Maximum economic market potential of PHEV and BEV vehicles in Germany in 2015 to 2030 under different policy conditions

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Abstract

The paper investigates an economic market potential for Plug-in Hybrid- and Battery Electric vehicles considering different categories of customers in Germany from 2015 to 2030. A multi-step methodology using constraints on the current vehicle registrations and inventory is developed to derive a general framework potential and a concrete economic potential for the different vehicles and ownership models under adjustable technical and legislative aspects.

1. Introduction

Climate change, resource scarcity and air pollution are widely recognized challenges to modern societies. One reason for these challenges lies, amongst others, in the intensive use of internal combustion engines in passenger cars for individual mobility. Hence, car manufacturers and policy makers aim to shift towards electric propulsion for some time now. While technology issues were increasingly overcome, the economic viability of electric drive trains remained harshly constrained by high battery prices.

Nevertheless, in the recent past these prices decreased significantly and made it very interesting to estimate the emerging potential for partly and fully electrified drive trains under the current economic and regulatory conditions.

2. Objective

The research presented in this paper shows an approach for analyzing the German car market's potential of electric vehicles (EVs). It clearly distinguishes the two concepts of Plug-in Hybrid EVs (PHEVs) and Battery EVs (BEVs) as their driving patterns and costs will differ significantly. Furthermore, three different ownership approaches are considered to illustrate how they influence the market potential. Technical, socio-demographic and economic limitations are modelled to derive possible sales potentials for electric passenger cars.

The analysis is conducted with a starting point in 2015 when car and infrastructure availability can be expected at a viable level. The aim was to develop a methodology which allows calculating the impact of different incentives, taxes and other regulatory scenarios on the maximum EV sales potential. The purpose of this analysis is not to determine precise sales forecasts (see chapter 3.1) but to calculate scenario results for the market potential which provide valuable insights for car manufacturers and policy design.

3. Applied method and data base

3.1. Overview

The procedure to determine the market potential of EVs includes two steps:

1. Identifying a general framework potential for the German car market
2. Calculating the economic potential

For the first step the current car fleet and new car sales distribution were analyzed and technically potential EV buyers were filtered using household characteristics and trip data.

The second step was performed on the basis of this general framework potential and applied the subsequent constraint of economic profitability for these potential buyers to replace their conventional vehicle, which mainly depends on the driven annual mileage. Furthermore the competition of PHEVs and BEVs was integrated as the modelled potential customers select the most profitable option.

Nevertheless, the realized car purchases are assumed to be significantly lower than the economic potential figured out here because of two key factors: First, the model assumed that all available cars can also be bought as a PHEV and BEV version. Second, “soft factors” like user acceptance, technology scepticism and adaptation as well as development delays or R&D profitability issues in industry are not considered. Modelling these elements would be subject to large uncertainties. However, since policy and tax design mainly influence the economic potential, they strongly benefit of the derived results. Fig. 1 shows an overview of the described potentials and the constraint methodology.

