Promoting Electric Vehicles in Germany via Subsidies – an Efficient Strategy?

Claudia Kemfert[1]

Electric mobility is becoming increasingly attractive: in big cities and metropolitan areas the quality of life is rising as more electric cars generate less noise, as well as lower emissions and particulates. Fossil fuels nevertheless still account for an extremely large share of the transportation system, as over 95% of all vehicles use conventional fuels. The transportation sector produces over 20% of all global CO2 emissions. In view of more ambitious climate goals and emissions reduction targets of up to 80% in the decades ahead – as set out in the most recent climate policy agreement reached in Paris – a sustainable mobility strategy needs to substantially increase the share of alternative and climate-friendly transportation technology and fuels. Electric mobility is indeed one component of a sustainable mobility strategy. With an increased share of electric vehicles and renewable energy for electricity production, emission reduction goals could be met. Not only electric cars, but also rail traffic and transport (including commuter railway systems) are now electric. Individual electric mobility could be a good complement to the existing rail transport system. Electric vehicles do not produce particulates, noise or other emissions and therefore meet several criteria for sustainable and climate-friendly mobility. Batteries of electric vehicles could be a storage option for volatile renewable energy. Decentralized electricity distribution grids could be unburdened by a higher share of storage batteries. Moreover, positive environmental effects could be achieved if electric vehicles were not filled with climate-unfriendly coal electricity, but with renewable electricity. Electric vehicles always need to be combined with a strictly sustainable transportation strategy (Dijk, Kemp and Orsato 2012).

[1] DIW Berlin.

Germany's electric vehicle plans

Germany's aim is to put one million electric vehicles on the road by 2020 and six million by 2030 (Die Bundesregierung 2011). Germany's federal government established a national strategy with the overarching aim of taking the market lead and becoming the key provider of electric vehicles in Germany (Die Bundesregierung 2014, 2015). Its main goals in promoting plug-in electric vehicles are to reduce dependency on oil product imports, to decrease carbon dioxide emissions and to strengthen the car industry's competitiveness (Federal Government of Germany 2009). Current sales figures show, however, that electric vehicles are still a niche product and far from diffusing into a mass-market (Bakker, Engels and van Lente 2012). Today, approximately 12,200 pure electric cars in Germany are on the road and about 85,500 hybrid cars (Kraftfahrt-Bundesamt (Federal Motor Transport Authority) 2016).

Plug-in electric vehicles are defined as vehicles featuring a battery that can be charged by electricity. Plug-in electric vehicles include battery electric vehicles, plug-in hybrid electric vehicles and range extended electric vehicles. While battery electric vehicles operate exclusively on electricity without any other power source, plug-in hybrid electric vehicles and range extended electric vehicles have internal combustion engines that are supplemented by an electric power train. Hybrid electric vehicles combine an electric power train with internal combustion engines, but cannot be charged by electricity (Bundesministerium für Umwelt 2014).

The diffusion of electric vehicles remains very slow as there are still substantial technical, social, and economic barriers to be overcome (The German National Platform for Electric Mobility 2013). When compared to internal combustion engine vehicles, electric vehicles perform relatively poorly in terms of total cost of ownership, vehicle cost, driving range, charging times and charging infrastructure (Transportation Research Board 2013).

According to the annual report of the Federal Motor Transport Authority, only around 26,000 battery electric vehicles and approximately 131,000 hybrid electric vehicles were registered by mid-2016. Compared to 54.6

million registered automotive vehicles in Germany, battery electric vehicles have a market share of around 0.7% (Kraftfahrt-Bundesamt 2016).

In order to reach the goal of one million electric vehicles on German roads, the government decided to pay a subsidy to car buyers. A buyer's premium of 4,000 EUR is paid for the acquisition of an electric car. Half of the buyer's premium is paid by the government and half of it by electric car manufacturers.

Experiences from other countries

In many countries, electric vehicles are financially subsidized. Although nearly all countries subsidize electric mobility, the total share of new electric cars is still very low at around 0.1% of total new cars (OECD/IEA 2016 and IEA 2013). In Europe, this share also lies below 1%, while hybrid cars account for 1.5 % of new cars (see Figure 1 and Table 1). Electric vehicles enjoy their largest market share in Norway, which has the highest number of electric vehicles per capita in the world.

