HIGHWAY LOSS DATA INSTITUTE

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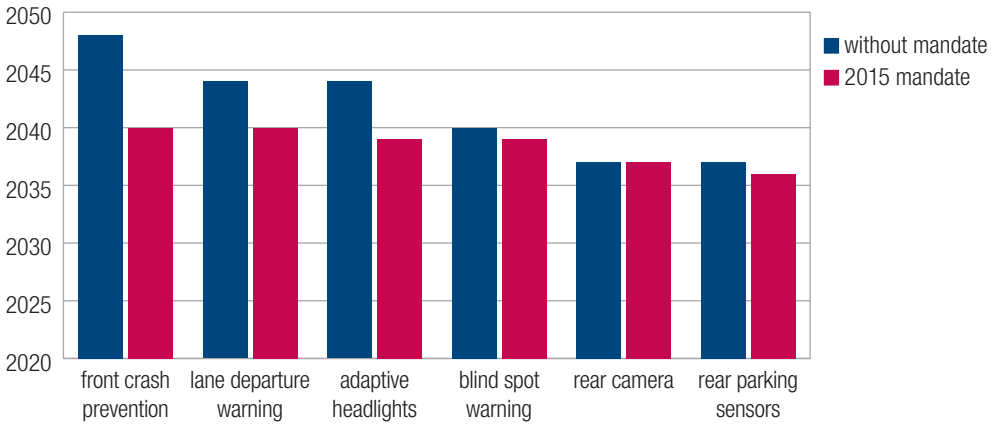
Predicted availability of safety features on registered vehicles – an update

Prior Highway Loss Data Institute (HLDI) studies have indicated that some collision avoidance systems are reducing insurance claims. Claim frequency reductions were found across all of the crash related coverages for front crash prevention systems. Reductions in bodily injury liability claims indicate the systems are functioning as intended because the systems are designed to prevent or mitigate the severity of front-to-rear crashes, the type of crash that typically results in a bodily injury liability claim. Initial evaluations of forward collision warning systems estimated reductions in bodily injury liability claim frequencies of 4–9 percent. Benefits were even greater for those systems that added autonomous braking. Systems that provided autonomous braking reduced bodily injury liability claim frequency by 14–32 percent. While the reductions are sizable, these systems were first introduced on a small number of luxury vehicles. Consequently, the impact of these systems on the population of all crashes has been limited.

Sensing technologies are evolving. Early front crash prevention systems were radar based while newer systems use radar, lasers, cameras, and/or a fusion of different sensing technologies. As the sensing technologies have evolved, the price of the systems have dropped and, as a consequence, some non-luxury vehicles are now available with these technologies. For example, the 2013 Honda Accord was offered with a camera-based front crash prevention system and lane departure system. A study of that system found reductions in claim frequencies across all of the crash related coverages. The bodily injury liability reduction was a statistically significant 40 percent. The Honda Accord is one of the best-selling cars in the United States. Given the high sales volume of this vehicle, the effectiveness of the front crash prevention system on the Accord could have an impact on gross insurance losses. Honda's decision to equip Accords with this technology may cause other manufacturers to equip comparable vehicles with comparable technologies causing a surge in the number of vehicles with available front crash prevention systems.

A prior report from HLDI (2012) showed that it typically takes approximately three decades for technologies to spread through the fleet. The current analysis uses similar methodology but focuses on collision avoidance features. The analysis shows that it typically takes decades before most vehicles on the road could have a given feature, either because it came as standard equipment or was offered as an option. For example, it will not be until 2037 that 95 percent of all registered vehicles could have rear park assist, which was rolled out in the United States in 1995. Front crash prevention systems, which rolled out in the United States in 2000, could take even longer. If it continues to follow its current trajectory, the crash avoidance technology will not be available in 95 percent of registered vehicles until 2048. Federal mandates would accelerate the fitment of these features. As shown below, a mandate for 2015 model vehicles could speed up the penetration of some features in the fleet by as much as 8 years.

Calendar year features reach 95% of registered vehicle fleet with and without mandate



Introduction

Given the potential and proven benefits of collision avoidance systems, it is almost certain that these systems will reduce the number of crashes and insurance claims. While estimating the efficacy of available systems is an important part of understanding the long-term impact of these systems, it is also important to understand the prevalence of these systems in the current fleet and to estimate their growth in the fleet over time. The purpose of this bulletin is to quantify the prevalence of vehicle features in the registered vehicle fleet, trace that prevalence from introduction through the most current registration data, and then to predict the prevalence in the future.

Methods

This bulletin combines vehicle feature information from the Highway Loss Data Institute (HLDI) with vehicle registration data from R.L. Polk and Company. For each feature studied there are three figures:

- The **first figure** illustrates the percentage of new vehicle series with a given feature by model year. In this figure, each new vehicle series (model year, make, series) is a single observation. The observations have not been weighted by insurance exposure or vehicle registration information. Using new vehicle series to illustrate how common a feature is can be deceiving because new safety features typically appear initially on luxury vehicles, which tend to be sold in lower volumes than non-luxury vehicles.
- The **second figure** for each feature illustrates the percentage of registered vehicles with a feature by calendar year. In this figure, each observation (model year, make, series) is weighted by the number of registered vehicles.
- The **third figure** for each feature illustrates the predicted availability for that feature. The actual availability is also displayed for comparison. This figure helps to provide insight into the time required for the presence of a feature to build in the registered vehicle fleet.

The following features are included in this bulletin: electronic stability control (ESC), rear park assist, front crash prevention systems, rear camera, adaptive front lighting systems, lane departure warning (LDW), and blind spot monitor.

Vehicle feature information was obtained by HLDI. The feature information is structured by model year, make, and series. The same three variables were mapped to the registration data from R.L. Polk. For each model year- make-series combination, one of three possible feature values are provided: "standard," "optional," and "not available."

Registration counts belonging to either of the first two groups are hereafter referred to as "available." For example, in calendar year 2008, 9.7 percent of registered vehicles had standard ESC and another 10.8 percent had it as an option, so it is said that ESC was available in 20.5 percent of the 2008 registered vehicles.

The most recent R.L. Polk data available to HLDI contains calendar years 1976 to 2013. For each calendar year, a number of recent model years is available, ranging from 9 model years for calendar year 1976 to 37 model years for calendar year 2013. The number of model years included in each calendar year has increased over time. For calendar years 2003 and later, the 37 most recent model years were available. For calendar years 1996 to 2002, 30 of the most recent model years were in the dataset. This covered at least 95 percent of the overall fleet in calendar years where safety features started to gain popularity. There are model years that are present in earlier calendar years, age out of the dataset, and then re-enter when the dataset was expanded. To increase the amount of usable data, missing values were extrapolated based on existing values. Polk has restated some of its data. In this report, original data was used from 1976 to 2008 while restated data was used for calendar years 2009–13.