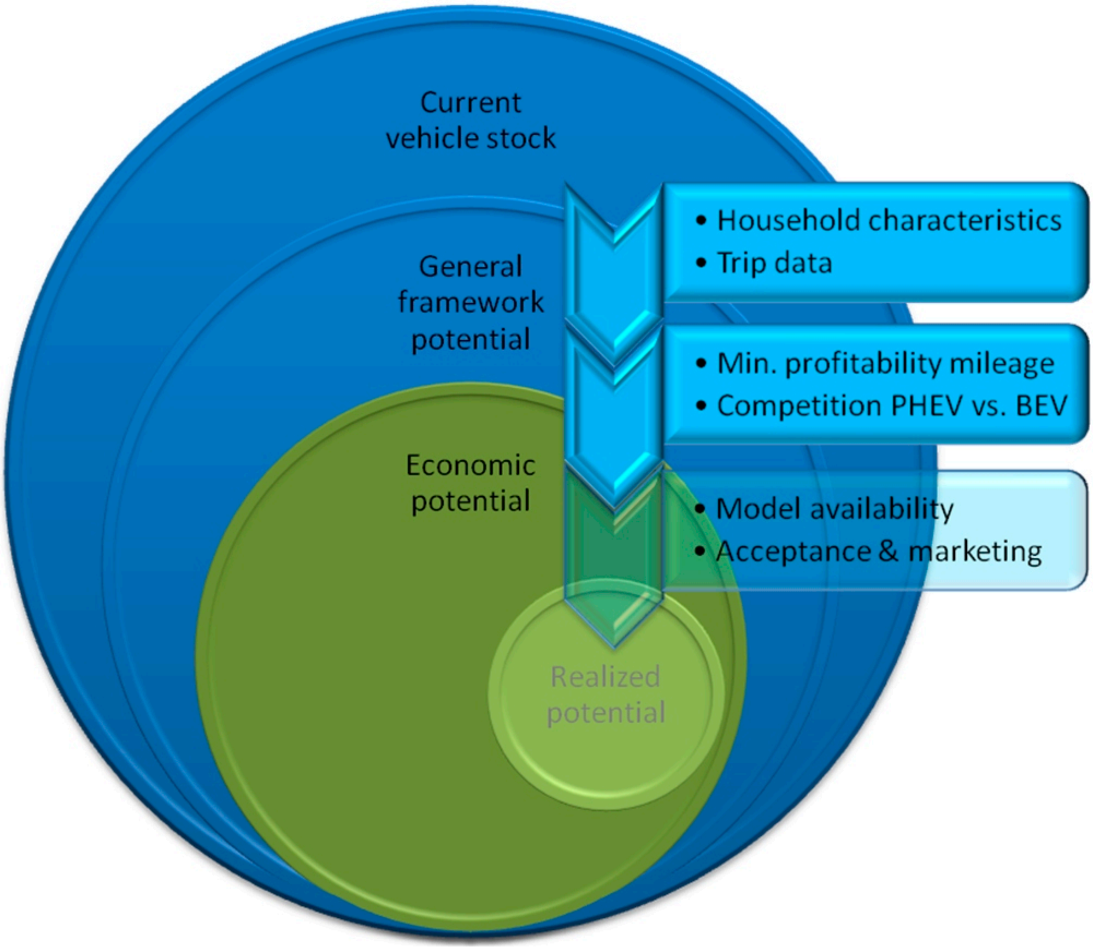

Fig. 1: Procedure to determine the EV market potential

3.2. Data basis

In the model the authors assumed constant sales figures and vehicle category distributions based on the sales and inventory data of the German KBA (Kraftfahrtbundesamt, Federal Motor Transport Authority) as of 01/01/2009[1]. Since the 2009 sales data were subject to heavy changes from the scrapping premiums of the German stimulus package, the authors used for modelling purposes the values of 2008 shown in Tab. 1, which were assumed remaining constant on these levels in the future.

	Sales 2008	Vehicle Stock 2008
Private passenger cars	1.356.528	37.168.026
Company cars	1.733.512	4.153.145
Total	3.308.415	43.123.728

Tab. 1: Total car sales and stock in Germany 2008

The analysis was separately performed for three ownership segments due to their different usages and financing model: private passenger cars and business passenger cars with and without private usage. Subsequent research will also include light commercial vehicles.

The data basis for the car fleet structure was derived from the two comprehensive studies “Mobiliät in Deutschland” 2008 (MiD)[2] for the private passenger cars and “Kraftfahrzeugverkehr in Deutschland” 2002 (KiD)[3] for the business cars. Some key elements of these surveys are shown in Tab. 2.

	KiD	MiD
Type of survey	National Travel survey	National Travel survey
Enquiry period	2001/2002	2008
Object of investigation	Vehicles	Households
Sample size	~77,000 vehicles	~26,000 households
Day-trips	~119,000	~193,000
Focus	Commercial transport	Private transport
Traffic modes investigated	Individual motorized traffic	Public and individual motorized and non-motorized traffic
Vehicle size classification	By kerb weight	Predefined classes (S/M/L)
Additional information used for market modelling	Availability for private usage	Parking site, general travel behaviour

Tab. 2: Characteristics of datasets used for modelling

MiD 2008 is the current successor of the “Continuous Survey on Travel Behaviour” (KONTIV) carried out in the former West Germany in 1976, 1982 and 1989 by the Ministry for Transport and the following MiD 2002. The main task of MiD is to compile representative and reliable information on the social demography of individuals and households and on their daily travel behaviour (e.g. trips made according to purpose and means of transportation used) for an entire year. Once it has been weighted and expanded, the information serves as a framework for and supplement to other travel surveys, such as traffic surveys in individual cities, cross-sectional censuses of traffic loads and the mobility panel. MiD also provides up-to-date data on important variables that influence mobility (e.g. number of driver's licences) and will be the basis for transport models. The results of the study are not only important for transport planning, research and academic interest; they also provide quantitative background information for concrete political decision-making.

KiD was conducted in 2001 and 2002 and put a focus on commercial vehicles, i.e. the craft is registered by industry. By doing so, the KiD 2002[a] is the first nationwide data available to access the characteristics and travel patterns of commercial motorized vehicles, including motorbikes, passenger cars as well as light commercial vehicles and heavy duty trucks. The questionnaire of KiD 2002 which mainly appears as a driver's log addresses the keeper of a vehicle and records a one day activity of the surveyed vessel, e.g. time of departure, destination and purpose of the trip. In addition to those data detailed information of KBA about every vehicle were added, e.g. kerb weight and fuel type. The KiD 2002 comprises almost 77,000 vehicles and nearly 119,000 trips (cf. Tab. 2). That sample is representative to the whole German market in 2002. Thus KiD 2002 is a favourable source to analyse the market's development towards electric mobility regarding the commercial transport. For consistent modelling purposes KiD 2002 data (readmissions and annual distance driven per vehicle) were recalculated to make sure that MiD and KiD are using the same starting point.

According to the MiD approach passenger cars were divided into three classes (small, medium, large). In contrast to MiD where the vehicle class is available in the data, KiD vehicles have been distinguished by their kerb weight for category analysis. The weight classes have been deduced from European statistics[4]. Furthermore a distribution between diesel and gasoline was applied using KBA data as described above. Hence, for modelling purposes the authors used 36 categories and 4 time periods to represent a disaggregated approach to analyse the market's development towards electric mobility. The modelling scheme is depicted in Fig. 2.

[a] The successor of KiD 2002, KiD 2010, is conducted currently but data will not be available before spring 2011.