In 2015 the market penetration of registered electric vehicles on Norway's roads surpassed the share of 20%. The financial promotion system started as early as 1990 with the temporary abolishment of an import tax that was made permanent in 1996, along with an accompanying reduced annual registration tax. In 2000 the company car tax was reduced. The maximum combined incentives available could amount to 17,524 EUR per electric vehicle in 2011 (JATO 2011), while the total subsidies and tax break savings, both upon purchase and recurring, could amount to 16,910 EUR per electric vehicle.

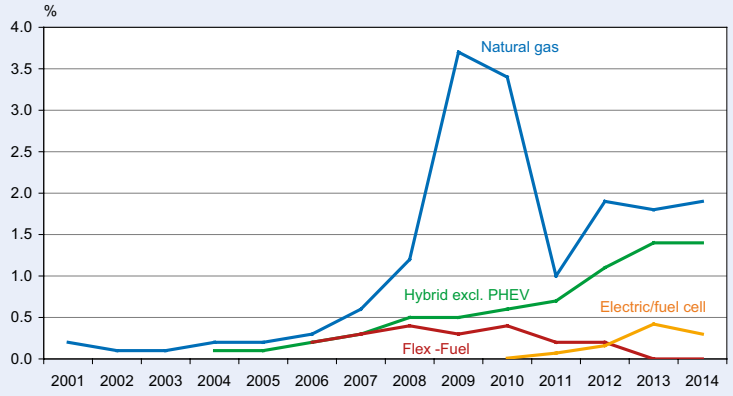
In the Netherlands the share of electric vehicles reached around 9%, versus approximately 2.3% in Sweden and 1.2% in France. In other nations market shares were in the range of around 1% (China) or below (US, Canada, Japan, UK and also Germany). Although the number of charging stations has been increased, it still remains very low (US: 12,100, China: 8,300, France: 8,000 and Germany: around 5,000). Many countries offer tax exemptions like, for example, the US with tax reductions of 7,500 USD or Canada with about 8,500 USD per electric car and free use of car lanes. Almost all countries charge no motor vehicle taxes for electric cars.

An explicit buyer's premium is offered in countries like France (6,500 EUR plus 10,000 EUR for old diesel cars), China (6,000 EUR and car permit), Sweden (4,500 EUR), Japan (6,500 EUR) and the UK (25 % of new car value). As the share of conventional cars in these countries is still very high, a buyer's premium for electric vehicles may not be a relevant economic driver for boosting the market. Technical barriers, such as the driving range, batteries and charging stations, tend to dominate as a result. Promotion and support policy strategies for electric vehicles should therefore primarily focus on reducing technical barriers. The introduction of a large number of charging stations, as well as an increase in the driving range of cars, would also be more promising.

China provides a one-off bonus for battery electric vehicles depending on their battery range and electric vehicles are exempt from acquisition and excise tax (Mock and Yang 2014). Incentives are paid to the auto-industry and are expected to trickle down to price reductions in the end product. China is the only country that provides vehicle production subsidies to the industry (Lutsey 2015). Local governments have also implemented their own respective local subsidies: in the city of Shenzhen, for example, the government offers up to 60% discounts on locally-produced new energy vehicles (Tagscherer 2012). This has the effect of further stimulating the local/regional electric vehicle industry. Some provinces and cities such as

Figure 1

Share of alternative fuels of new cars in Europe



Note: 2013: EU27, 2014: EU28.

Source: ICCT International Council on Clean Transportation; Calculations of DIW Berlin.