Approach used to estimate the number of new vehicles: In order to estimate the number of new vehicles in 2014, registrations for new vehicles for the prior 5 calendar years (2009–13) were averaged. New vehicles are defined as vehicles aged 0 and -1. For example, a 2012 model year in calendar year 2012 would have a vehicle age of 0 while a 2013 vehicle in the same calendar year would be aged -1. To predict new vehicle registrations for calendar years 2015–50, a 30-year past trend in new vehicle registrations was studied. Over this period, new vehicle registrations increased on average 1.4 percent per calendar year. New vehicle counts for 2015 and beyond were calculated by adding 1.4 percent to the prior year registration counts.

Approach used to estimate attrition rates: Attrition rates were calculated for each calendar/model year combinations through 2013 and applied to future years (2014–50) and vehicles of the same age. Additionally, to account for changes in attrition, a 30-year past trend was studied. Over this time period, attrition rates declined on average 0.2 percent per calendar year. Based on this, the attrition was estimated to be slower by 3.8 percentage points (0.2% * (1+37)/2) on average in the future years (2014–50). Different attrition rates were explored and can be seen in the **Appendix**. For the next 20 years, there was little difference between the rates. The attrition assumptions will be monitored, refined, and modified as needed for future analysis.

The estimation procedure was conducted separately for each feature in the study. The procedure involved running a logistic regression model (assuming a binomial distribution with a probit link) on the past year data where feature prevalence is known and then applying the model estimates to predict the feature prevalence for future years.

The dependent variable in the model was the ratio of the registration count where the feature was available to the total registration count. The only two independent variables were calendar year and model year.

Results

Figure 1: Percentage of new vehicle series with ESC

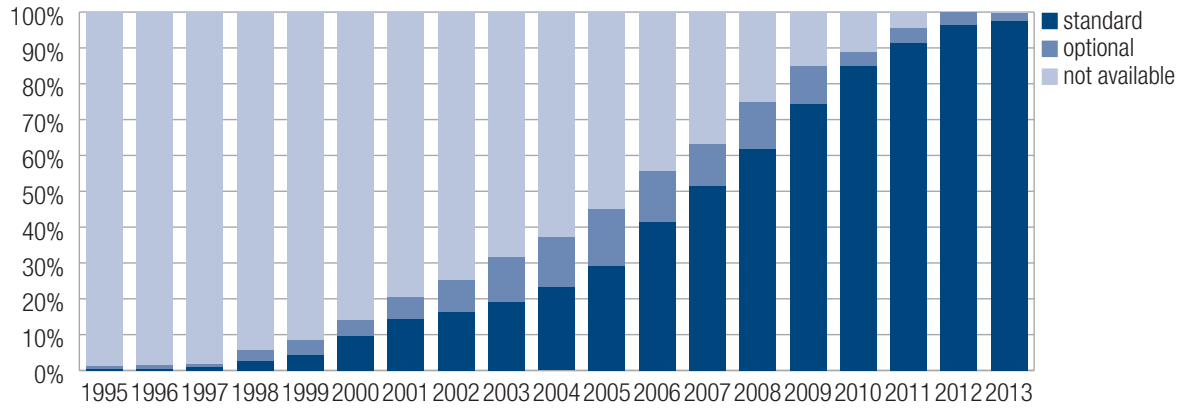


Figure 1 shows the percentage of vehicle series by model year with either standard or optional ESC. ESC was introduced in model year 1995 and by the 2004 model year had become standard on 23 percent and optional on 14 percent of vehicle series. For the 2013 model year, ESC was standard on 97 percent and optional on 2 percent of vehicle series. ESC has been required on all light duty vehicles beginning September 1, 2011. In model year 2013, the only vehicles that do not have standard ESC are very large pickup trucks weighing more than 10,000 pounds and not subject to the regulation.

Figure 2: Percentage of registered vehicles with ESC

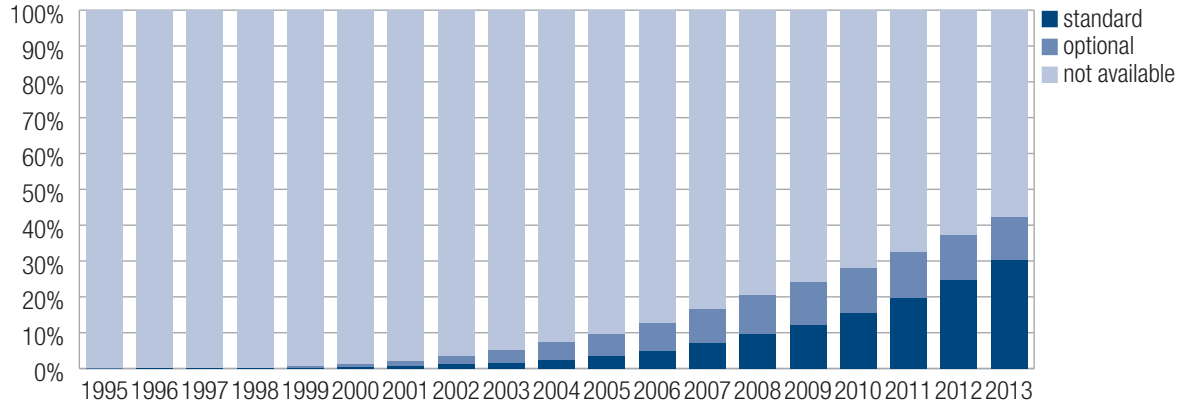


Figure 2 shows the percentage of registered vehicles by calendar year with either standard or optional ESC. By 2004, ESC had become standard on 2 percent and optional on 5 percent of registered vehicles. By 2013, ESC was standard or optional on 42 percent of registered vehicles.

Figure 3: Predicted percentage of registered vehicles with ESC

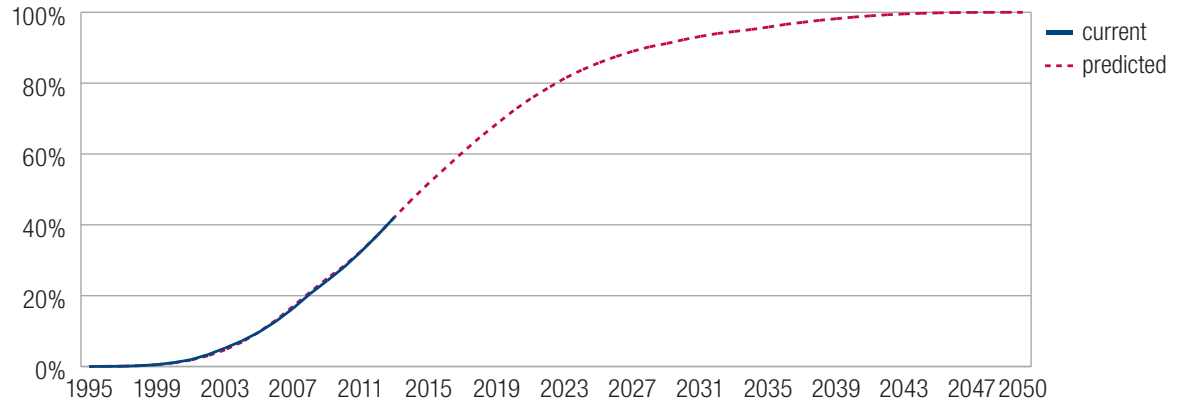


Figure 3 shows the percentage of predicted registered vehicles by calendar year with either standard or optional ESC. It is predicted that ESC will be standard or optional on 95 percent of registered vehicles in 2033.

