WORKING PAPER 21

PROJECTING INTERNATIONAL PLUG-IN ELECTRIC VEHICLE ADOPTION: IS THE RECENT PAST A PROLOGUE FOR THE FUTURE?

GLOBAL FUEL ECONOMY INITIATIVE

FOR ZERO CARBON VEHICLES BY 2050

UC DAVIS

INSTITUTE OF TRANSPORTATION STUDIES

Projecting international plug-in electric vehicle adoption: is the recent past a prologue for the future?

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Summary

The potential future growth of electric vehicle sales worldwide is highly uncertain, although it is often assumed it will eventually reach complete market dominance. Some insights into potential futures can be gleaned from examining actual plug-in electric vehicle (PEV) sales to date. We gather sales data from around the world, from 2010 to 2017, including electric and conventional vehicles across the range of light-duty vehicle market classes. We estimate a vehicle choice model for five major vehicle markets worldwide: the United States, China, Germany, France, and the United Kingdom. The choice model is estimated on the basis of actual choices made by buyers (as represented by sales shares), given the range of vehicle makes and models they are presented. The choices they make reflect how they value the different attributes of the vehicles. The values of these attributes are estimated and calibrated to real world data as we match the modeled vehicle shares against observed vehicle sales. Notably, we employ a novel modeling technique that takes into account observed changes in preference for electric vehicles over time—one of the fundamental challenges of choice models which typically presume static attribute values.

We find that, assuming ongoing reductions in battery (and thus vehicle) costs, increases in numbers of available PEV models, and an ongoing trend of increasing interest and “positive impression” of the buying public toward PEVs into the future, there appears to be a good chance that PEV market shares will reach 100 million or more by 2030. In particular, the trends in PEV “technology-specific preferences” are very important in determining future success rates for these technologies. However, our model currently misses key market drivers and policies, and looks only at the demand side; more refinements and supply side (producer behavior) aspects will be added to the model in future research efforts.

Introduction

Light-duty plug-in electric vehicles (PEVs), composing battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), have grown rapidly over the last decade in the global vehicle market, though from a tiny base. While many countries offer significant incentives to consumers of PEVs, such as Norway, which has reached 50% PEV market share LDV sales, the worldwide market share of these vehicles remains below 2% of all passenger vehicles sold. In light of the local pollution and global climate change impacts of internal combustion engine (ICE) vehicles, many governments have turned to electric vehicle technology to curb emissions in the transportation sector. Besides the purchase incentives, policies encouraging the production and adoption of electric vehicles include sales target setting, emissions rate standards such as the US Corporate Average Fuel Economy standards or the EU vehicle CO_2 emission standards; electric vehicle production/sales mandates such as the California Zero Emission Vehicle requirements or China's New Energy Vehicle mandate; bans on internal combustion engine vehicles (entirely or in specified zones); and a host of other policies.

In May 2017, UC Davis prepared a report for GFEI that projected potential electric and plug-in hybrid sales to 2050, with a particular focus on 2030, asking the question "Can we reach 100 million electric vehicles worldwide by 2030?"[1]. To answer this, UC Davis developed a projection tool to relate the factors affecting PEV sales in recent years to their potential changes and impacts on future sales. In sum, we found that reaching high levels of sales and stocks, such as 100 million by 2030, looked challenging, particularly if consumer interest in PEVs does not increase fairly dramatically in the coming years. This report updates that analysis, by adding two more years of data and investigating the trend in a number of PEV sales factors internationally in a deeper way, specifically with a novel approach to control for changes in consumer preferences

[1] GFEI, 2017, Working paper 16: *Can we reach 100 million electric cars worldwide by 2030? A modelling/scenario analysis,* co-authored by Lew Fulton, Alan Jenn and Gil Tal of the Institute of Transportation Studies, University of California, Davis. https://www.globalfueleconomy.org/data-and-research/publications/gfei-working-paper-16

for PEVs over time. It should be noted that since that report, other publications have reached higher projection totals. Notably, the IEA's Global EV Outlook 2019 has a high scenario where plug-in vehicles reach over 200 million in 2030[2].

Like our previous study, this study aims to help policymakers and other stakeholders better understand the future market potential for electric vehicle adoption using existing international sales data for these vehicles. We estimate a vehicle choice model for five major vehicle markets worldwide: the United States, China, Germany, France, and the United Kingdom. The choice model is estimated on the basis of actual choices made by buyers (as represented by sales shares), given the range of vehicle makes and models they are presented with. The choices they make reflect how they value the different attributes of the vehicles. The values of these attributes are estimated and calibrated to real world data as we match the modeled vehicle shares against observed vehicle sales. Notably, we employ a novel modeling technique that takes into account observed changes in preference for electric vehicles over time—one of the fundamental challenges of choice models which typically presume static attribute values. The trends in these "technology-specific preferences" reveal potential future success rates for these technologies. With the statistical model we estimate, we are able to make projections about potential future growth in electric and plug-in hybrid vehicle sales by country.

The following sections cover the data used, recent trends in PEV characteristics and sales, development of our statistical model, and the projections made with that model. The paper concludes with a discussion of these projections, key findings and caveats, and considerations for next steps in the research.

Data Overview and Recent Trends

For the statistical analysis, we employ a large dataset from IHS Markit that contains comprehensive vehicle model registration counts for new vehicles sold in 53 countries from 2005

[2] Global EV Outlook 2019, International Energy Agency, Paris https://www.iea.org/gevo2019/

through 2017 (although data is not available for all countries in all years). For each vehicle model, the data also contains corresponding information on vehicle attributes including the make, body type, trim level, fuel type, engine size, engine power, drive type, transmission, weight, dimensions, fuel consumption/efficiency, price, and several other features. These attributes are critical in calibrating our choice model: we estimate the relative utility of each vehicle attribute to help make predictions in the future for new vehicle models.