Table 1

Country electric vehicle market shares (% of new car registration)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sources
Australia						0.11%				ev-sales
Austria						0.26%	1.20%			(Shahan 2014) & Adapted from (ACEA)
Belgium						0.17%	0.42%			(Shahan 2014) & Adapted from (ACEA)
Brazil										
Canada				0.00%	0.10%	0.20%	0.30%	0.40%		OECD/IEA. 2016
China			0.00%	0.00%	0.10%	0.10%	0.40%	1.00%		OECD/IEA 2016
Cyprus										
Czech Republic							0.30%			Adapted from (ACEA)
Denmark						0.29%				(Shahan 2014)
Estonia						0.73%	1.92%			(Shahan 2014) & Adapted from (ACEA)
Finland						0.17%	0.41%	0.64%		(Shahan 2014) & Adapted from (ACEA)
France				0.10%	0.30%	0.50%	0.70%	1.20%		OECD/IEA 2016
Germany				0.10%	0.10%	0.20%	0.40%	0.70%		OECD/IEA 2016
Greece							0.09%			Adapted from (ACEA)
Hungary										
Iceland					0.21%	0.94%				ev-sales & (Shahan 2014)
India			0.00%	0.00%	0.10%	0.00%	0.00%	0.10%		OECD/IEA 2016
Ireland						0.08%		0.49%		(Shahan 2014) & Adapted from (Ieahev 2016)
Israel										
Italy					0%	0.10%	0.10%	0.10%		OECD/IEA 2016
Japan		0.00%	0.10%	0.40%	0.50%	0.60%	0.70%	0.60%		OECD/IEA 2016
Korea				0.00%	0.10%	0.15%	0.10%	0.20%		OECD/IEA 2016
Latvia							3.02%			Adapted from (ACEA)
Malta										
Monaco										
Netherlands				0.20%	1.00%	2.50%	3.90%	9.70%		OECD/IEA 2016
New Zealand										
Norway	0.20%	0.10%	0.30%	1.50%	3.20%	5.80%	13.70%	23.30%		OECD/IEA 2016
Portugal				0.10%	0.10%	0.20%	0.20%	0.70%		OECD/IEA 2016
Romania										
Slovakia							0.23%			Adapted from (ACEA)
Spain				0.10%	0.10%	0.10%	0.20%	0.20%		OECD/IEA 2016
Sweden				0.10%	0.30%	0.50%	1.40%	2.40%		OECD/IEA 2016
Switzerland						0.44%		1.70%		(Shahan 2014) (Ieahev 2016)
Turkey										
UK				0.10%	0.10%	0.20%	0.60%	1.00%		OECD/IEA 2016
US			0.00%	0.10%	0.40%	0.60%	0.70%	0.70%		OECD/IEA 2016
World Total									0.10%	OECD/IEA 2016

Beijing, Shanghai, and Guangdong provide additional bonuses that may double the incentive provided at the national level (Mock and Yang 2014).

In Japan, electric vehicle incentives are based on the price difference between the electric car and its conventional gasoline counterpart. The maximum subsidy available is equivalent to around 6,300 EUR (Lutsey

2015). The government program was launched in 2009 and has gradually become less generous over the years. Furthermore, electric cars are exempt from acquisition tax based on vehicle price and engine displacement (Mock and Yang 2014).

South Korea's ministry of the environment provides a nationwide electric vehicle subsidy of 9,000 EUR for each car, and 3,000 EUR for the installation of slow chargers, with another 3,000 EUR available in tax support (Ieahev 2016). The hybrid electric vehicle subsidy budget is only 750 EUR per vehicle, while an additional 2,000 EUR is available in tax cuts (Ieahev 2016).

In the Netherlands, cars with zero CO2 emissions are exempt from registration and ownership tax – for vehicles with emissions there is a differentiated and progressive tax system based on the vehicle's CO2 emissions (OECD/IEA 2016). Electric vehicle users enjoy a lower surcharge on income taxes for the private use of company cars. The tax advantage amounts to around 2,000 EUR per year compared to a conventional company car (NEA 2015).

France introduced a "bonus-malus" scheme in 2008 and its government supports the purchase of low-emission vehicles. Electric vehicle car owners get 6,300 EUR, while hybrid car owners are given 1,000 EUR. Penalties for high-emission cars can reach up to 8,000 EUR per car. The scrap disposal of diesel cars is subsidized by up to 10,000 EUR per car (Tietge et al. 2016).

In the US there is a federal subsidy program worth up to a maximum of 7,500 USD in the form of a tax credit, which depends on the battery capacity of the vehicle (Mock and Yang 2014). The upper boundary of 7,500 USD is reserved for long-range plug-in hybrid electric vehicles (Lutsey 2015). In California another subsidy program exists at the state level. Buyers of battery-powered electric vehicles are given an additional 2,500 USD, whilst plug-in hybrid electric vehicle buyers are granted 1,500 USD in a one-off bonus payment (Mock and Yang 2014). An even greater amount is granted to low-income consumers. Additionally, there are annual fee exemptions for electric vehicles (OECD/IEA 2016).