Figure 4: Percentage of new vehicle series with rear park assist

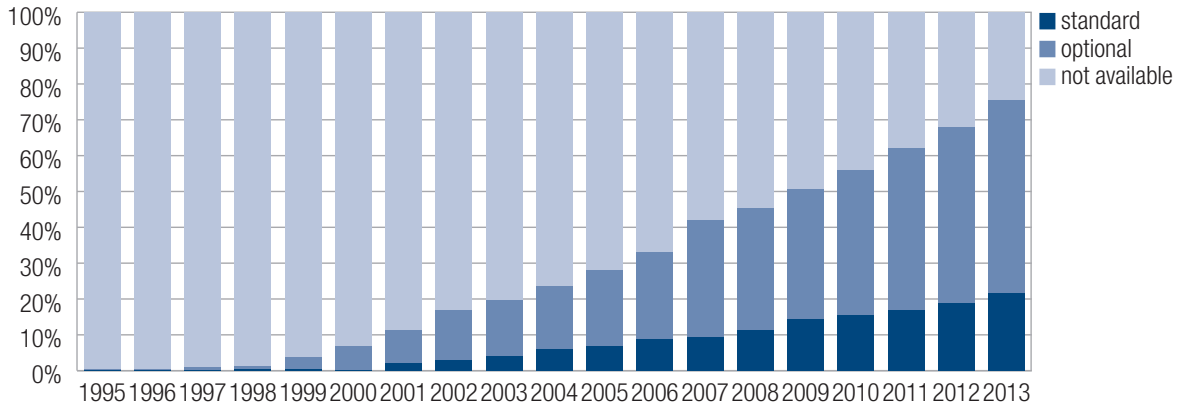


Figure 4 shows the percentage of vehicle series by model year with either standard or optional rear park assist. Rear park assist was introduced in model year 1995 and by the 2004 model year had become standard on 6 percent and optional on 18 percent of vehicle series. For the 2013 model year, rear park assist was standard on 22 percent and optional on 54 percent of vehicle series.

Figure 5: Percentage of registered vehicles with rear park assist

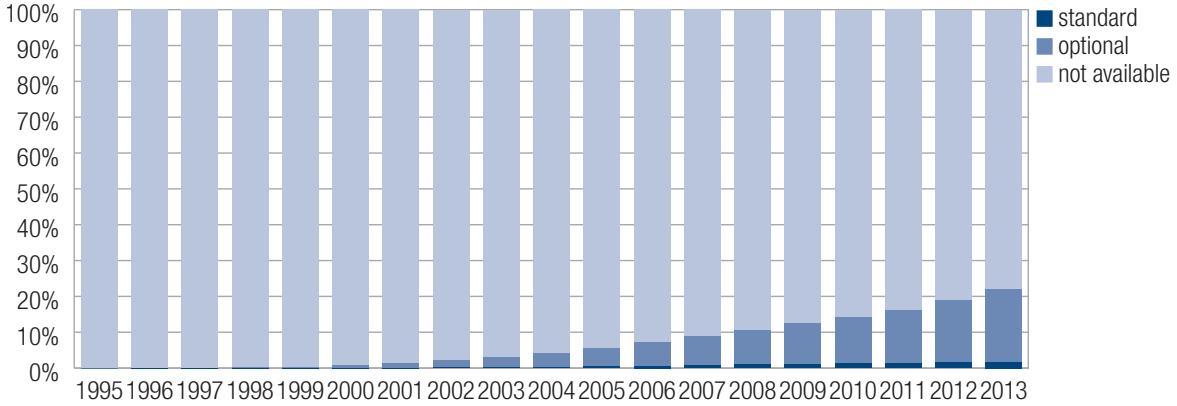


Figure 5 shows the percentage of registered vehicles by calendar year with either standard or optional rear park assist. By 2004, rear park assist had become standard on less than 1 percent and optional on 4 percent of registered vehicles. By 2013, rear park assist was standard or optional on 22 percent of registered vehicles.

Figure 6: Predicted percentage of registered vehicles with rear park assist

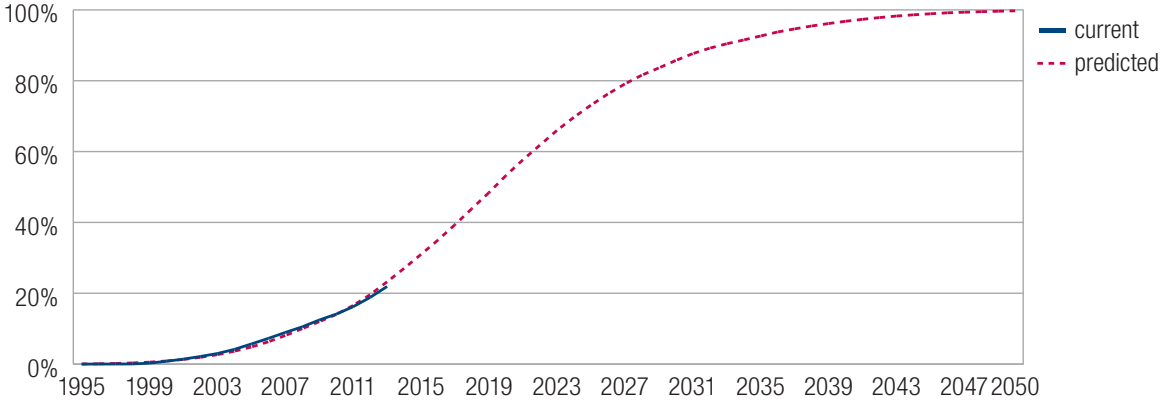


Figure 6 shows the percentage of predicted registered vehicles by calendar year with either standard or optional rear park assist. It is predicted that rear park assist will be standard or optional on 95 percent of registered vehicles in 2037.