The electric vehicle market has been expanding worldwide: in the span of less than a decade since the introduction of the first commercial vehicle model, automakers have sold several million electric vehicles with sales exceeding 1 million annually in 2017 (see Figure 1)[3]. An examination of the year-on-year trends reveals that nearly every country has consistently increased sales of electric vehicles. However, we note that the overall volume of vehicles is still relatively small compared to the sales of traditional gasoline vehicles (which numbers at 75-85 million vehicles per year in the 53 countries of our dataset). In addition, much of the growth is buoyed by China, which has had a faster growth (in absolute number) of electric vehicle sales than all other countries within the past few years. By 2017, Chinese electric vehicles sales exceeded the PEV sales in the rest of the world combined. Whether other countries' PEV markets will benefit from China's explosion of electric vehicles remains to be seen, particularly since many automakers producing electric vehicles are exclusive to China.

[3] GEVO 2019 takes this data trend out one more year and shows that global PEV sales in 2018 were around 2 million.

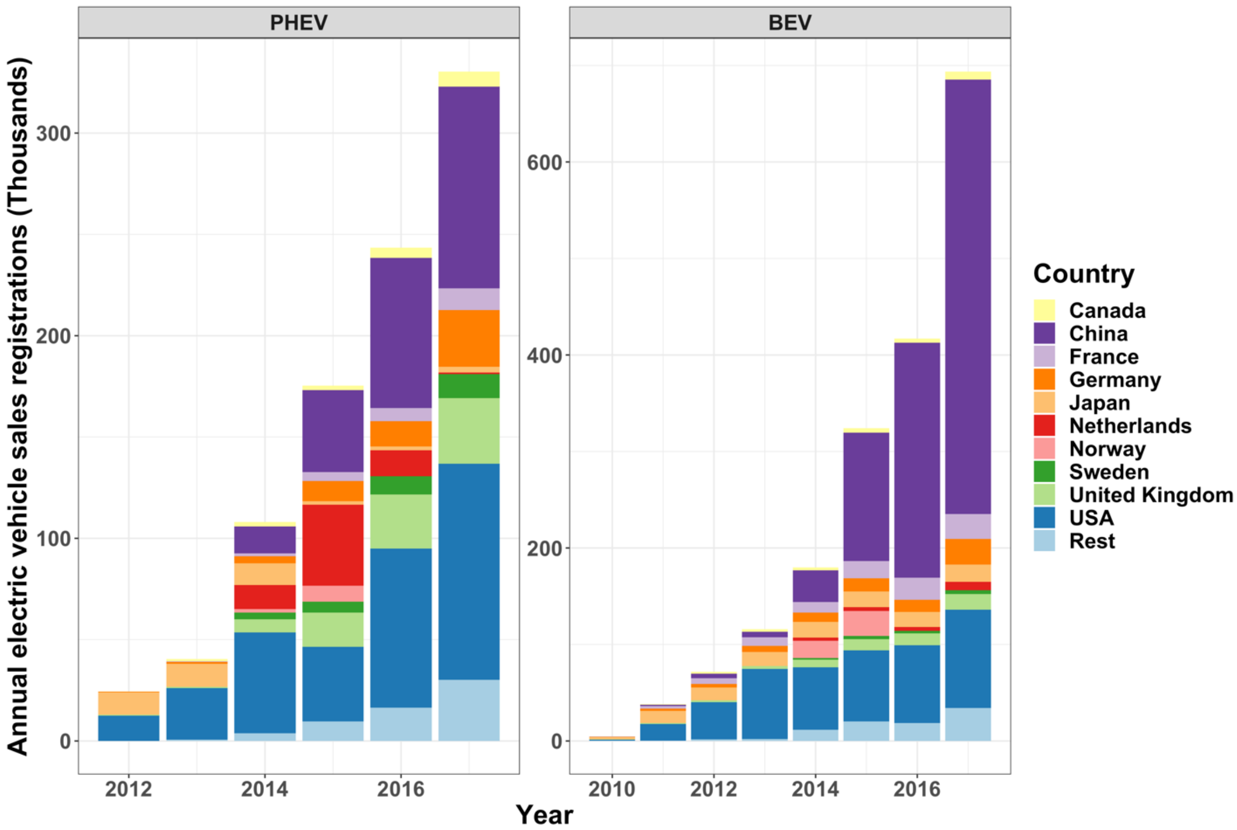

Figure 1: Annual electric vehicle sales (including both BEVs and PHEVs) by country from 2010 through 2017 for 53 countries

Key message: BEVs and PHEVs have both grown steadily and strongly over the decade in most major markets, with China dominating recent years' growth

One of the key aspects for the growth and success of the PEV market is the availability of models in different vehicle classes and segments. The presence of electrification technology in multiple vehicle class sizes opens the door to new segments of the market—and to more consumers' consideration sets. For example, if electric vehicles are only present in models of a small vehicle size which comprises 20% of the market, the remaining 80% of the market remains closed to the new technology. We are able to observe the composition of electric vehicle sales by vehicle segment in **Error! Reference source not found.**. The vehicle classes available for electric vehicles are primarily in smaller class sizes in China and France while in the United States and the United Kingdom, electric vehicles are available in slightly larger segments. None of the countries have noticeable volumes of PEVs sold in popular large vehicle segments such as large/luxury car, Pick-up trucks, Sport Utility Vehicles, and Vans.

