HLDI
Highway Loss Data Institute

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Predicted availability of safety features on registered vehicles — a 2022 update

Highway Loss Data Institute (HLDI) studies have indicated that some collision avoidance systems, particularly front crash prevention systems, are reducing insurance claims. While some of 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.

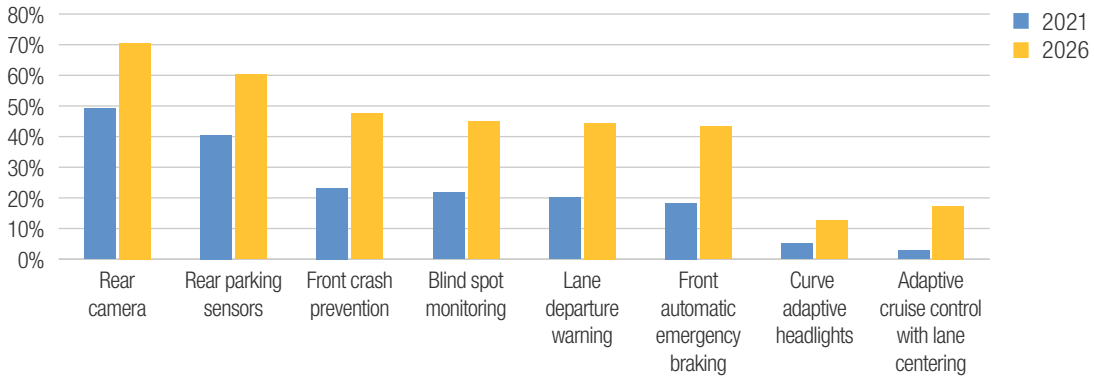
Prior HLDI studies have shown that it typically takes decades after a feature is introduced before it is installed on most vehicles on the road. This study updates the forecasted availability of collision avoidance features with the addition of a new feature: adaptive cruise control with lane centering.

The COVID-19 pandemic caused unusual patterns in new vehicle registrations in 2020. For this reason, 2020 data were excluded when predicting future new vehicle registrations. It may take several years before the economic ramifications of the pandemic are fully understood. This study will be updated as new information becomes available.

The figure below shows the percentage of registered vehicles estimated to be equipped with safety features in calendar years 2021 and 2026. The presence of most systems is estimated to increase by over 20 percentage points by 2026. However, curve adaptive headlights and adaptive cruise control with lane centering are only estimated to increase by 7 percent and 15 percent, respectively.

Two features are estimated to be on more than half of the registered vehicle population in 2026. Rear cameras and rear parking sensors are estimated to be on 71 percent and 60 percent of the registered vehicle fleet in 2026, respectively. Front automatic emergency braking (AEB) is estimated to increase from 18 percent of the registered vehicle population in 2021 to 43 percent in 2026. This increase may be due to the voluntary agreement to equip vehicles with AEB by 2022.

Predicted registered vehicles equipped with collision avoidance systems, 2021 and 2026 calendar years



Introduction

Given the potential and proven benefits of collision avoidance systems, it is almost certain that these systems will continue to 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 study 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 predict the prevalence of these features in the future.

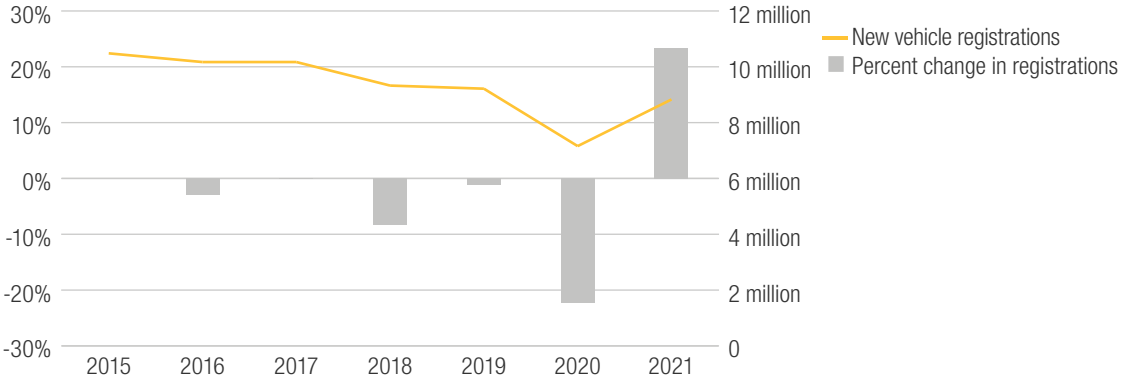
Prior HLDI studies (2012, 2014b, 2015, 2016, 2017, 2018, 2019b, 2020, 2021) showed that it typically takes decades after introduction before most vehicles on the road have a given feature. Most of the prior studies examined the prevalence of the systems based on availability, meaning the feature was available as standard or optional equipment. The percentage of vehicles equipped with an optional feature was unknown.