Figure 7: Percentage of new vehicle series with front crash prevention

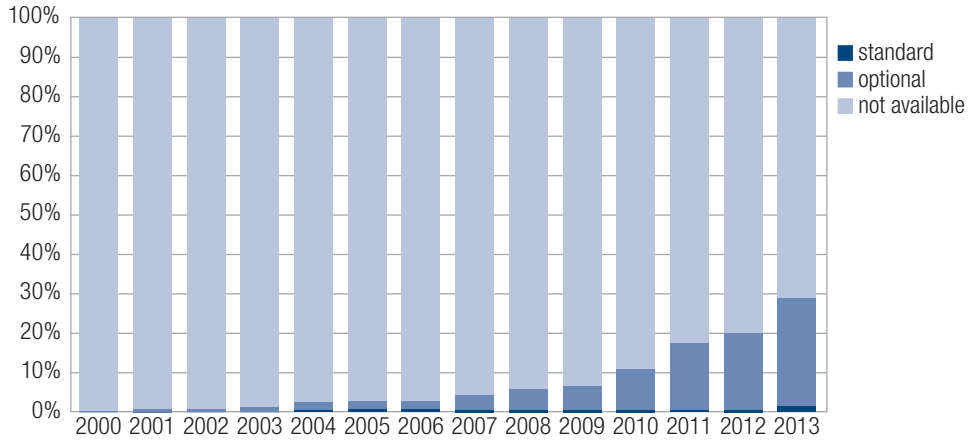


Figure 7 shows the percentage of vehicle series by model year with either standard or optional front crash prevention. Front crash prevention was introduced in model year 2000 and by the 2006 model year had become standard on 1 percent and optional on 2 percent of vehicle series. For the 2013 model year, front crash prevention was standard on 2 percent and optional on 27 percent of vehicle series.

Figure 8: Percentage of registered vehicles with front crash prevention

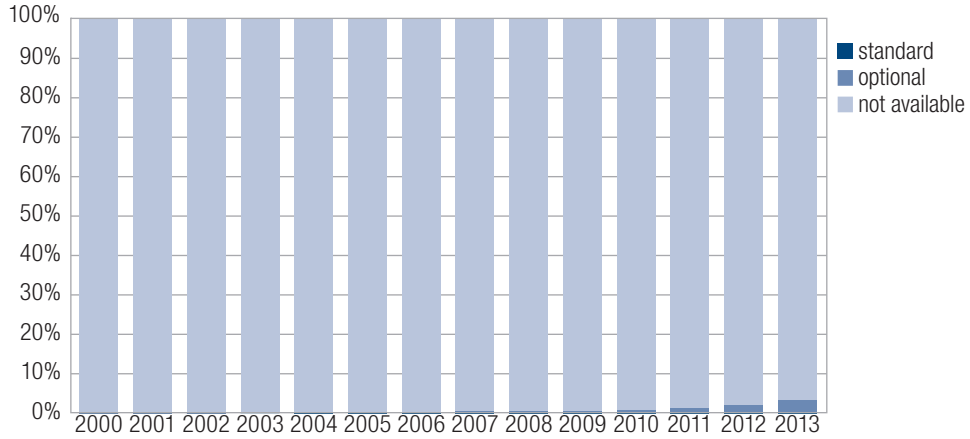


Figure 8 shows the percentage of registered vehicles by calendar year with either standard or optional front crash prevention. By 2006, front crash prevention had become standard on less than 1 percent and optional on less than 1 percent of registered vehicles. By 2013, front crash prevention was standard or optional on 3 percent of registered vehicles.

Figure 9: Predicted percentage of registered vehicles with front crash prevention

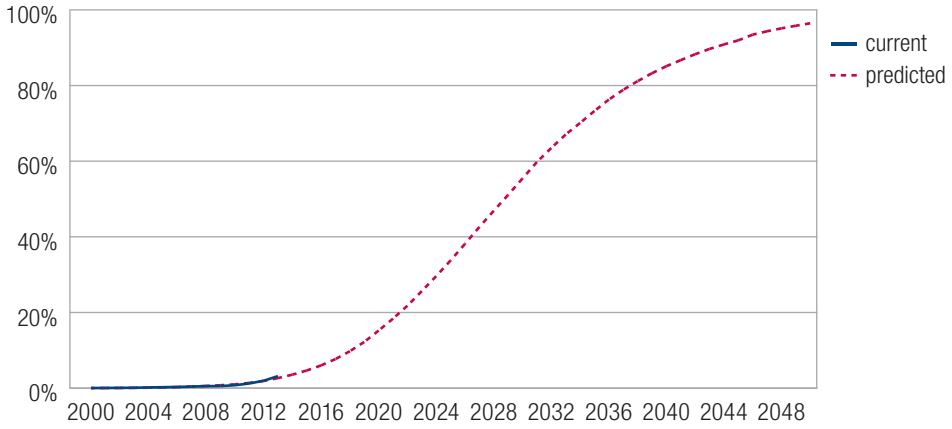


Figure 9 shows the percentage of predicted registered vehicles by calendar year with either standard or optional front crash prevention. It is predicted that front crash prevention will be standard or optional on 95 percent of registered vehicles in 2048.

Figure 10: Percentage of new vehicle series with rear camera

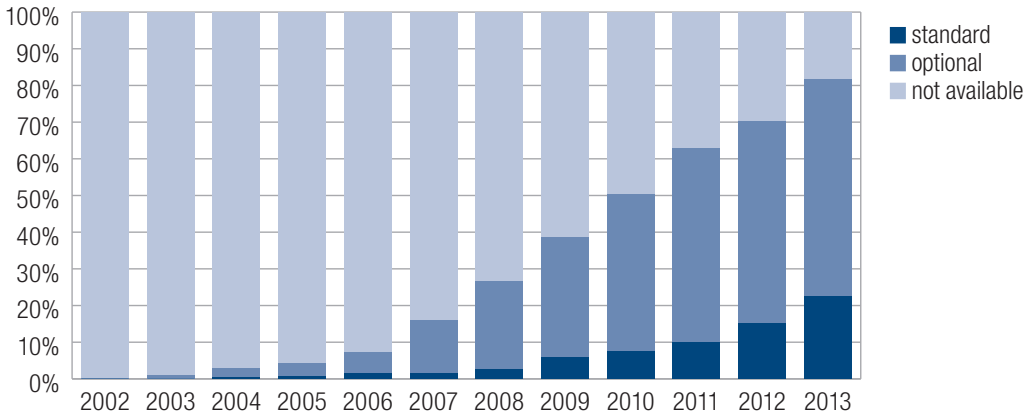


Figure 10 shows the percentage of vehicle series by model year with either standard or optional rear cameras. Rear cameras were introduced in model year 2002 and by the 2007 model year had become standard on 2 percent and optional on 14 percent of vehicle series. For the 2013 model year, rear cameras were standard on 23 percent and optional on 59 percent of vehicle series. Rear cameras will be required in all new vehicles starting May 1, 2018.

Figure 11: Percentage of registered vehicles with rear camera

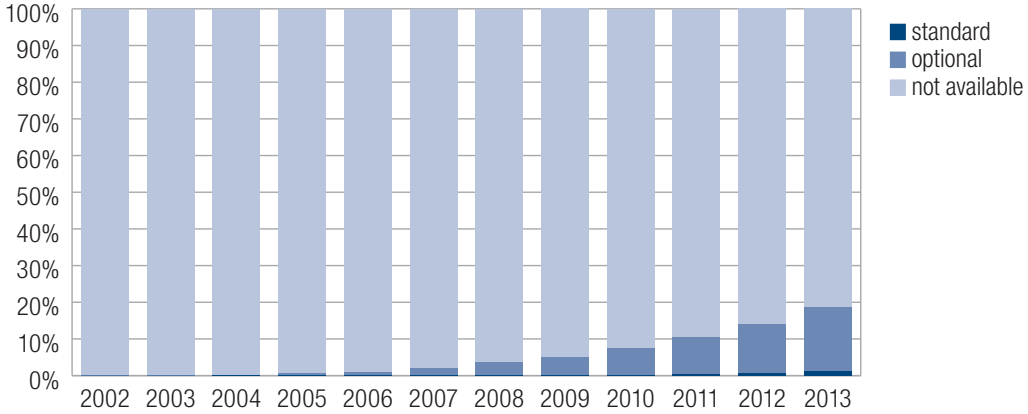


Figure 11 shows the percentage of registered vehicles by calendar year with either standard or optional rear cameras. By 2007, rear cameras had become standard on less than 1 percent and optional on 2 percent of registered vehicles. By 2013, rear cameras were standard or optional on 19 percent of registered vehicles.