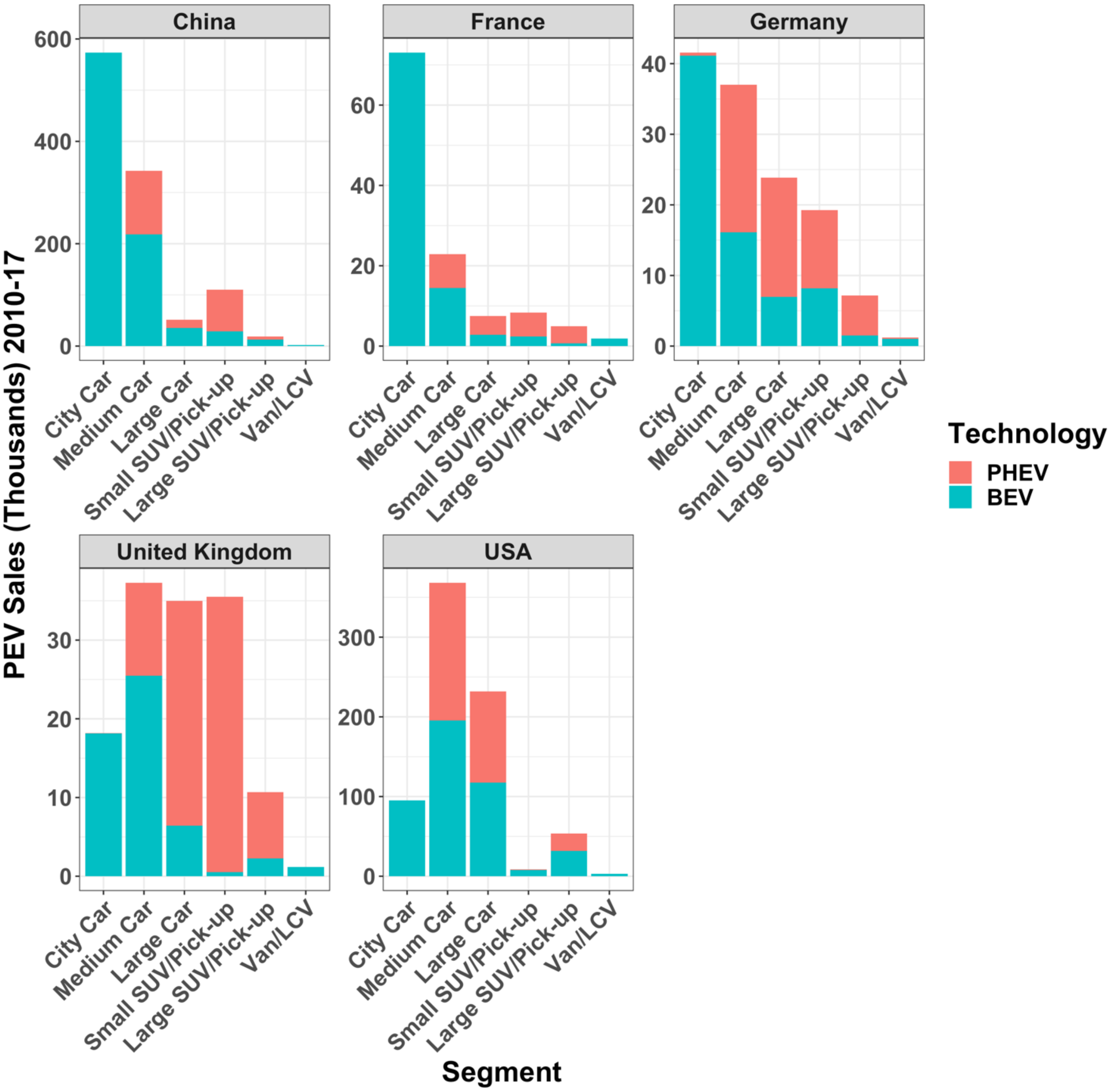

Figure 2: Cumulative electric vehicle sales by segment from 2010 through 2017 by segment and country for five major markets. Note: The segments follow the classification of the Euro NACP.

Key message: while there is a diversity of electric vehicles by segment in different countries, larger segments such as Class E vehicles and Large SUVs/Pick-ups consistently remain low in volume.

However, it should be noted that lower sales of electric vehicles within a segment may simply be following market preference for particular vehicle sizes in a given vehicle market. We therefore provide a comparison of traditional gasoline/diesel vehicles to electric vehicles broken down by vehicle class (Figure 3). As the product matures and becomes more widely available, PEVs should begin to mirror the traditional vehicles in share of segments because the market has been developed long enough to accommodate each population's vehicle class preferences. We are therefore able to identify which vehicle classes are under- and over-represented by electric vehicles in the market. In the United States, small cars are over-represented while small and large SUVs and pick-up trucks are heavily underrepresented[4]. This is similar to France and China, which also have an over-representation of PEVs in the city car category but are both lacking in the medium car and small SUV segments. In contrast, the United Kingdom actually has underrepresentation of smaller segments such as city cars and overrepresentation in SUVs. As electrification continues to expand, these discrepancies will likely converge to the shares seen in the traditional gasoline and diesel vehicle market (and track the differences in ICE sales across countries) as representation of PEV models in other classes improves.

[4] It should be noted that this finding, like all findings in this paper, is based on data for sales through 2017. Changes in sales patterns in 2018 and later years are not reflected here.