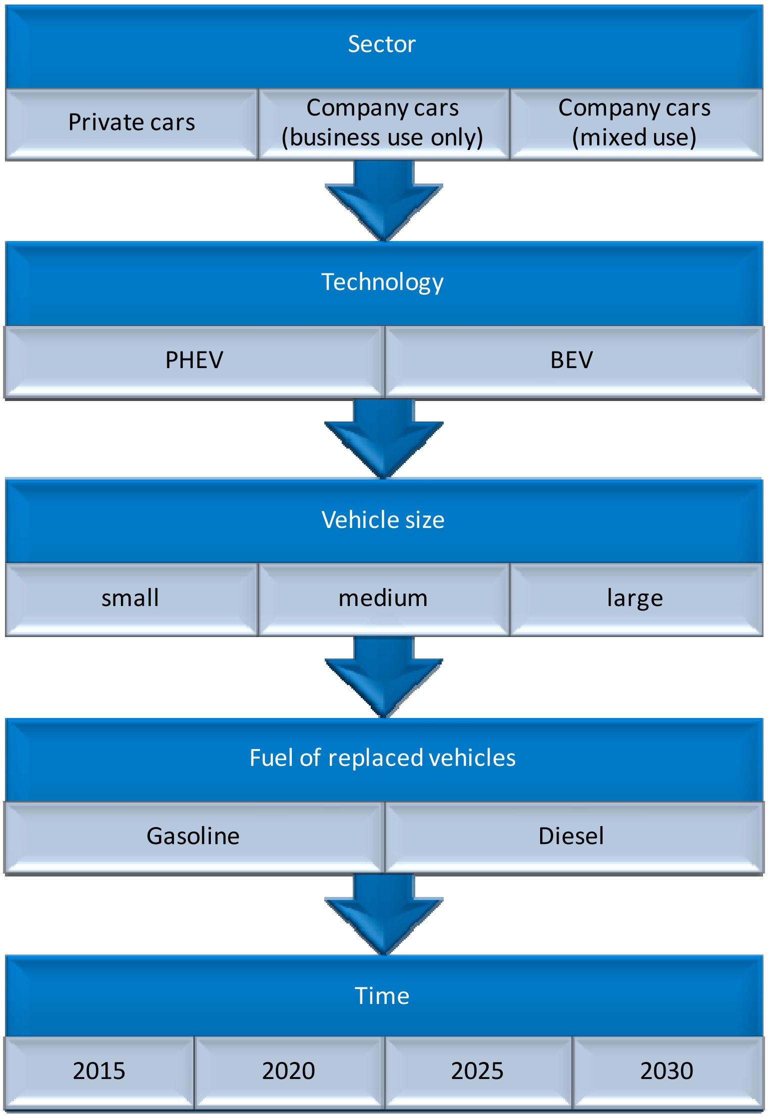

Fig. 2: Modelling scheme and disaggregation of vehicle stock

3.3. General framework potential

The general framework condition for private cars comprises of some principle preconditions regarding parking space availability, the number of cars in the prospective household and its travel behaviour as well as the maximum daily trip length of its current car. Until 2020 the restrictions for private car buyers are numerous: The car must be parked on site and in case of a BEV it cannot be the only vehicle if more than two persons live in the household. Furthermore the household's long-distance travel behaviour can only limitedly be performed by car if this car would be all-electric.

For company cars the only constraint for EV usage is the total daily trip length, this is mainly due to data availability but also applicability of household criteria for the commercial sector. To represent increasing infrastructure availability and faster recharge technologies, a rise of the trip length over time was implemented. Tab. 3 gives an overview of the criteria of the general framework potential.

The described constraints lead to a general framework potential which represents the theoretical usability and can be seen as an absolute upper limit.

		2015	2020	2025	2030
Parking distance	BEV	on-site	close to site	close to site	-
	PHEV				
Cars in household	BEV	household size > 2 → min. 2 cars	-	-	-
	PHEV	-	-	-	-
Long-distance travel by car[b]	BEV	Max. 100km if number of cars in household <2	Max. 150km if number of cars in household <2	Max. 200km if number of cars in household <2	Max. 250km if number of cars in household <2
	PHEV	-	-	-	-
Max. daily trip length[c]	BEV	small: ≤100 km	small: ≤200 km	small: ≤225 km	small: ≤250 km
		medium: ≤150 km	medium: ≤300 km	medium: ≤337.5 km	medium: ≤375 km
		large: ≤300 km	large: ≤600 km	large: ≤675 km	large: ≤750 km
	PHEV	-	-	-	-

Tab. 3: Filter for potential PHEV and BEV customers

3.4. Economic potential

Based on the general framework potential a crucial constraint was applied: The economic profitability for these potential customers for the replacement of the currently used conventional vehicle by a PHEV or BEV.

Therefore, the second step was to compute the net present value (NPV) of the electric versions' extra investment for the whole car holding period. Since all variable cost elements depend on the annually driven kilometres, the minimum driven kilometres to achieve NPV=0 was seen as the profitability limit. The series of cash flows consists of the following values:

1. The initial investment for the PHEV/ BEV surcharge compared to a conventional vehicle: This value integrates all incentives and discounts as well as an assumed ecologic willingness-to-pay.
2. Variable annual cash flows through consumption savings: This value depends on the scenario's fuel and electricity cost evolution as well as on assumptions for the specific energy consumption of the cars. However, the most important input for the cash flows are the annually driven kilometres.
3. Fix annual cash flows from tax differences: Here, the current and assumed future tax legislation is modelled. This integrates CO2 limits, displacement differences between PHEV and conventional engines as well as possible flat taxes for BEVs which cannot be taxed by engine displacement. Since a high share of new cars in Germany is sold to companies[1],[5],[6], two special conditions are taken into consideration: For all company-owned vehicles all affected values are calculated without their respective

[b] Within the MiD the interviewees had to state their last three private travels. It is assumed that households with only one car who travel more often and longer distances by car would not choose a BEV which has a restricted range. The MiD Long distance travels by car mean private travels

[c] In case of company cars, trip length is the only applicable constraint.

value added taxes. Furthermore the German company car tax is integrated (see below).