The optional-equipped rate was estimated for each feature based on known take rates from some manufacturers. Using this information, the percentage of registered vehicles equipped with a certain feature, along with future predictions, can be better estimated.

The COVID-19 pandemic has affected the economy, including new and used vehicle sales. Compared to 2019, new vehicle registrations fell 22 percent in 2020, which is much different from 2015–19. However, by June 2021, the U.S. economy was considered to be fully recovered (Siegel & Dam, 2021). As shown in **Figure 1**, new vehicle registrations rose 23 percent in 2021 compared with 2020 and totaled only 4 percent lower than the number registered in 2019. Therefore, the future new vehicle registrations are based on the trend of the past 30 years, excluding the exceptional 2020 data.

Recent and future surges in COVID-19 cases could bring uncertainty, and it may take several years before the full ramifications of the pandemic are researched and understood. This study will be updated as new information becomes available.

Figure 1: Change in new vehicle registrations, 2015–21



Methods

This study combines vehicle feature information from HLDI with vehicle registration data from IHS Markit. For each feature studied, there are three figures:

- The **first figure** for each feature 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.

- 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. This second figure also includes an "equipped" line that estimates the percentage of the vehicle fleet with the feature installed.

- The **third figure** for each feature illustrates its predicted availability. The actual availability is also displayed for comparison. One set of lines represents predicted availability with the optional take rate considered, while the other set represents the estimate without including that rate. This figure provides 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 study: electronic stability control (ESC), rear parking sensors, front crash prevention systems that warn and those that automatically brake, rear cameras, curve adaptive headlights, lane departure warning, blind spot monitoring, and adaptive cruise control with lane centering.

HLDI compiled the vehicle feature information by model year, make, and series and mapped these same three variables to the registration data from IHS Markit. For each combination of model year, make, and series, one of three possible feature values are provided: "standard", "optional", or "not available".

Registration counts belonging to either of the first two groups (standard and optional) are hereafter referred to as "available". For example, in calendar year 2021, 6.3 percent of registered vehicles had rear parking sensors as standard equipment and another 45.7 percent had them as an option, so it is said that rear parking sensors were available in 52 percent of the 2021 registered vehicles.

The most recent IHS Markit data available to HLDI cover calendar years 1976–2021. For each calendar year, multiple recent model years are used, ranging from 10 model years for calendar year 1976 to 40 model years for calendar year 2021. The number of model years included in each calendar year has increased over time. For calendar years 2009 and later, more than 50 of the most recent model years are available, but the analysis was limited to 40 model years. This covered at least 95 percent of the overall fleet in calendar years during which safety features started to gain popularity. Some model years are present in earlier calendar years, age out of the dataset, and then reenter when the dataset is expanded. To increase the amount of usable data, missing values were extrapolated based on existing values. IHS Markit has restated some of its data. In this report, original data were used from 1976 to 2008, while restated data were used for calendar years 2009–21.

Approach used to estimate optional-equipped rates: This study estimates the optional-equipped rates for each of the features using HLDI feature data and vehicle identification number (VIN) information from 12 manufacturers. Using HLDI's vehicle information, vehicles registered in 2021 with optional features were identified. Individual feature-equipped rates for a calendar year were estimated based on VIN data that HLDI previously received from a limited number of manufacturers. The equipped rate for each feature was estimated using several regression models that included some or all of the following variables: model year, size, class, and vehicle base price. Where possible, HLDI used the equipped rates from the participating manufacturers to estimate those for other vehicles of the same model year, size, class, and price. Where that level of detail was not available, the equipped rates were estimated with regression models according to the variables with known values. In the worst-case scenario, the estimated equipped rates were based exclusively on model year and vehicle price.

Once these estimated rates were assigned to the unknown values in the historical data, the optional and standard feature data from past years were used to estimate future feature-equipped rates.