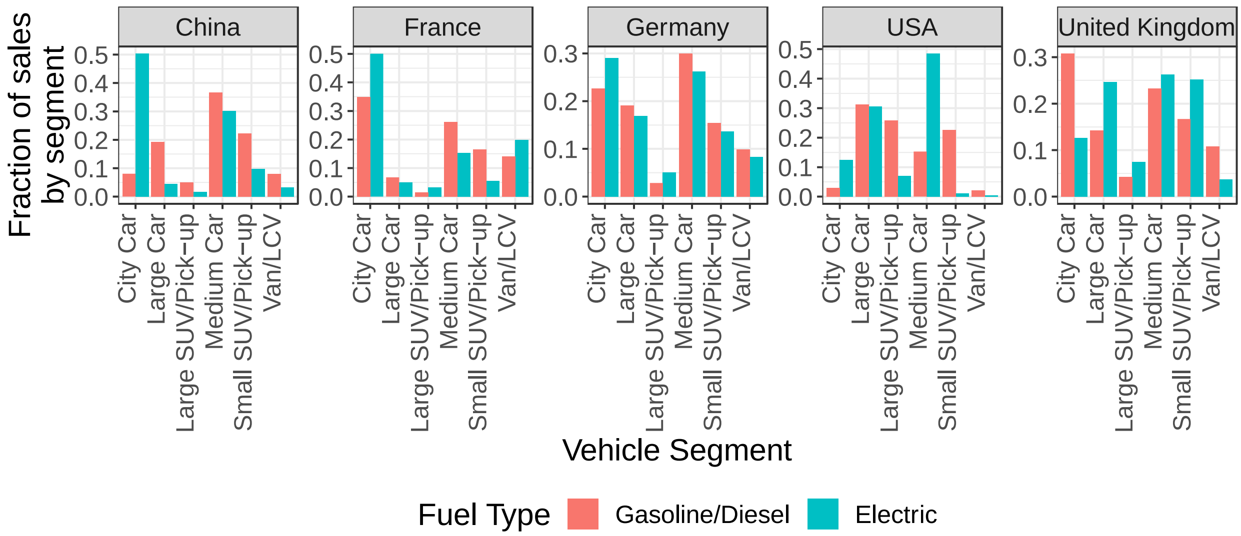

Figure 3: Comparison of market share between gasoline/diesel vehicles and electric vehicles in the five markets examined in this study.

Key message: differences in market composition by segment where gasoline/diesel shares are noticeably higher than electric vehicle shares represent opportunities for adoption in new vehicle classes.

Figure 4 provides insight into the evolution of electric vehicle market segmentation in the five major markets of this study. It is immediately clear that in all markets, the shares of vehicle classes are constantly changing over time, unlike the shares of gasoline and diesel vehicles which are substantially more stable. In many countries, the first PEVs available on the commercial market were relatively smaller segments such as Class A vehicles. As more vehicle models enter the market, we generally observe a decrease in the smaller vehicle segment shares and a corresponding increase in other larger vehicle segments. There are a relatively small number of Class E and large SUV/pick-up vehicles, though introduction of additional vehicle models in those segments will likely lead to rapid growth in a similar manner to previous electric vehicle entrants into the market.

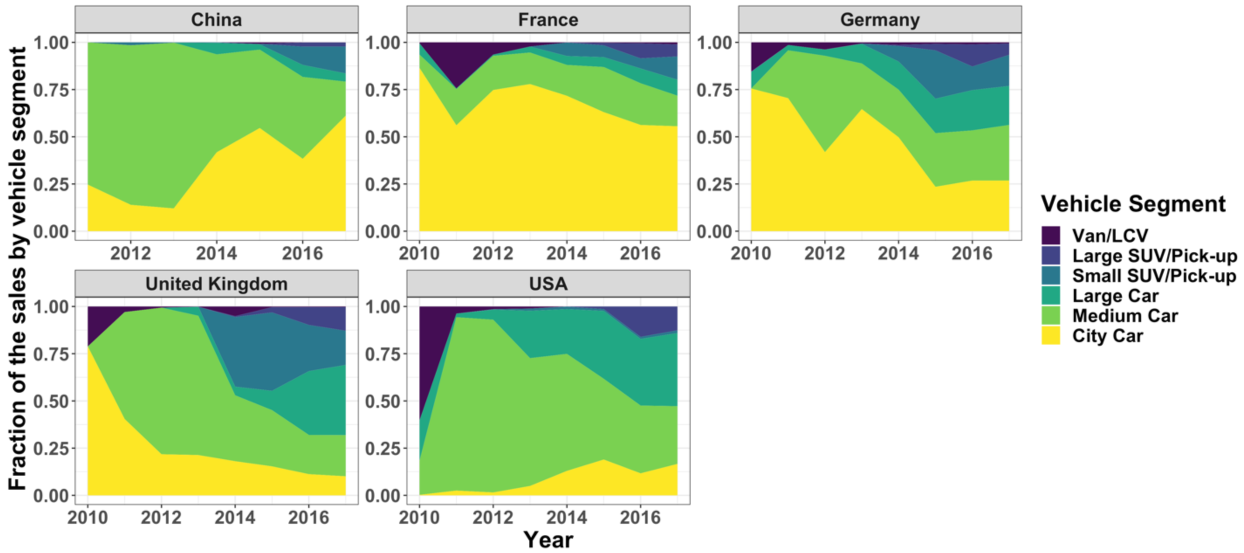

Figure 4: Market share evolution in five major markets of electric vehicle segmentation from 2010 through 2017.

Key message: trends have indicated consistent shrinking in market share of the small vehicle Class A segment and growth in larger vehicle Classes C and D.

Given the importance of the availability across different segments, one of the novel approaches taken in this study is to introduce electric vehicle models in various segments when forecasting future PEV sales.

Discrete Choice Approach and Outcomes

Using the historical data, we develop and estimate a choice model that relates the vehicle shares of each model by attributes associated with that vehicle. Specifically, we estimate a choice model with utility *u* for each vehicle model *i* as follows:

$$u_i = \sum_j \beta_j x_{ij} + \xi_i + \varepsilon_i \qquad (1)$$

Where x_j represent a vector of values for vehicle attributes across a set of *j* vehicle attributes that include the vehicle price, emissions rate, footprint, curb weight, horsepower, make, fuel technology, segment, transmission type, turbo type, and vehicle drive. Additionally, the ξ term represents an alternative specific constant which serves to calibrate each utility function to exactly match observed market shares for every vehicle model post-estimation. The random utility model is estimated using a logistic regression where the probability of a specific vehicle model choice outcome is matched to each vehicle model share.

We separately run the series of choice models for the United States, China, Germany, France, and the United Kingdom each year from 2010 through 2017. We are primarily interested in the relative utility of the fuel technologies corresponding to electric vehicles. In Figure 5, we provide two examples of how the coefficients related to battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) change over time in the United States and in Germany from 2010 through 2017 and 2013 through 2017, respectively. We find a consistent upwards trend in the relative utility of the new technologies, thus indicating that consumers increase their preferences for electric vehicles over time. We find that this same trend in all modeled countries, providing strong evidence that preferences for PEVs do not remain static and are improving over time.