4. Fix annual revenues from “Vehicle to Grid” power sales.
5. In the last period the resale value of the electric drive train is considered due to its special depreciation over holding period and usage[7]. This value depends on the assumed holding period and the total driven kilometres and is expected being floored at a residual material value, especially of the battery. This calculation will be explained below in more detail.

The respective necessary yearly kilometres to reach profitability for each segment, vehicle category and concurring conventional engine was calculated in the model for all time steps and applied as an additional filter to the above mentioned maximum potential. Thus, all potential customers derived from the datasets would achieve profitability of their investment due to their driven mileage. In case of households or companies being potential customers for both PHEVs and BEVs the more profitable option (with less necessary annual mileage) was chosen in order to avoid double count.

Major assumptions

A number of key figures had to be set for the model calculation. They are derived from literature as illustrated in the following paragraphs.

The surcharges for PHEVs and BEVs compared to conventional vehicles are directly influenced by the price per kWh of battery capacity as it forms the most expensive part of the drive train. From multiple sources[7]-[14] average prices for the battery in mass production are assumed as shown in Tab. 4.

	2015	2020	2025	2030
€ / kWh	409	300	250	211

Tab. 4: Battery price for both PHEV and BEV technology

The electric range of the respective vehicles is another central input factor. Based on OEM announcements the authors assumed the values shown in Tab. 5. Ranges differ between the vehicle size categories according to common expectations of consumer. It was assumed that ranges stay constant in the future since lower prices resulting from an increasing efficiency are supposed to attract more customers than increased ranges at constant purchase prices.

Category	Electric range [km]
PHEV small	50
PHEV medium	60
PHEV large	70
BEV small	100
BEV medium	175
BEV large	250

Tab. 5: Electric range of modelled PHEVs and BEVs

Surcharges for electric cars include electric drive train cost[14] and battery costs according to the energy demand. Moreover, two aspects are considered: First, a fix 800 € was included for charging infrastructure[14]. Second, a general discount was implemented on the final price to represent ecologic willingness-to-pay. From literature on consumer behaviour when selecting a green electricity provider[15]-[19] a conservative surcharge value of 7 % has been derived.

Surcharge in €		2015	2020	2025	2030
PHEV vs. Gasoline	small	5,739	4,675	4,169	3,782
	medium	8,365	6,706	5,916	5,311
	large	11,954	9,422	8,217	7,295
PHEV vs. Diesel	small	4,817	3,753	3,247	2,859
	medium	7,047	5,388	4,598	3,994
	large	10,241	7,709	6,504	5,582
BEV vs. Gasoline	small	6,275	4,573	3,763	3,143
	medium	14,437	10,342	8,393	6,901
	large	25,932	18,486	14,942	12,230
BEV vs. Diesel	small	5,523	3,821	3,011	2,391
	medium	13,362	9,267	7,318	5,826
	large	24,535	17,089	13,545	10,832

Tab. 6: Surcharges of PHEV/BEV versions on vehicle prices

The values of the electric drive train components were assumed to depreciate faster than the ones of the conventional car parts and also more correlated to the driven mileage[20]. Based on OEM announcements on durability and warranty issues, the following depreciation formula was assumed:

Depreciation_E_Parts = 20 + 5 / year + 0.4 / 1,000km [%]

As it will be demonstrated in the results section of this paper, revenues from V2G can be a crucial element for EV profitability. Concrete values largely vary in literature, but there is visible consensus about proportionality to the battery size[21]-[23]. Based mainly on expected off-peak recharge savings, the values depicted in Tab. 7 were assumed with a linear growth over time. Since they remain rough estimations and no detailed V2G calculations, regulations and announcements are available, the sensitivity of these values will be discussed further below.

Technology	Size	Battery kWh approx.	V2G €/a 2015	V2G €/a 2020	V2G €/a 2025	V2G €/a 2030
PHEV	small	10	40	60	80	100
	medium	15	60	90	120	150
	large	25	100	150	200	250
BEV	small	15	60	90	120	150
	medium	40	160	240	320	400
	large	70	280	420	560	700

Tab. 7: Assumed V2G revenues in different time periods

Since an important share of new car sales in Germany is marketed in terms of leasing towards commercial owners as an incentive for their employees[6], it was assumed as a simplification that all such mixed business/private passenger cars are leased[d]. Furthermore, these vehicles were all supposed to allow private usage and their drivers must pay the German corporate car tax. Based on a market review over the largest German car leasing companies the following contract conditions were integrated in the calculation:

[d] But it is strongly represented in data, especially in KiD 2002 where this sole category shows a mean holding period of three years, which is fiscally almost only possible in terms of leasing.

- Leasing factor (monthly rate as percentage of list price): 1.3 %
- *Mileage_accounting = (20,000 – yearly_km) * list_price / 90,000 [€/year]*

In addition, private use of corporate cars in Germany is subject to income tax based on a fringe-benefit of monthly 1 % of the car's list price plus 0.03 % of the distance between home and workplace[24]. For the tax calculations an average income tax rate of 20.9 %[25] was used and an average way to work of 15 km. To compensate the share of such cars not being leased, all company cars with business use only were in turn assumed to be purchased.