Figure 12: Predicted percentage of registered vehicles with rear camera

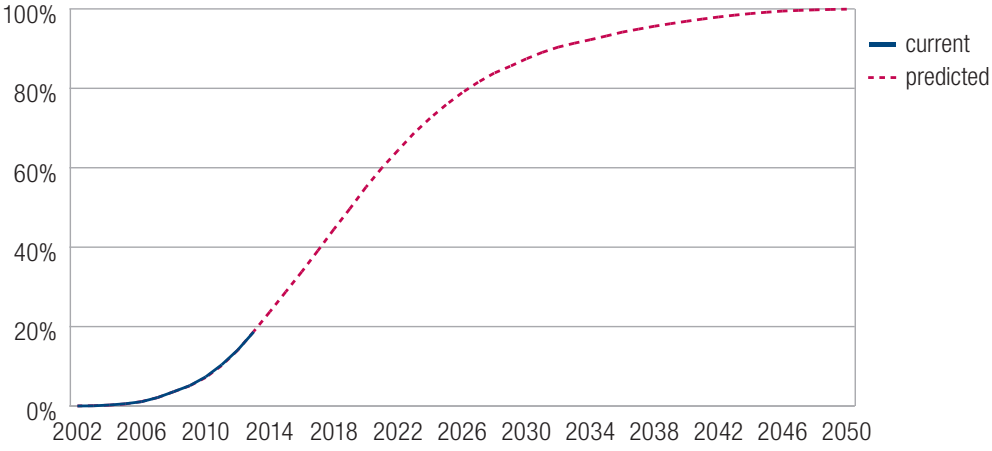


Figure 12 shows the percentage of predicted registered vehicles by calendar year with either standard or optional rear cameras. It is predicted that rear cameras will be standard or optional on 95 percent of registered vehicles in 2037.

Figure 13: Percentage of new vehicle series with adaptive headlights

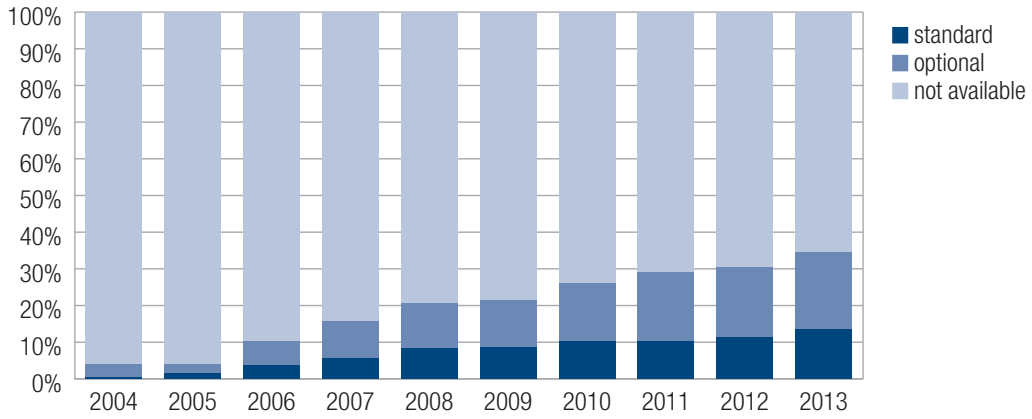


Figure 13 shows the percentage of vehicle series by model year with either standard or optional adaptive headlights. Adaptive headlights were introduced in model year 2004 and by the 2008 model year had become standard on 8 percent and optional on 12 percent of vehicle series. For the 2013 model year, adaptive headlights were standard on 14 percent and optional on 21 percent of vehicle series.

Figure 14: Percentage of registered vehicles with adaptive headlights

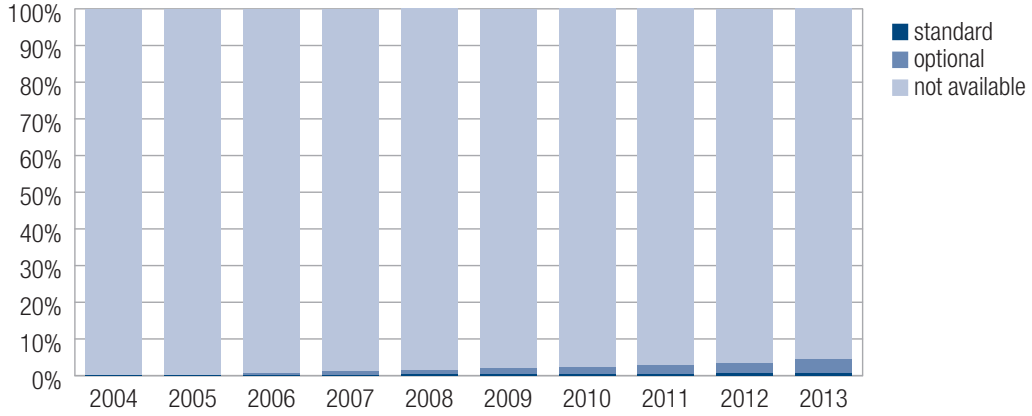


Figure 14 shows the percentage of registered vehicles by calendar year with either standard or optional adaptive headlights. By 2008, adaptive headlights had become standard on less than 1 percent and optional on 1 percent of registered vehicles. By 2013, adaptive headlights were standard or optional on 4 percent of registered vehicles.