In the United States, from 2010 to 2017, the coefficient levels for BEVs rises from -8 to about -5.5 and the coefficients for PHEVs rise from -5.5 to about -2. In Germany, from 2010 to 2017, the coefficient levels for BEV technology increases from -8 to -4 and from 2013 to 2017, the coefficient levels for PHEV technology increases from -4 to -1.5. While there is some variation in coefficient values for other fuel technologies, the values generally stay constant on average. These results suggest that while preferences for most other fuel technologies (primarily gasoline) are staying relatively constant, consumer preferences are increasing for both BEVs and PHEVs even after controlling for various vehicle attributes such as price, size, brand, and power. These preferences likely relate to the awareness of the population that they are available, and level of interest as a purchase option. The coefficient may also be capturing aspects of the technology that are not captured in the model (driving range, recharge time) or are not related to the vehicle (charging station availability). It also relates to the increasing availability of PEVs, since there are more choices for the technology every year.

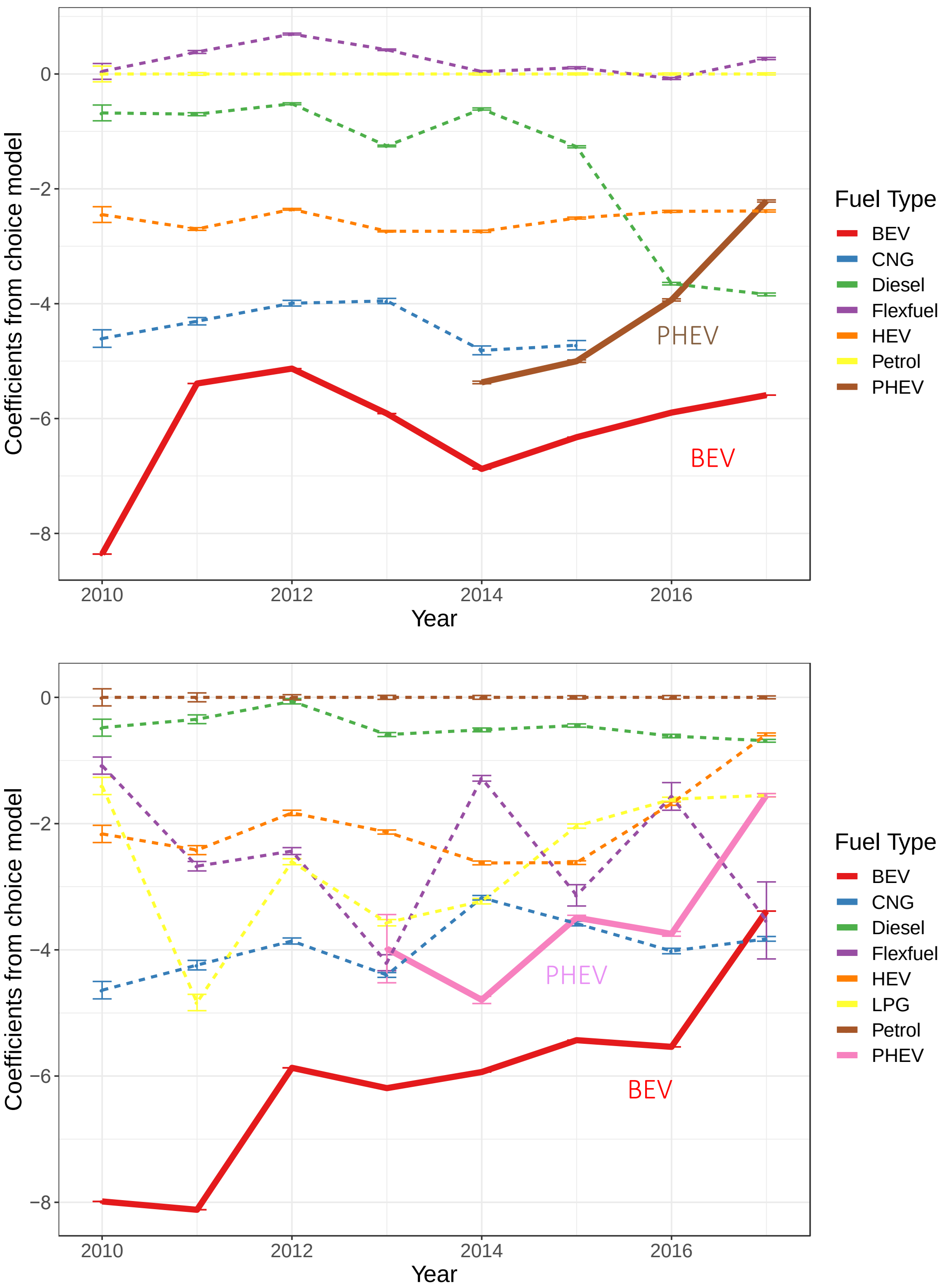

Figure 5: Results from the discrete choice model for the United States (top) and Germany (bottom) estimated with a logistic regression.

Key Message: year-on-year coefficients for vehicle fuel types relative to gasoline (petrol) vehicles in the United States and Germany indicate rising interesting in PEVs.

We employ the results of the discrete choice model in our forecast by predicting the outcome market share variable of each vehicle model in the latest year available for all five countries through 2040. The market shares are altered by 1) making specific assumptions and 2) modifying certain model coefficient values.

New Projections to 2050

Using the estimated model with its vehicle choice coefficients, one can project a range of independent factors into the future to estimate potential sales and market shares for BEVs and PHEVs by country. This is inherently very uncertain, since the factors affecting sales in the past may not look much like factors in the future, and the vehicles themselves may change in ways that are difficult to predict. Nevertheless, the exercise can help increase understanding in how various trends in the vehicles and consumer attitudes could affect sales in the future.