Buyer's premium in Germany – an efficient strategy?

The very strict buyer's premium, however, may not be an efficient instrument for increasing the share of electric vehicles. Electric vehicles remain unattractive as long as conventional mobility has a competitive advantage. Electric mobility needs a high density of operational charging infrastructure. A buyer's premium additionally benefits high-income families, who might not replace a conventional car with an electric vehicle, but may add one to their existing fleet. Such a second or third car purchase, however, does not lead to a sustainable mobility strategy.

Electric mobility is merely one module among many. As long as diesel cars in Germany are indirectly subsidized by tax reductions and there is no overall strategy for environmentally-friendly transportation, a buyer's premium for electric vehicles is myopic and not sustainable.

Electric mobility needs support. Germany should not lose its grip on this important market, or it will fail to meet the targets that it has set itself. The electric vehicles market is underdeveloped and growing too slowly. Competitors from other nations are increasingly leading the market, not only by producing the cars, but also the batteries essential to them. Years ago German battery producers enjoyed a competitive advantage, but lost it as other manufacturers outperformed them. Germany's competitive advantages can only be reinforced with a coherent and sustainable transportation policy.

Backward transportation policy in Germany is also responsible for the misery of lost competitiveness thanks to lobbies for low-emission standards in Brussels. There is still no real policy commitment to systematically making German transport systems more sustainable. Initial steps in the right direction would be to abolish diesel tax exemptions and to promote cars powered by alternative fuels such as natural gas, or "power to liquids" options and work on an effective traffic avoidance, optimization and environmental strategy. The avoidance of diesel tax reductions – 18 cent/liter lower taxes on diesel than on gasoline – would boost German revenues by 7 billion EUR per year. In other words, an 18 cent/liter increase in diesel tax would raise tax revenues by 7 billion EUR per year. This money could be spent on promoting a sustainable transportation policy.

Traffic congestion cannot be avoided with electric cars. Sustainability also cannot be achieved, as the share of coal is still high in Germany and produced and "tanked" electricity is still dirty. Germany should start a coal phase-out. Electric vehicles need to be filled with electricity from renewable energy to make them environmentally-friendly. Freight and goods traffic should also

be made more sustainable by using climate-friendly fuels and rail transport.

Sustainable transportation means that unnecessary traffic is avoided, traffic optimization is implemented, multi-modal systems need to be supported and different forms of traffic are better interlocked and oriented towards climate protection. Climate-friendly fuels need to be used in the road, rail and aviation transportation areas and public transportation needs to be better connected with car sharing systems and bicycles. In the future, mobility services will be purchased in metropolitan areas, not cars. The rail transport system should be strengthened by avoiding unnecessary disadvantages of this means of transport. New and efficient transportation technologies are needed urgently.

Climate-friendly policy concepts should support railway transportation, raise emissions standards, promote environmentally-friendly fuels, and avoid the tax advantages of conventional fuels, especially diesel. An overall strategy should optimize traffic flows and infrastructure. Natural gas vehicles are more climate-friendly than diesel and gasoline cars, but enjoy fewer advantages.

The German car sector, especially component suppliers, are crucial to the economy and employ over 700,000 workers nationwide. With alternative drive engineering, technology and fuels, new markets could be developed and value added and jobs created. The "diesel scandal" provided impressive proof of how harmful such a strategy is for a whole sector and the economy. It should be a wake-up call for changing firm strategies for a climate-friendly future. The economic opportunities of a sustainable mobility are huge. The later the start of the transformation, the more expensive the new start will be. In an increasingly globalized world there is also a growing danger that the necessary logistical interconnections will be lost.

A buyer's premium for electric cars might sound alluring to policy makers. However, without an effective strategy for a truly sustainable transportation policy, and when keeping advantages for conventional fuels, such a premium will neither support the transformation required, nor will it create the necessary markets as it should. If combined with a sustainability and environmentally- and climate-friendly strategy, however, it might be a right step into the future. An efficient strategy would be to first implement a transportation policy that reduces the advantages of conventional fuels and cars, while supporting the transportation of goods and people via rail, and promoting car sharing concepts and bicycle use in metropolitan areas. In the absence of such a strategy, a buyer's premium for electric cars is a waste of money. With all these sustainability strategies, however, a higher share of electric vehicles is clearly needed – and a financial support a clever concept.