4. Results

The model described in Chapter 3 was used to first calculate the general framework potential of EVs based on the travel surveys (see 4.1). Second, four different scenarios regarding the economic market potential for the period from 2015 to 2030 have been computed:

4.2. A "base" scenario of EV sales potentials under current policy assumptions

4.3. A "bonus" scenario of EV sales potentials in 2015 under different bonus payments

4.4. A "company car tax" scenario of EV sales potential under modified company car taxation

4.5. A "NoV2G" scenario of EV sales potential without any V2G revenues.

4.1. Framework potential result

The maximum yearly potential for electric powered vehicles regarding only the general framework limitations shown in chapter 3.3 are summarised in Tab. 8. The general framework potentials of PHEVs and BEVs may not be regarded independently but rather with BEVs being a competitive subset of the PHEV potential.

Hence, it can be observed that from beginning 2015 around 60 % of the German new car sales could theoretically be EVs when not regarding economic issues and assuming the availability of an EV version for every car. It is striking that the highest rise in EV potentials is between 2015 and 2020 with especially medium-sized BEVs almost doubling. Afterwards only slight additional potentials enlarge the market. This is mainly due to the loosened parking and travel restrictions and the fact that BEVs are assumed to be able to fully replace conventional cars in terms of usability.

With the exception of BEVs in 2015, company cars show very constant shares of the respective sectors' potentials. Within these company cars, unvarying three quarters are used for both business and private trips. These figures highlight the equal distribution of the framework potential development.

Technology		Size	2015	2020	2025	2030
EV potential (BEV + PHEV)		small	424,917	550,110	550,110	550,959
		medium	865,235	993,892	993,892	997,465
		large	565,951	565,951	565,951	571,193
		total	**1,856,103**	**2,109,953**	**2,109,953**	**2,119,617**
Share of company cars			49 %	44 %	44 %	43 %
- thereof mixed usage			74 %	74 %	74 %	74 %
	BEV only	small	276,456	343,236	344,786	349,409
		medium	332,810	646,118	648,548	658,855
		large	356,392	380,421	386,230	388,995
		total	**965,658**	**1,369,775**	**1,379,564**	**1,397,259**
	Share of company cars		77 %	61 %	61 %	60 %
	- thereof mixed usage		75 %	75 %	75 %	75 %

Tab. 8: General framework potential of the modelled EV categories

The framework potential underlines the high share of cars with short trip lengths and suitable characteristics for electric mobility within the current German vehicle stock.

Nevertheless, integrating the economic constraints will reduce these sales potentials significantly since short trip length and limited usage of the identified conventional cars to be replaced also influences the minimum annual driven mileage necessary for the profitability of the electric vehicles. Therefore, in the scenarios the economic potential has been calculated based on these general framework results.

4.2. Economic potential

4.2.1. Base Scenario

From the general framework potential the share being profitable for the respective customer was calculated for PHEVs and BEVs. Initially, a base case scenario was calculated assuming the continuation of the current regulations without any changes. The results are depicted in Tab. 9 and Fig. 3.

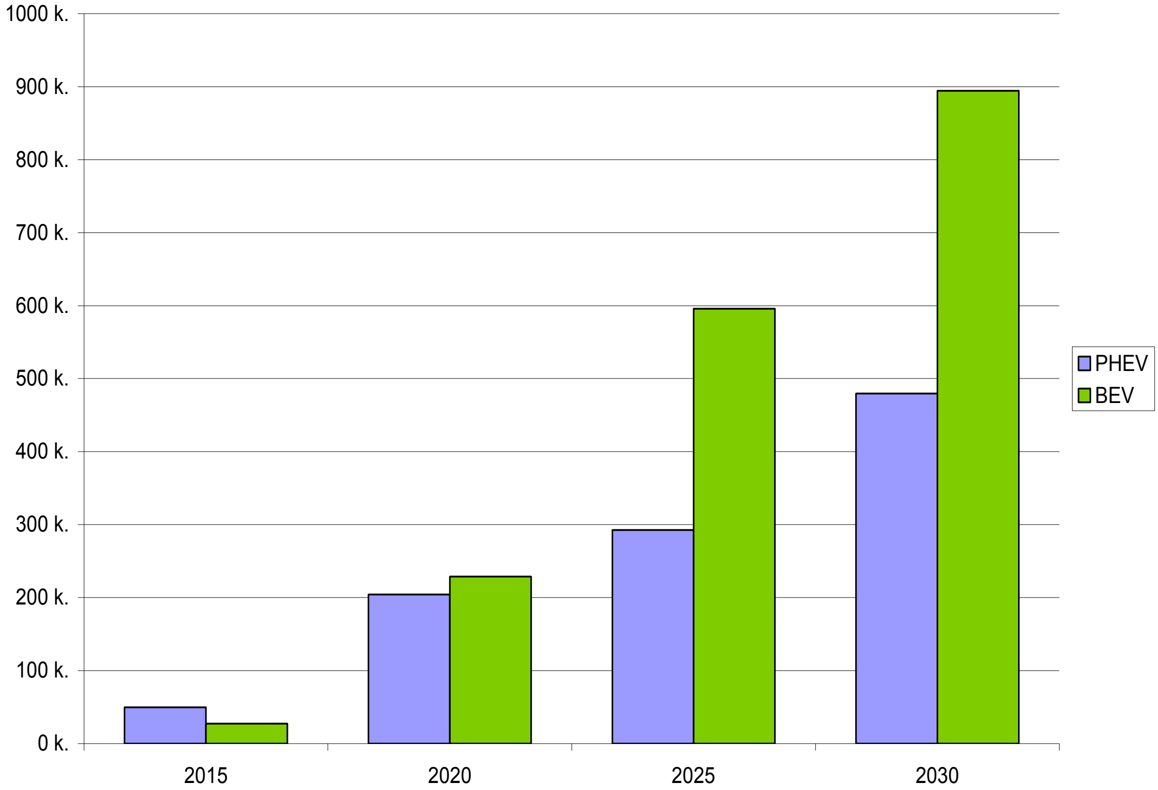

Fig. 3: Electric vehicle potential in the “base scenario”