Projection approach

Our forecasts rely on the outcomes of the discrete choice models and for future projections we exogenously modify several aspects of the vehicle market into the future:

1. Fuel technology composition of the vehicle market in terms of available makes and models
2. Electric vehicle prices
3. Relative utility of PEV technology

We discuss each of the assumptions in the remainder of this section. As we project into the future, we alter the composition of the vehicle market by assuming a total number of vehicle makes and models available, and artificially "electrifying" randomly selected vehicle models. The process of electrification involves changing the fuel type of a vehicle from a gasoline vehicle to a BEV or PHEV (which affects the utility attribute related to the vehicle fuel type) and slightly modifying the vehicle price (typically upwards) based on a battery price estimate. All other vehicle attributes remain the same. Therefore, over time, a larger number of vehicle models are electrified. This assumption is based on empirical observations of increasing numbers of electric vehicle models in existing international markets. This does not guarantee they will increase their sales, but it does mean more choices for consumers, which is a significant factor for PEV sales in our historical data (see Figures **Error! Reference source not found.**, Figure 3, and Figure 4). Based on these observations, we develop three scenarios and classify model availability changes over time into different rates of each, in terms of percent increase in the number of PEV makes/models:

- Baseline scenario: 1%±0.2% increase in available models per year
- Low scenario: 0.5%±0.1% increase in available models per year
- High scenario: 2%±0.4% increase in available models per year

As vehicle models are electrified, there is a larger subset of PEV choices for consumers in the discrete choice model and this is expected to increase adoption. These changes mirror real-world shifts in electric vehicle model availability, which do not remain static over time.

As battery production improves in efficiency and decreases costs through economies of scale and learning by doing, the corresponding prices for electric vehicles will continue to fall. We extend these costs to the vehicle prices that consumers observe by uniformly decreasing the cost of PEV models on an annual basis. We assume changes in price drawn from a uniform distribution in three scenarios:

- Baseline scenario: $250-$750 decrease per year
- Low scenario: $100-$400 decrease per year
- High scenario: $500-$1000 decrease per year

Lastly, as described above, one of the major issues in choice modeling forecasts for new technologies is that the utility associated with the new technology is assumed to be static. However, with nearly a decade of data on electric vehicle sales, we were able to calibrate a choice model independently for each year and country, observing significant increase in consumer preferences over time for both BEVs and PHEVs (see Figure 5). For our projections, we continue these trends in an exponential decay function with three different rates of decay after the 2017 values:

- Baseline scenario: 0.75 decrease in the rate of growth per year
- Low scenario: 0.5 decrease in rate of growth per year
- High scenario: no decrease in the rate of growth per year

While its components are not described explicitly, this variable implicitly includes a confluence of factors that may change over time: policy incentives and regulations, consumer knowledge and awareness, their interest in purchasing BEVs and PHEVs, the average vehicle driving range, charging availability and vehicle performance (such as acceleration and top speed), to name a few. The three scenarios (baseline, low adoption, and high adoption) provide a range of possible outcomes for PEVs.

Baseline Scenario results

Our baseline forecasts for vehicle adoption by fuel technology are shown in Figure 6. Extending the trends we observe from our choice models over time reveals fairly diverse adoption rates in the five modeled markets. Nevertheless, over the next two decades we observe that electric vehicles grow fairly rapidly, offering significant competition to the incumbent gasoline vehicle technology—and in some cases entirely replacing it as the primary vehicle technology. Both the United States and China achieve full vehicle electrification by 2040 and 2030 respectively, dominated by BEVs. Given the rate of growth of electric vehicles in the Chinese market (see Figure 1), it is perhaps unsurprising that PEVs rapidly replace gasoline vehicles as the dominant vehicle technology. Interestingly, our model indicates that PHEVs do not take off in the Chinese market and that BEVs are the sole technology once passenger vehicles are fully electrified. One of the most important factors pushing the PEV market in China is the New Energy Vehicle (NEV) mandate, a government regulation that requires a certain portion of each automakers' sales be electric. While our regression model does not explicitly capture this effect, this term is likely influencing our fuel technology coefficient. Hence the upward trend in the coefficient will likely qualitatively align with the increasing stringency of the policy.

The United States market follows in second place behind China's aggressive electric vehicle adoption. While the growth of the market is relatively tame over the next decade, the growth of BEVs accelerates quite rapidly beginning in 2030 with nearly full electrification happening by 2040. One of the interesting dynamics we observe in the US market is initial rapid growth of PHEV technology before being overtaken by BEVs in the late 2020s. In the decay function of the fuel technology coefficient, the BEV preferences tend to rise faster over time and this leads to a higher sales growth over longer periods of time. The decrease in gasoline vehicle sales is substantially slower than in China (taking an additional 10 years to decrease in market share), likely due to policies and cultural differences in consideration of vehicle attributes.

The three major European markets lag behind both China and the US in terms of electric vehicle adoption. Unlike the two previous examples, neither France, Germany, nor the United Kingdom reach full saturation of market share in either BEV or PHEV technologies. France observes a steady growth in their market for electric vehicles, reaching about 45% market share for PHEVs and 30% market share for BEVs by 2040, with the remaining market evenly split between gasoline and diesel cars. Over the entire course of growth, PHEVs retain a larger market share than BEVs in France. In contrast, by 2040 in both Germany and the UK, BEVs surpass PHEVs in market share (though this does not occur until the late 2030s in the UK). Germany has a market share of about 40% BEVs and 25% PHEVs in 2040 while the UK has a market share of about 50% BEVs and 45% PHEVs. Contrary to the Chinese and US markets, the European countries we analyzed retain their preferences for PHEVs as evidenced by their market share in comparison to the BEVs.

The uncertainties in

Figure 6 are a result of the random draws from sampling the distributions for model replacement, variation in price change over time, and standard errors for the BEV and PHEV coefficients from the discrete choice model. The shaded portion (outlined by dotted lines) in the figure represent the uncertainty in our assumptions for all three of our exogenous modifications in the forecast for the baseline scenario, they do not represent the low and high scenarios for adoption.