References

ACEA (2015), New Electric Vehicle Registrations in the European Union, http://www.acea.be/uploads/press_releases_files/ACEA_Electric_Vehicle_registrations_Q4_14-13.pdf (accessed 22 June 2016).

Bakker, S., R. Engels and H. van Lente (2012), "Competition in a Technological Niche: The Cars of the Future", *Technology Analysis & Strategic Management* 24 (5), 421–34.

Die Bundesregierung (2011), *Regierungsprogramm Elektromobilität,* Die Bundesregierung, Berlin.

Die Bundesregierung (2014), Weg vom Öl mit Elektromobilität, https://www.bundesregierung.de/Content/DE/Artikel/2014/05/2014-05-23-e-mobility-hendricks.html (accessed 16 July 2016).

Die Bundesregierung (2015), Entwurf eines Gesetzes zur Bevorrechtigung der Verwendung elektrisch betriebener Fahrzeuge (Elektromobilitätsgesetz – EmoG), https://www.gesetze-im-internet.de/bundesrecht/emog/gesamt.pdf (accessed 22 July 2016).

Dijk, M., R. Kemp and R. Orsato (2012), "The Emergence of an Electric Mobility Trajectory", *Energy Policy* 52, 135–45.

Federal Government of Germany (2009), *German Federal Government's National Electromobility Development Plan,* Federal Government of Germany, Berlin.

Federal Ministry for Economic Affairs and Energy (2016), General Information: Electric Mobility, http://www.bmub.bund.de/en/topics/air-mobility-noise/mobility/electric-mobility/ (accessed 16 July 2016).

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2007), *The Integrated Energy and Climate Programme of the German,* Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Berlin.

The German National Platform for Electric Mobility (2010), Functioning of the NPE, http://nationale-plattform-elektromobilitaet.de/en/the-npe/history/ (accessed 16 July 2016).

Ieahev (2016), Hybrid and Electric Vehicles: The Electric Drive Commutes, http://www.ieahev.org/news/annual-reports/ (accessed 27 June 2016).

IEA (2013), *Global EV Outlook 2013 – Understanding the Electric Vehicle Landscape to 2020,* IEA, Paris.

JATO (2011), Incentives Fail to Stimulate European EV Sales, http://ww11.jato.com/PressReleases/Incentives%20Fail%20to%20Stimulate%20European%20Electric%20Vehicle%20Sales.pdf (accessed 23 June 2016).

Kraftfahrt-Bundesamt (2016), Fahrzeugzulassungen, http://www.kba.de/SharedDocs/Publikationen/DE/Statistik/Fahrzeuge/FZ/2016_monatlich/FZ8/fz8_201606_pdf.pdf?__blob=publicationFile&v=2 (accessed 16 July 2016).

Lutsey, N. (2015), Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments, www.theicct.org/sites/default/files/publications/ICCT_GlobalZEVAlliance_201509.pdf (accessed 16 July 2016).

Mock, P. and Z. Yang (2014), *Driving Electrification – A Global Comparison of Fiscal Incentive Policy for Electric Vehicles*, International Council on Clean Transportation, Washington, D.C..

NEA (2015), Electromobility in the Netherlands: Highlights 2014, http://www.rvo.nl/file/electromobility-netherlands-highlights-2014 (accessed 18 July 2016).

OECD/IEA (2016), *Global EV Outlook 2016 – Beyond 1 million cars*, 1–51, http://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf. (accessed 14 June 2016).

Shahan, Z. (2014), Electric Vehicles Market Share in 19 Countries, http://www.abb-conversations.com/2014/03/electric-vehicle-market-share-in-19-countries (accessed 16 June 2016).

Tagscherer U. (2012), "Electric Mobility in China – A Policy Review", *Frauenhofer ISI* no. 30.

Tietge U., P. Mock, N. Lutsey and A. Campestrini (2016), *Comparison of Leading EV Policy and Deployment in Europe*, International Council on Clean Transportation, Berlin.

Transportation Research Board (2013), *Overcoming Barriers to Electric-Vehicle Deployment: Interim Report,* The National Academies Press, Washington D.C..