Approach used to estimate the number of new vehicles: New vehicles are defined as vehicles aged 0 and −1 years. For example, a 2012 model year vehicle in calendar year 2012 would have a vehicle age of 0 years, while a 2013 vehicle in the same calendar year would be aged −1 years. Prior HLDI studies estimated the number of new vehicles in the first unknown year in the future by averaging the registrations for new vehicles for the last 5 known calendar years. However, as the COVID-19 pandemic affected new vehicle sales in 2020, the present study averaged the number of registrations for new vehicles in calendar years 2016–19 and 2021 to estimate the number of new vehicles in 2022. To predict new vehicle registrations for calendar years 2022–50, a 30-year past trend in new vehicle registrations was studied. During this period, new vehicle registrations increased by an average 0.5 percent per calendar year. New vehicle counts for 2022 and beyond were therefore calculated by adding 0.5 percent each year on a cumulative basis.

Approach used to estimate attrition rates: For a given model year, registration counts typically peak at age 1 and then decline over time. For example, in calendar year 2013 there were fewer model year 2008 registrations than there were in 2012. The rate at which registrations declined as a vehicle aged 1 year (i.e., as the vehicle aged from 1 to 2, 2 to 3, 3 to 4 years, etc.) was calculated for every model year/age change combination over the past 30 years of data. The average attrition rate for a given age change was then calculated and applied to future years (2022–50) and vehicles undergoing the same age change.

Additionally, to account for changes in attrition, a 30-year past trend was studied. During this period, attrition rates declined by an average 0.12 percent per model year. Based on this, the attrition for each subsequent model year was slowed by an additional 0.12 percent. In other words, the attrition rate for the 2025 model year was projected to be 0.12 percent less than the attrition rate for the 2024 model year, which was 0.12 percent less than the 2023 model year, etc. 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's data, for which 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 registrations with the feature available to the total registration count. The only two independent variables were calendar year and model year.

Results

Figure 2: Percentage of new vehicle series with ESC by model year

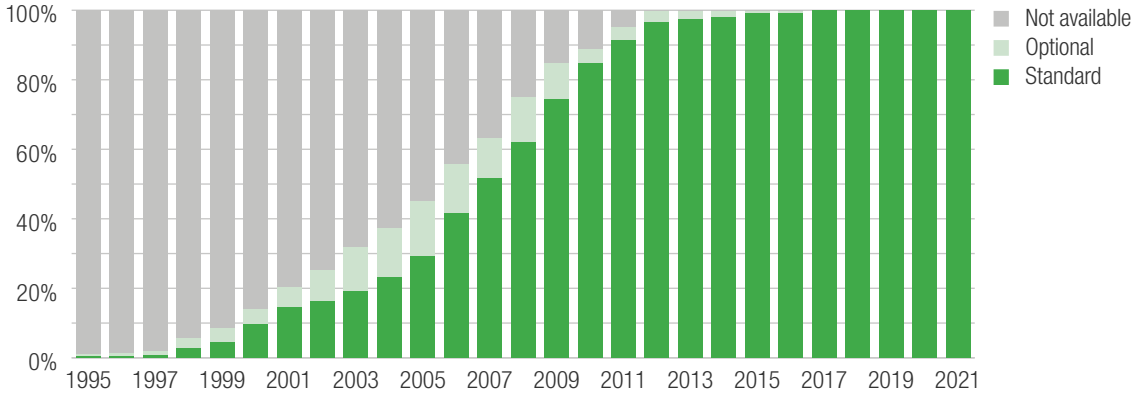


Figure 2 shows the percentage of vehicle series with either standard or optional ESC by model year. ESC was introduced in model year 1995 and by the 2004 model year had become standard on 23 percent and optional on 14 percent of vehicle series. **ESC has been required on all light-duty vehicles beginning September 1, 2011**. From model year 2013 to 2016, the only vehicles that did not have standard ESC are very large pickup trucks weighing more than 10,000 pounds, which were not yet subject to the regulation. By the 2017 model year, all vehicle series had standard ESC.