The base scenario shows a strong development for both PHEV and BEV markets. PHEV registrations are higher than BEV until 2020, then increasing BEV market growth rates result in a higher BEV share until a final maximum sales potential of over 900,000 BEVs and about 500,000 PHEVs is reached in 2030. This is particularly interesting because the framework potential for BEVs remains significantly below the one for PHEVs (see above) but economic motivations lead to substitution.

Technology	Size	2015	2020	2025	2030
PHEV	small	2,405	3,848	11,826	59,630
	medium	41,860	121,828	94,540	138,710
	large	5,419	78,821	186,476	281,313
	total	**49,684**	**204,496**	**292,842**	**479,654**
Share of company cars		94 %	66 %	48 %	32 %
- thereof mixed usage		99 %	87 %	75 %	69 %
BEV	small	27,300	195,944	258,427	304,668
	medium	0	33,109	337,582	529,666
	large	0	0	0	60,166
	total	**27,300**	**229,053**	**596,009**	**894,501**
Share of company cars		53 %	73 %	77 %	78 %
- thereof mixed usage		45 %	41 %	42 %	43 %

Tab. 9: Electric vehicle potential in the base scenario

There are several other striking observations in the development of the PHEV and BEV potential:

First, the competition between the two EV types is mainly decided by vehicle size – small electric vehicles are mostly BEVs while large ones are mostly PHEVs. Profitable medium-sized EVs are expected to be almost only PHEVs until 2020. Afterwards, this market is dominated by the extreme profitability increase for BEVs, even leading to a slight temporary reduction in the concurrent medium-sized PHEV sales potential in 2025.

Second, company cars play a special role in the sales potentials, mainly in earlier periods until 2020. Most sectors and periods with strong market growth show a high share of company cars, in many cases higher than in the general framework potential. This is not due to prior profitability (i.e. at low mileages) – the calculated minimum annual mileage for company cars lies higher than for private cars. But the reason for the high company car sales potentials (especially for early PHEVs) lies in their generally higher driven mileage, amortizing even cars which are unprofitable for private customers.

Third, it can be observed that a high share of company cars goes along with a high share of mixed business-private usage within them. Since this sector is subject to the most unattractive regulation of the three investigated categories towards high-investment, high-efficiency vehicles, the reasons for such high potentials lie in their market shares and their high annual driven mileages. The effect of company car taxation will be further discussed in the respective scenario (see 4.2.3) below.

It has to be recalled that the result should not be seen as a forecast for vehicle sales, but as a maximum market size in case of full model availability (every car model replaceable by corresponding PHEV/ BEV version) and user acceptance.

4.2.2. Bonus Scenario

Currently many countries are planning or have already decided to support the purchase of electric vehicles with a bonus payment. Such bonus only influences directly the sales period where it is paid (regardless possible effects like mass production enablement or employment creation which is beyond the model’s scope). Regarding current announcements this period will be rather early. Thus, the bonus scenarios depicted in Fig. 4 show the impact of federal bonus payments to lower the surcharges of EVs in the model's first year, 2015. Five bonus arrangements have been calculated: Both PHEV and BEV buyers receiving 1,000, 2,000 or 4,000 € as well as receiving a split bonus of 1,000 or 2,000 € for PHEVs and 2,000 or 4,000 € for BEVs. It is illustrated how the two markets react to the payments and at which point substitution between them takes place only because of the bonus.

A bonus of 1,000 € would more than double both EV markets, while 2,000 € would have a stronger relative effect on BEVs (again more than +100%). Another doubling of the bonus to 4,000 € would have a decreasing impact on BEVs if only raised for them (less than +100%). If 4,000 € are paid for all EV with more than 50 km electric range (and therefore all PHEVs and BEVs), the PHEV market would grow by +1,300 % (which is still below the framework potential) and first substitutions of BEV candidates can be observed.

Concluding the results of the bonus scenario, a wise design of the bonus payments is needed to promote the new electric cars effectively.