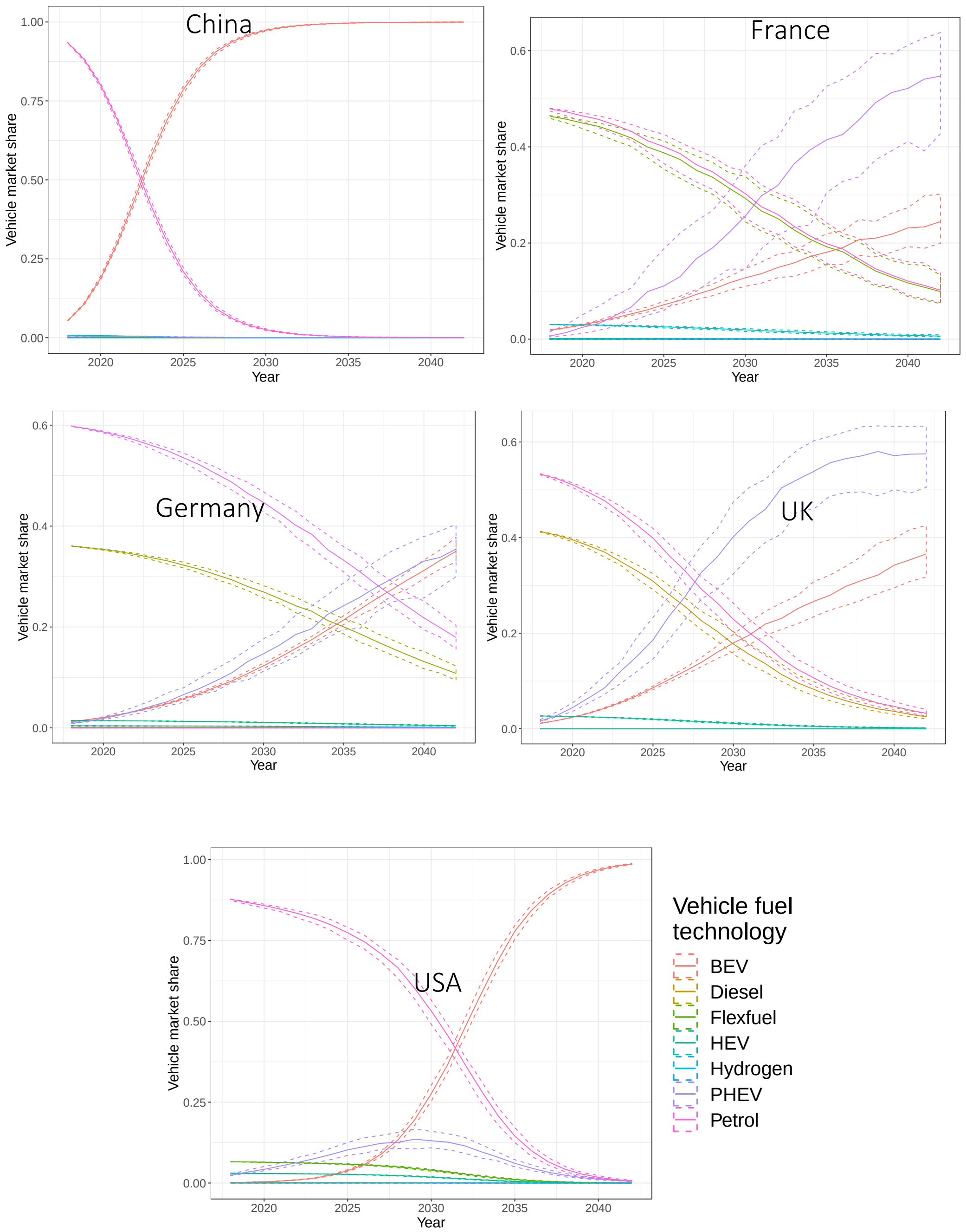

Figure 6: Projections of vehicle adoption by technology in five major international markets with baseline assumptions (decreasing PEV prices, available PEV models, changes in attitudes).

Key message: both China and USA achieve 100% electrification in 2030 and 2040 respectively, while none of the European countries achieve full electrification by 2040.

While the uncertainty from parameter estimates are included in

Figure 6, we only include the baseline assumptions for vehicle prices, PEV vehicle model availability, and PEV technology preferences. In Figure 7 we display the full scenario analysis of PEV adoption across more pessimistic and optimistic assumptions for the three factors. Besides China, which continues with a fairly aggressive adoption of electric vehicles even in the most pessimistic scenario, most of the other countries' low adoption scenario does not lead to a majority share of PEVs in the vehicle market. By far the most significant influencer of the adoption rate is the assumption of PEV technology preference change over time. Alongside the availability of PEVs in the market, our model reveals that the factors related to PEV technology preference are far more influential than the attributes of the vehicles themselves. As mentioned, this preference variable may reflect some trends in the attributes of vehicles not otherwise included in the model, such as driving range and vehicle performance. It could also reflect improvements in recharging infrastructure. In a model where more of these variables were explicitly included, we would expect the effect of "consumer preference" variable to be lower. Specification of such a model is a possibility for future extensions of this research.