Figure 15: Predicted percentage of registered vehicles with adaptive headlights

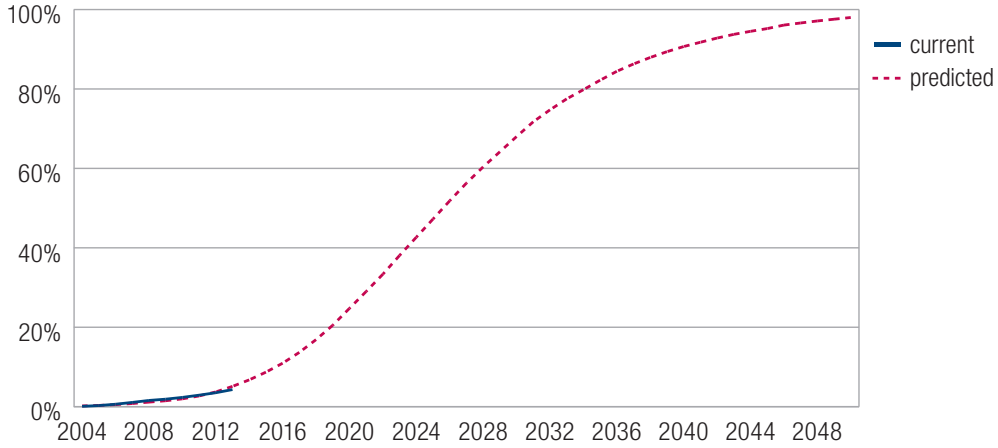


Figure 15 shows the percentage of predicted registered vehicles by calendar year with either standard or optional adaptive headlights. It is predicted that adaptive headlights will be standard or optional on 95 percent of registered vehicles in 2044.

Figure 16: Percentage of new vehicle series with lane departure warning

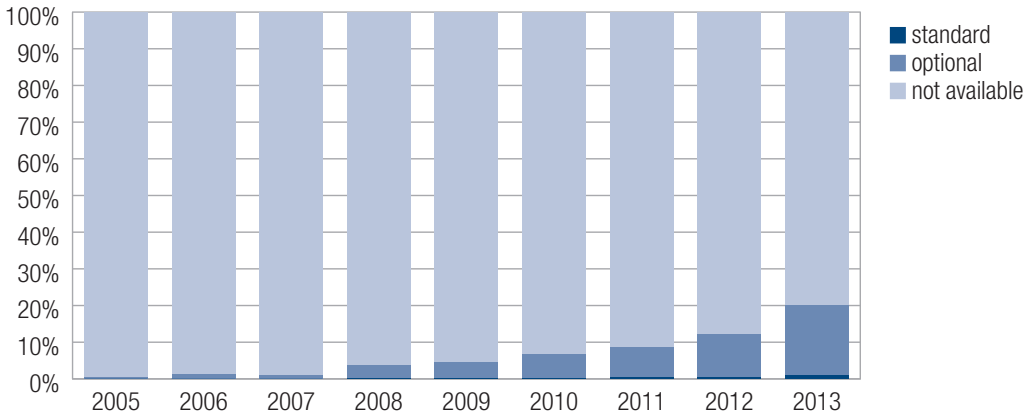


Figure 16 shows the percentage of vehicle series by model year with either standard or optional lane departure warning. Lane departure warning was introduced in model year 2005 and by the 2009 model year had become standard on less than 1 percent and optional on 4 percent of vehicle series. For the 2013 model year, lane departure warning was standard on 1 percent and optional on 19 percent of vehicle series.

Figure 17: Percentage of registered vehicles with lane departure warning

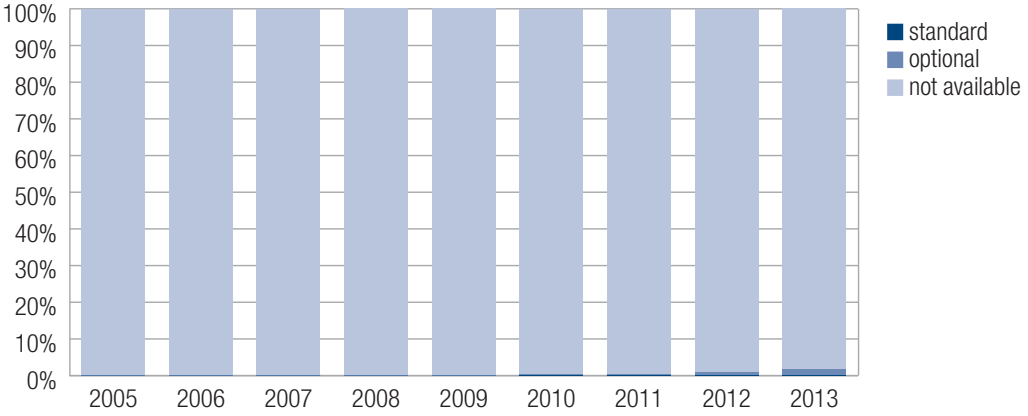


Figure 17 shows the percentage of registered vehicles by calendar year with either standard or optional lane departure warning. By 2009, lane departure warning had become standard on less than 1 percent and optional on less than 1 percent of registered vehicles. By 2013, lane departure warning was standard or optional on 2 percent of registered vehicles.

Figure 18: Predicted percentage of registered vehicles with lane departure warning

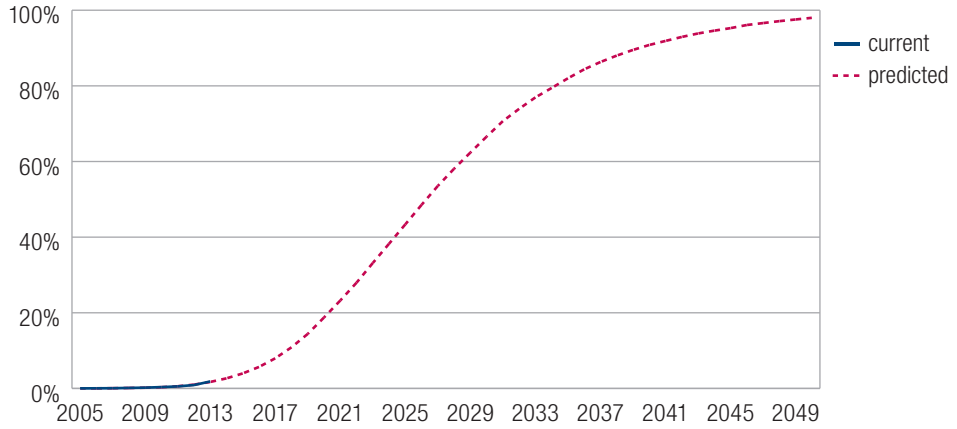


Figure 18 shows the percentage of predicted registered vehicles by calendar year with either standard or optional lane departure warning. It is predicted that lane departure warning will be standard or optional on 95 percent of registered vehicles in 2044.

Figure 19: Percentage of new vehicle series with blind spot monitor

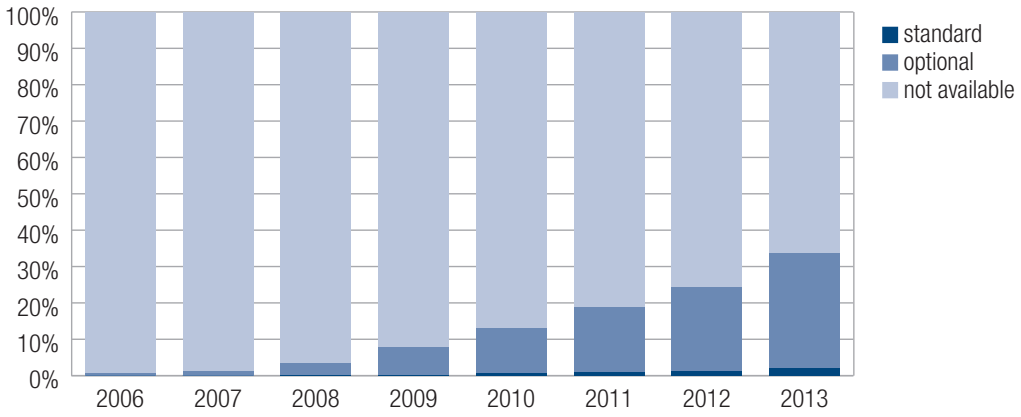


Figure 19 shows the percentage of vehicle series by model year with either standard or optional blind spot monitor. Blind spot monitor was introduced in model year 2006 and by the 2009 model year had become standard on less than 1 percent and optional on 8 percent of vehicle series. For the 2013 model year, blind spot monitor was standard on 2 percent and optional on 31 percent of vehicle series.