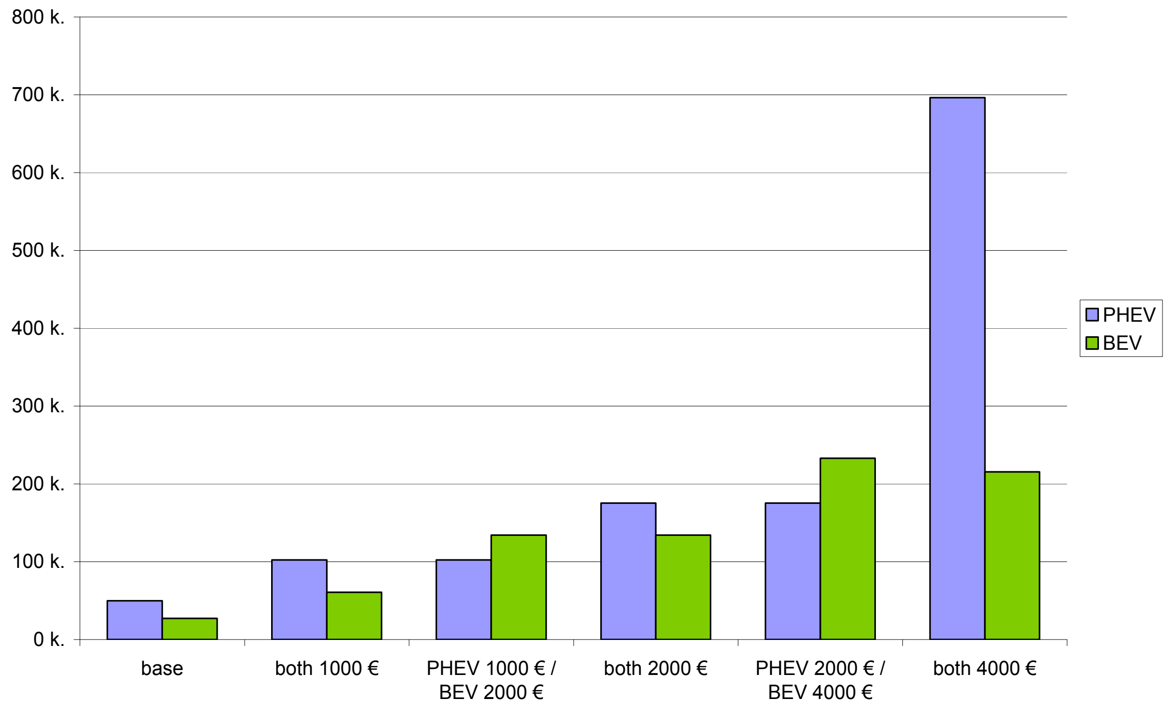

Fig. 4: Sales potential sensitivity for bonus payments in 2015

4.2.3. Company Car Tax Scenario

Another policy option can be seen in the restructuring of the company car tax. Originally aiming to allow employees the private use of their corporate car (often used as an incentive instead of higher salary), its current design may actually hinder them in ordering more expensive but fuel-efficient cars: While the employee's monthly car fringe-benefit subjected to taxing is directly proportional to the car's list price (and the employees income tax rate), the fuel expenses are paid by the employer and can therefore be seen like tax-free salary. Furthermore, the employer can deduct the value added tax on fuel expenses[5].

To model a more eco-investment-friendly alternative, the scenario "New corporate car tax" assumes that the current corporate car tax is dropped entirely. In the same time employees benefiting of private usage of their corporate car must pay all fuel expenses on their own and including all fuel taxes. Mixed use corporate cars are therefore treated like private cars (even though paid by the company) and their usage for business trips is to be billed separately between the employee and the company.

The results of this scenario are shown in Fig. 5. It can be seen that all periods and categories are influenced positively. Especially PHEVs in early time steps are increasing very largely because of their high yield of fuel savings per investment and the generally high share of these mixed-use company cars in this segment and time (as could already be observed in the base scenario). This underlines how the new annual cost structures incite the purchase of fuel-efficient and therefore electrified vehicles.

In a first estimation, the total tax difference (decreased tax receipts from fringe-benefits vs. increased state revenues from fuel taxes) would sum up to cumulative losses for the state of 1.14 billion € until 2030 if every economically potential EV is bought.

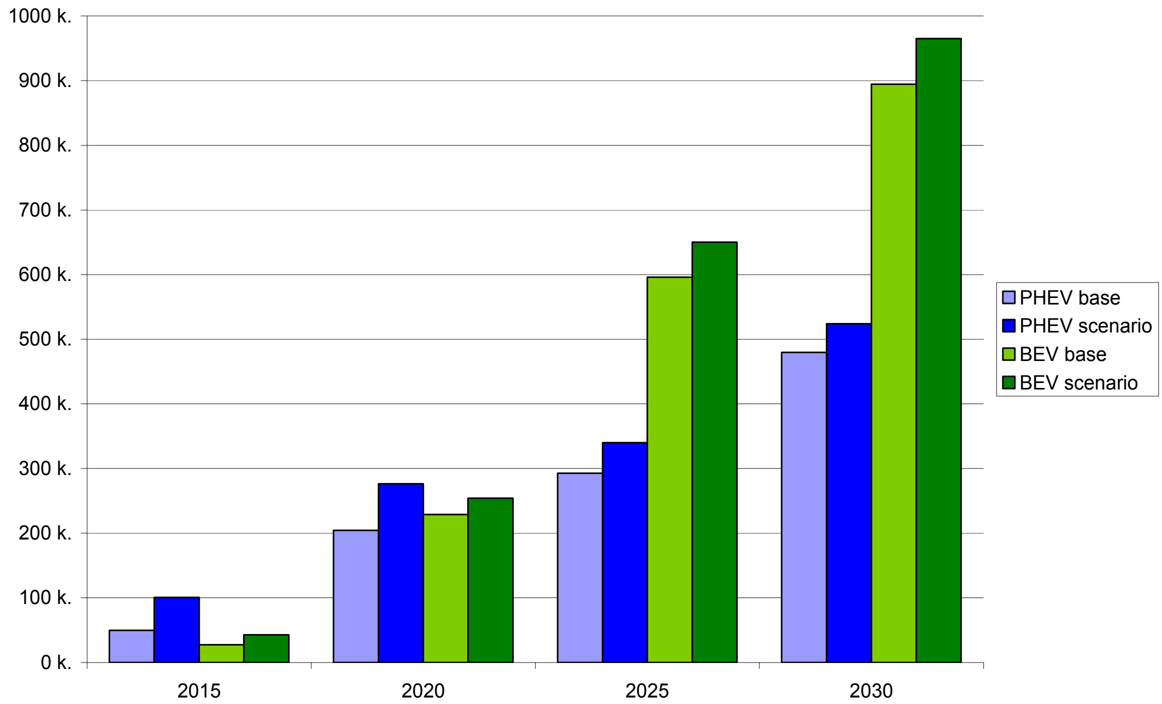

Fig. 5: Electric vehicle potential in the “company car tax scenario”