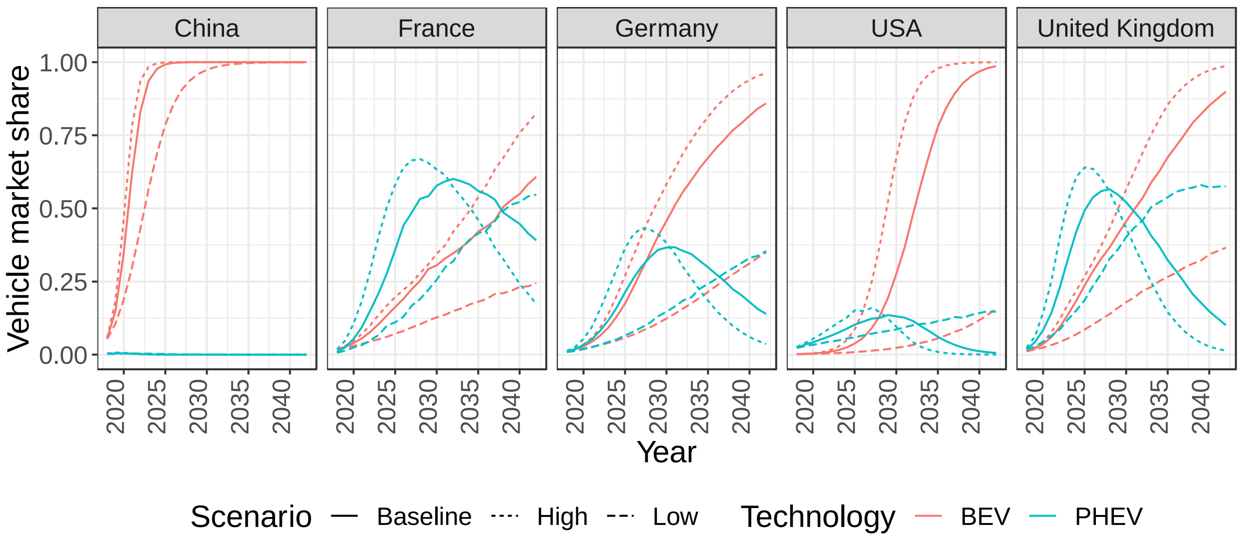

Figure 7: Three scenarios of adoption in five major PEV markets: low, baseline, and high Note: the assumptions behind each of the scenarios are described in the Projections Approach section.

Key Message: the aggressiveness of adoption is most sensitive to the assumption of how PEV technology preferences change over time.

Our projection approach provides insight into how a trajectory of preference changes over time can be a driving force for adoption of new technologies. This is an important contrast to traditional choice models that take these preferences as static. The forecast scenarios provide a general sense of what is possible over the next several decades with regards to electric vehicles in the passenger car and light-duty truck market. And despite the relatively large range of possibilities, we have been able to determine that the factors extrinsic to the car are the most important to consider for the success of the technology (rather than the measured vehicle attributes). If we consider that the preference variable captures factors such as policy incentives and regulations, the low adoption scenario can be qualitatively considered to represent a scenario in which these policies stagnate or are removed while the high adoption scenario may represent a scenario in which these policies are more widely adopted or improved (independent of their effect on prices and supply availability).

Discussion

In contrast to our 2017 report, the baseline results of our projections here indicate a fairly promising trajectory for the adoption of BEVs worldwide alongside PHEVs in our five major markets. By 2040, both the US and China fully transition to electric vehicles while the three major markets we investigated in Europe are at a vast majority in market share. However, the results are also quite sensitive to the scenario assumptions as can be seen in the discrepancies between the low, baseline, and high adoption scenarios.

The major difference between the current projections and those from our previous report is the emergence of positive trends in the variable linked to general interest in BEVs and PHEVs. This preference variable captures the increased tendency to purchase these vehicles independent of changes in vehicle price and the availability of a range of makes/models. In assuming that this trend will continue into the future, the result is a strong increase in PEV market shares, in our baseline case all countries exceed 50% PEV market shares by 2040. On the other hand, using a pessimistic case for the increase in tendency to purchase these vehicles suggests that strong policies will be needed to achieve the same targets.

While our work does not explicitly model policy outcomes, it should be noted that electric vehicle policies and regulations are in place in all the markets we examined. As a result, the technology specific coefficients in the discrete choice model would capture their effects. While we do not disentangle these policies from other factors (vehicle range, charging time, station availability, knowledge and awareness), suffice it to say our assumption that the technology preference for electric vehicles continues their trend of increasing over time relative to gasoline technologies would likely result from a continuation (if not a strengthening) of the existing PEV policies.

Ultimately, the model estimated here suggests that for PEVs to succeed, there must be a continuation in trends of price reduction, model availability, and consumer preference. Perhaps the most challenging will be the last. The implication is that interest in PEVs will move from "pioneer adopters (the first few percent of purchasers) to early adopters, into mass market consumers. There will also be laggards such as technology conservative types and even individuals who are hostile to the new drive train and energy types of vehicles. To progress steadily through these groups and eventually interest a high share of consumers in buying these types of vehicles, there may need to be much large ad campaigns (e.g. from companies themselves), support and preferential treatment for those who purchase these vehicles (such as parking advantages and good recharging infrastructure), and eventually stronger measures to discourage the purchase of internal combustion engine vehicles.

Conclusions and Next Steps

Overall the development of the choice model and its use to project future PEV sales reflects many assumptions and uncertainties – the future could unfold in many different ways depending on both technological evolution of vehicles, availability of those vehicles, consumer interest in purchasing those vehicles, and a range of policies to encourage their purchase. What this analysis cannot do is predict how these different "drivers" of change will unfold, but it seems clear that strong trends for each are necessary to reach high PEV shares in most countries by

2030 and beyond. In a “base case” future, it does appear that the current trends are on the right track to reach fairly high shares, especially in the US and China.

The next phase of this research involved developing a more formal model, with both supply and demand considerations, and especially take into account supply factors more explicitly. These will include not only the numbers of makes and models offered but also their production levels in years when these seem to be constraint and affecting sales. More detailed tracking and projection of vehicle attributes will also be explored, such as driving range and performance. Features on some models such as “auto pilot” could also be included in the analysis. Finally, a deeper exploration of policies, including tax advantages, provision of recharging infrastructure, and driving/parking advantages for PEVs (dedicated lanes and parking spaces) will be undertaken. More years of data will also be added as these become available.

GLOBAL FUEL ECONOMY INITIATIVE

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