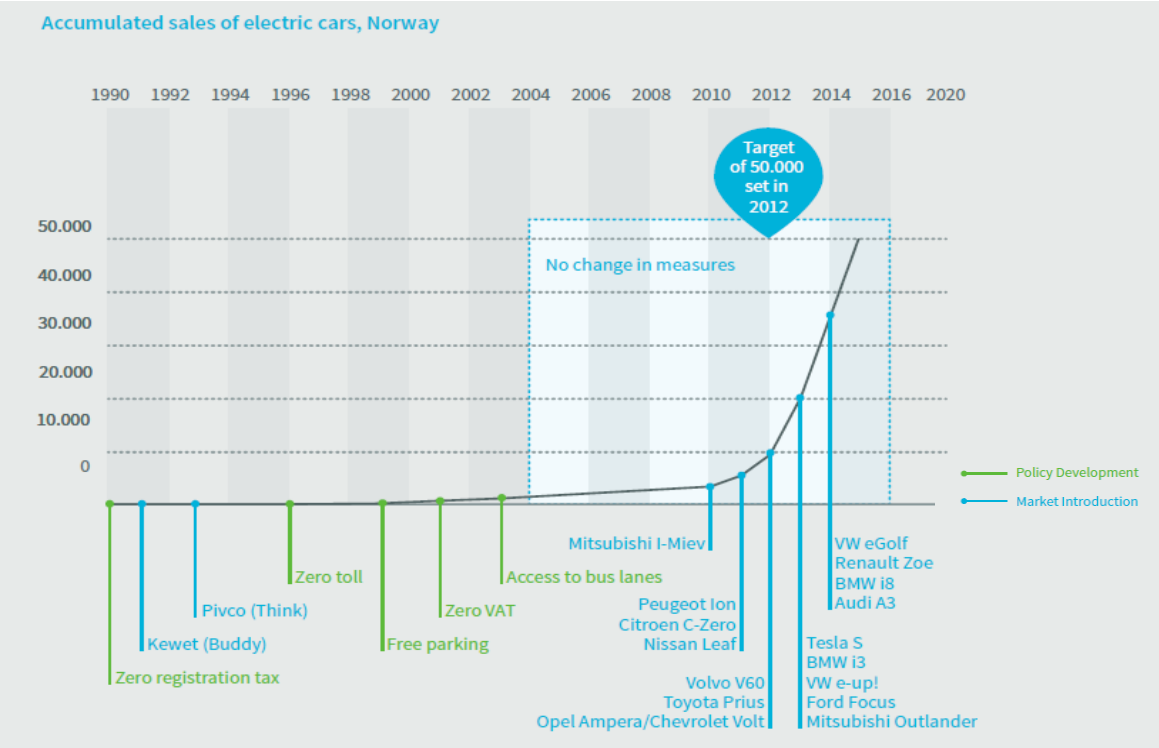

Figure 3: Effect of incentives and available models on the development of e-vehicle sales in Norway [27].

In addition, car manufacturers currently invest too much capital in the development of plug-in hybrids. In the future, manufacturers should focus on full electric vehicles - plug-in hybrids remain an interim solution. Installing two drive systems in a vehicle requires more time and money, which means that hybrid cars cannot be competitive in the long run.

Along with these and other recommendations for action, however, BuW identified other areas where research is needed. Over the last few years, the focus has been mainly on private users. However, the potential of e-mobility in the commercial sector may be even higher. This is why future research projects should focus particularly on the electrification of road freight transportation. The state should also adopt appropriate measures designed to simplify the use of e-mobility for goods traffic. Existing legal regulations should be applied and regulations for courier, express and parcel services revised.

Another important research topic for the future will be the linkage of electrification and digitalisation. It is true that the two developing technologies of e-mobility and autonomous driving are not necessarily linked to each other. Nonetheless, both of them contribute to the objective of a more sustainable mobility and both will have equal influence on the development of new vehicles. The legal framework governing the expansion of e-mobility has already been significantly changed. Germany is pioneering in the field of creating reliable framework conditions for autonomous driving. In May 2017, a law setting the framework conditions for autonomous driving came into force. There are, however, still open issues. Some people doubt, for example, that matters of data protection have been adequately addressed. In this respect, electric driving also has to clarify some open issues. BuW recommends that a reliable legal framework must be created for dealing with data arising from electric vehicles. This recommendation can subsequently be seamlessly extended to automated and autonomous driving. The adopted law refers only to automated driving and leaves open various legal issues of autonomous driving, like insurance and liability matters. In these fields, legislators need to set up clear rules as soon as the technology is ready for the market.

In addition to these economic, technical, and legal issues, it is important to bear in mind that a social transformation process is required to introduce both e-mobility and automated driving. Some of our mobility habits will be contested fundamentally. At the same time, needs of users must be fulfilled. E-mobility has to be as attractive as possible so that people learn to appreciate the advantages of this technical innovation and integrate benefits into their daily life. A made-to-measure market incentives programme may help to convince people to change to electric vehicles. However, cultural background must not be neglected. In

Germany, the long-standing history of the combustion engine makes the changeover process even more difficult.

The Showcase Programme provided important impulses for the introduction of electric mobility in Germany. It linked the most important groups of the transformation process, politics, OEMs, charging station operators and network operators and supported the German National Platform for Electric Mobility. It helped to shape the market and mainstream e-mobility in Germany.

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