Figure 20: Percentage of registered vehicles with blind spot monitor

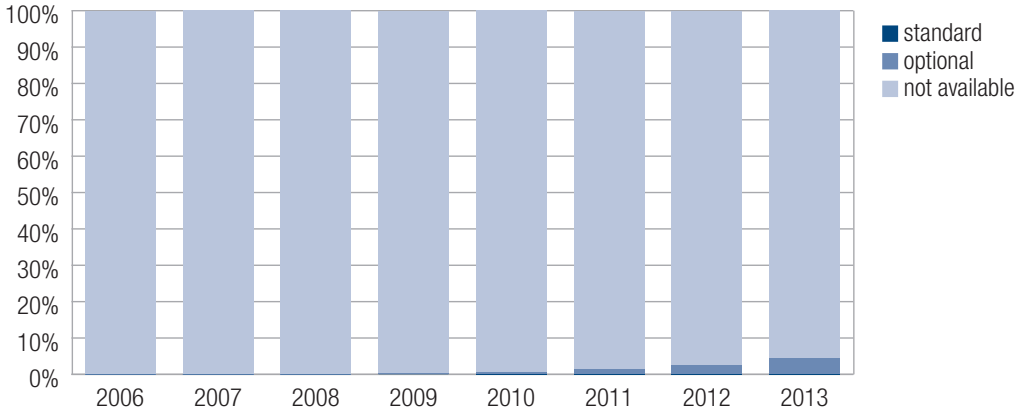


Figure 20 shows the percentage of registered vehicles by calendar year with either standard or optional blind spot monitor. By 2009, blind spot monitor had become standard on less than 1 percent and optional on less than 1 percent of registered vehicles. By 2013, blind spot monitor was standard or optional on 4 percent of registered vehicles.

Figure 21: Predicted percentage of registered vehicles blind spot monitor

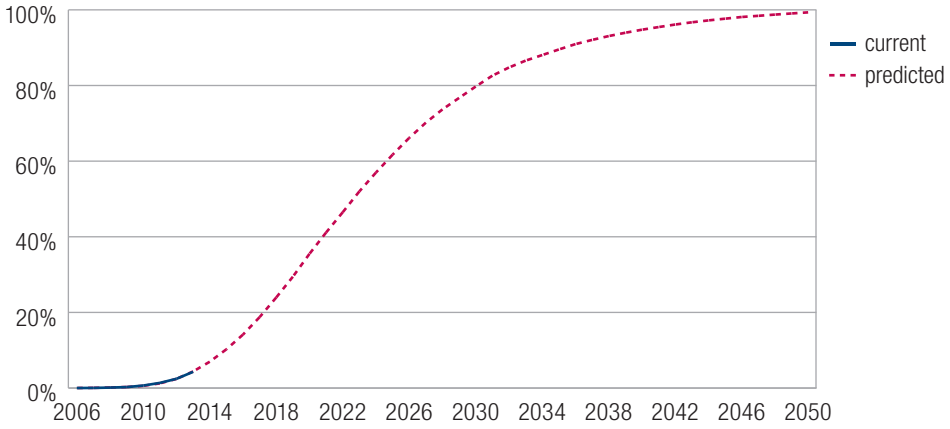
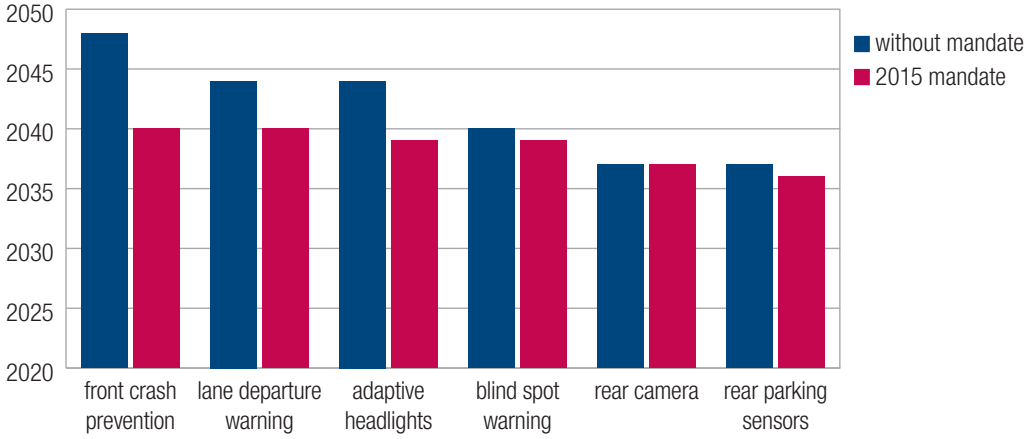


Figure 21 shows the percentage of predicted registered vehicles by calendar year with either standard or optional blind spot monitor. It is predicted that blind spot monitor will be standard or optional on 95 percent of registered vehicles in 2040.

Discussion

It takes a long time for new vehicle features to spread through the registered vehicle fleet. Even when features are required by NHTSA, it takes many years for features to be available on all vehicles. ESC for example, was first available to consumers in 1995 and shown to be effective in reducing insurance losses and deaths. It has been required on all light duty vehicles since September 1, 2011. However, even with that requirement in place for several years only 42 percent of the vehicle fleet had this feature available in 2013. It will take until 2033 for 95 percent of the fleet to be equipped with ESC. Many collision avoidance features have been recently introduced to the fleet and to date only rear cameras have been mandated by NHTSA. Figure 22 demonstrates the length of time it takes a feature to reach 95 percent of the fleet. Front crash prevention, for example, will not reach 95 percent until 2048, and a 2015 mandate would only accelerate the time by 8 years. While these collision avoidance features may be reducing collisions and losses, it will be many years before vehicles fitted with them represent a significant portion of the vehicle fleet.