4.2.4. NoV2G Scenario

As discussed above, V2G revenues are an important source of profitability for the investment in PHEV or BEV. Since many factors affecting the development of the monetary reward trough V2G to customers depend on policy (for example regulation of grid access and parking, feed-in tariffs and infrastructure investments), it may be helpful to analyze the situation without any V2G revenues as a comparison. Results of the scenario calculation can be found in Fig. 6.

It shows strong reductions of the market potentials in general. The cut is especially large for BEVs where only half of the market size remains without V2G. PHEVs are less affected since their smaller batteries allow smaller revenue potentials. Additionally they may be substitutes for BEV vehicles not being profitable without V2G. This effect can be observed in 2025, when the PHEV potential even rises despite the generally lowered EV profitability.

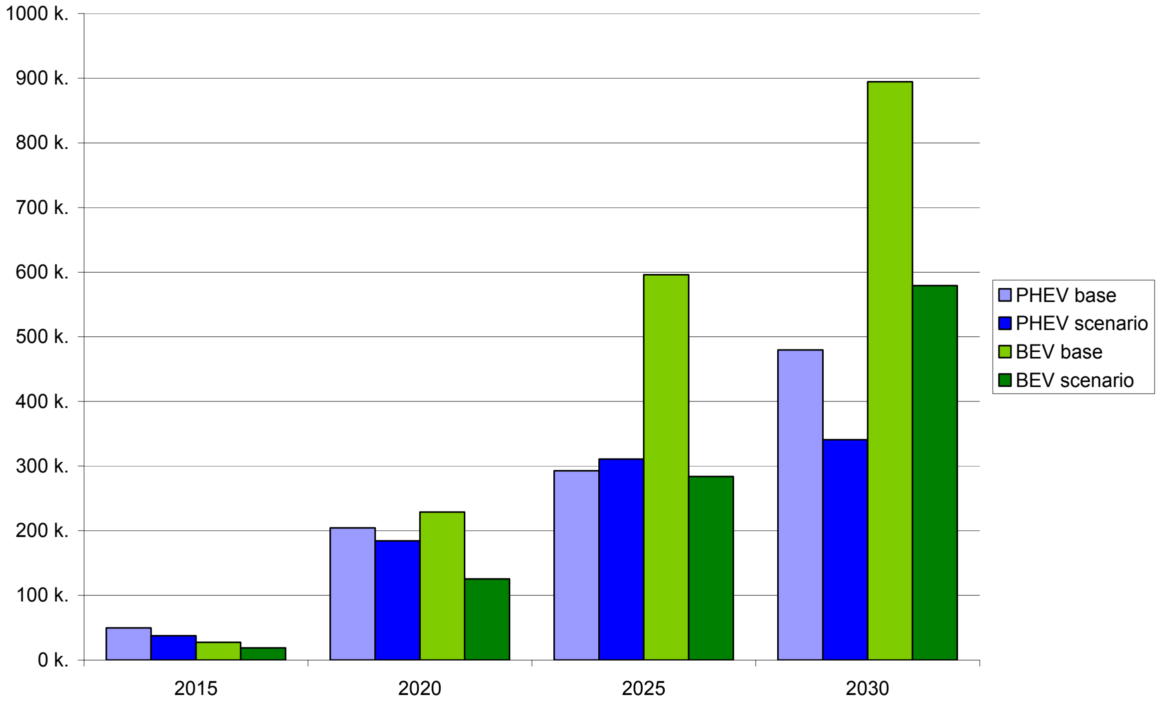

Fig. 6: Electric vehicle potential in the “NoV2G scenario”

5. Conclusion and Outlook

The sales potential for electric drive trains in Germany is not only restricted by infrastructural and technical constraints but also strongly by the economic conditions for the prospective customers.

The results for the base scenario clearly show a growing potential for market diffusion for both PHEV and BEV until 2030. Nevertheless additional policy measures are needed to reduce the actual economic drawbacks of EVs. These measures may consider the important differences between private and company cars to promote electric mobility equally towards all actors.

The model results show intensive changes in the economic potential especially for three scenarios: A bonus paid on EVs can accelerate market entry of such vehicles in general, a redesigned corporate car tax could encourage employees to choose more fuel-efficient vehicles, and a scenario without V2G revenues depicts a very strong market cut particularly for BEVs.

From the scenario analysis the PHEV and BEV markets turned out to interact strongly with each other. Hence, policy measures targeting only one market will have certain influence on the other one as well.

Policies to drive EVs to the market may consider these results to design optimally combined solutions of inciting with bonuses, new taxing approaches and ensuring V2G payments. However, there is further need for research as the actual realized share of the potential also depends on EV acceptance and actual user behaviour. Therefore, fleet tests and surveys are crucial to understand the demand side – in order to encourage the supply side to develop a suitable model range of electric cars and to assemble them in a sufficient amount.

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