Figure 22: Calendar year features reach 95% of registered vehicle fleet with and without mandate

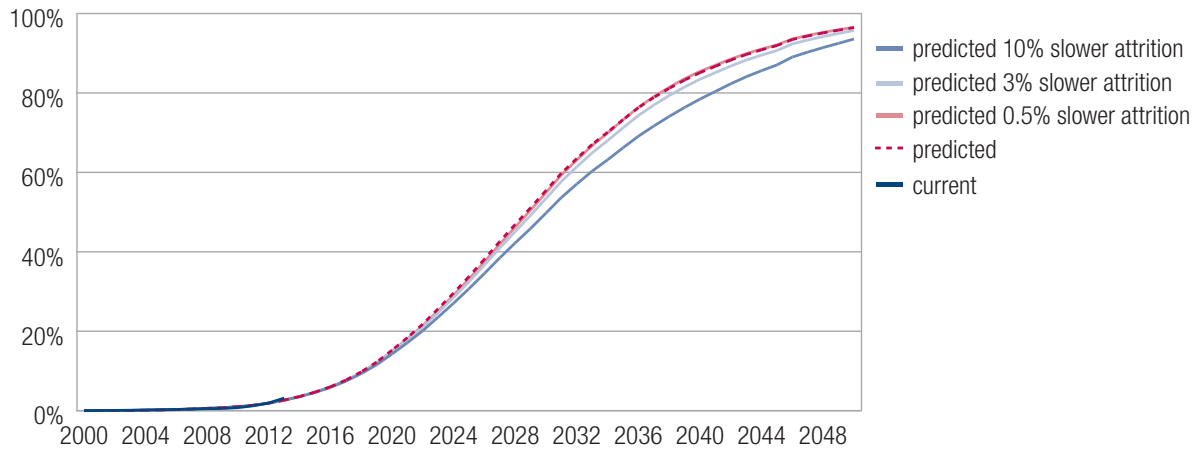


Limitations

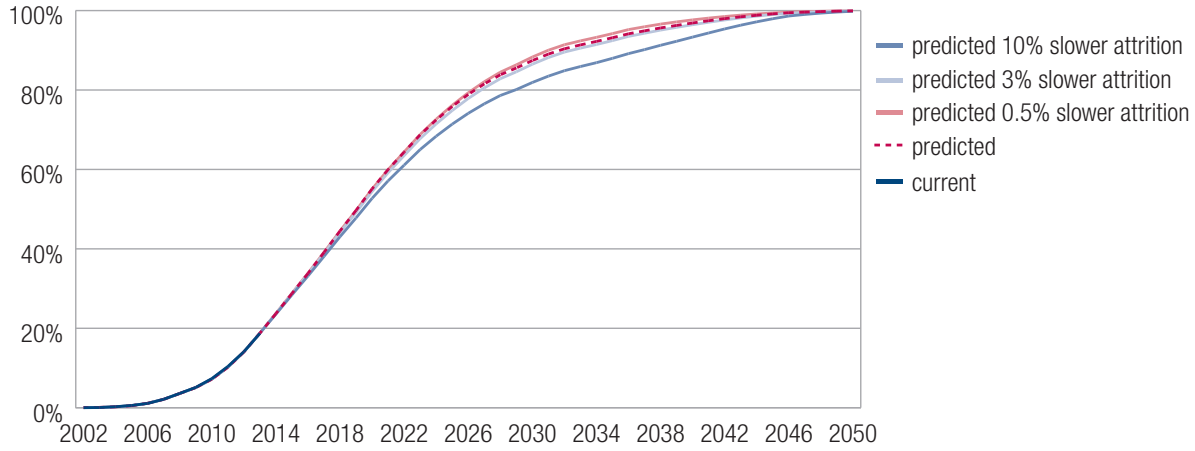
One limitation of the logistic model with a probit link is that it assumes a distribution with an asymptote of 100 percent, which it approaches slowly towards the end of the distribution. When a given feature's prevalence reaches 95 percent, its growth substantially slows and it takes a number of years to capture the remaining 5 percent. It is not known how this remaining small percentage will be captured since no feature has reached 100 percent prevalence yet. The model was carefully chosen to fit the existing (past year) data well, and there is reason to believe that it does not adequately describe the future data. It may be the case that the full 100 percent prevalence is never reached, as some people tend to keep old cars as collectable vehicles. Even if so, the goal of the study was to estimate when each feature will be available for the vast majority of the fleet, not 100 percent of the fleet.

Another limitation is that the prediction was based on the coarse calendar/model year registration counts rather than stratified by make and series. However, the stratified approach would be difficult if not impossible to accomplish. The future is uncertain, and so is the future new model fleet. Even with the present approach, a bold assumption of stalled vehicle sales had to be made. Making further assumptions on which makes and series will be popular in the future or which manufacturers will introduce safety features more aggressively is beyond the scope of this analysis. However, as mentioned previously and reflected in the graphs, the model fits the existing data well, and consequently it is reasonable to believe that the predictions for the future fleet are the best possible.

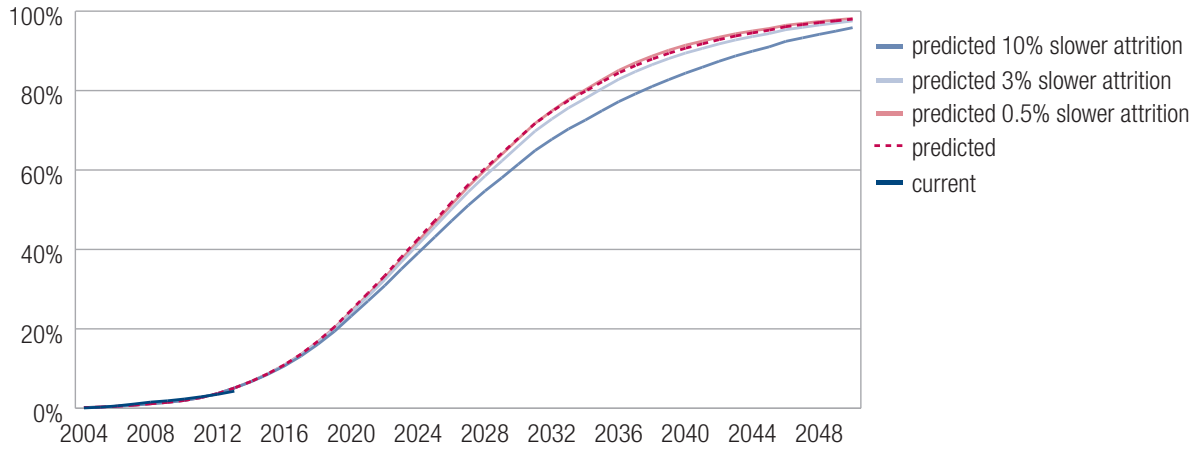
Appendix Figure 1: Predicted percentage of registered vehicles with front crash prevention



Appendix Figure 2: Predicted percentage of registered vehicles with rear camera



Appendix Figure 3: Predicted percentage of registered vehicles with adaptive lights



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Highway Loss Data Institute. 2012. Predicted availability of safety features on registered vehicles. *Loss Bulletin*. Vol. 28, No 26. Arlington, VA.

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The Highway Loss Data Institute is a nonprofit public service organization that gathers, processes, and publishes insurance data on the human and economic losses associated with owning and operating motor vehicles.