Figure 3: Percentage of registered vehicles with ESC by calendar year

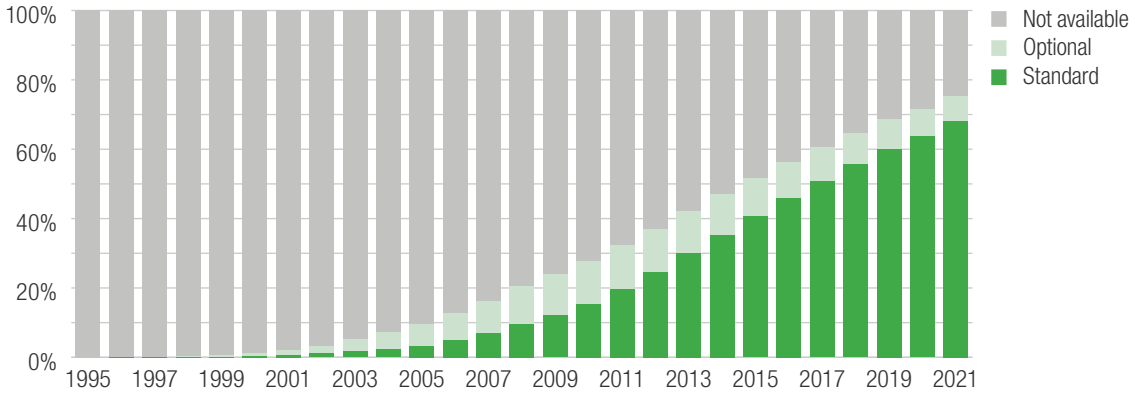


Figure 3 shows the percentage of registered vehicles with either standard or optional ESC by calendar year. By 2004, ESC had become standard on 2 percent and optional on 5 percent of registered vehicles. By 2021, ESC was standard or optional on 75 percent of registered vehicles. Data were not available to estimate the optional-equipped rate for ESC.

Figure 4: Predicted percentage of registered vehicles with ESC by calendar year

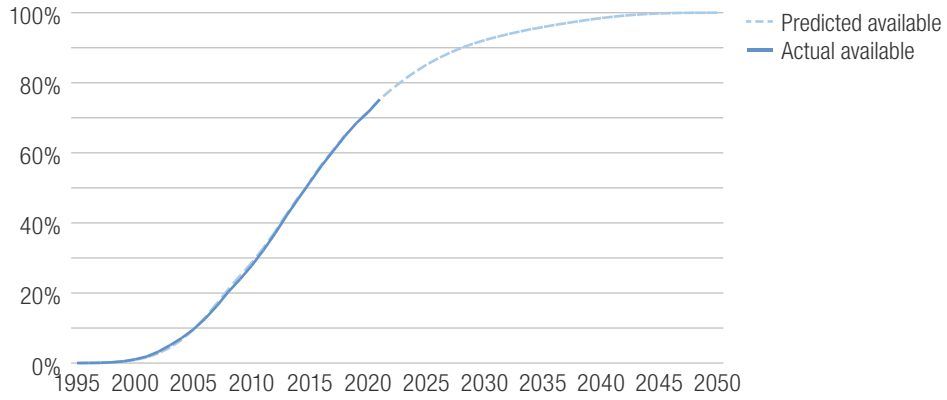


Figure 4 shows the percentage of predicted registered vehicles with either standard or optional ESC by calendar year. It is predicted that ESC will be standard or optional on 95 percent of registered vehicles in 2035.

Figure 5: Percentage of new vehicle series with rear parking sensors by model year

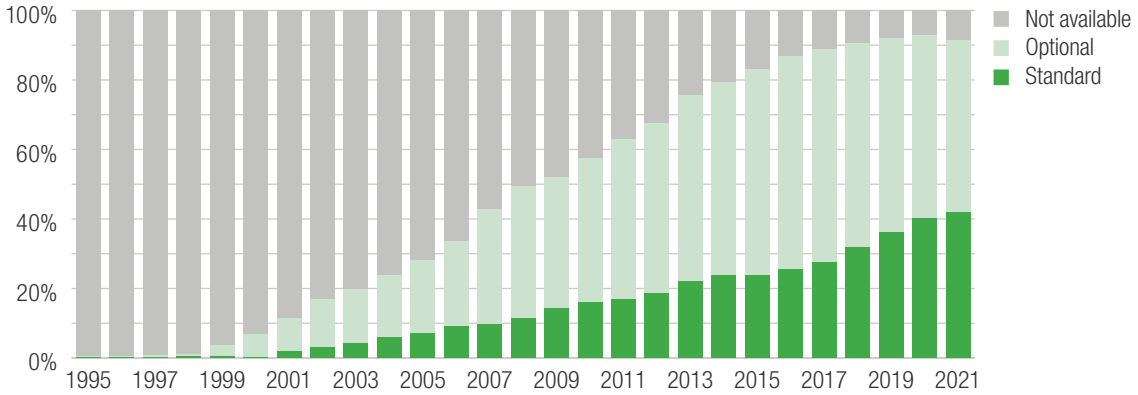


Figure 5 shows the percentage of vehicle series with either standard or optional rear parking sensors by model year. Rear parking sensors were introduced in model year 1995 and by the 2004 model year had become standard on 6 percent and optional on 18 percent of vehicle series. For the 2021 model year, rear parking sensors were standard on 42 percent and optional on 50 percent of vehicle series.

Figure 6: Percentage of registered vehicles with rear parking sensors by calendar year

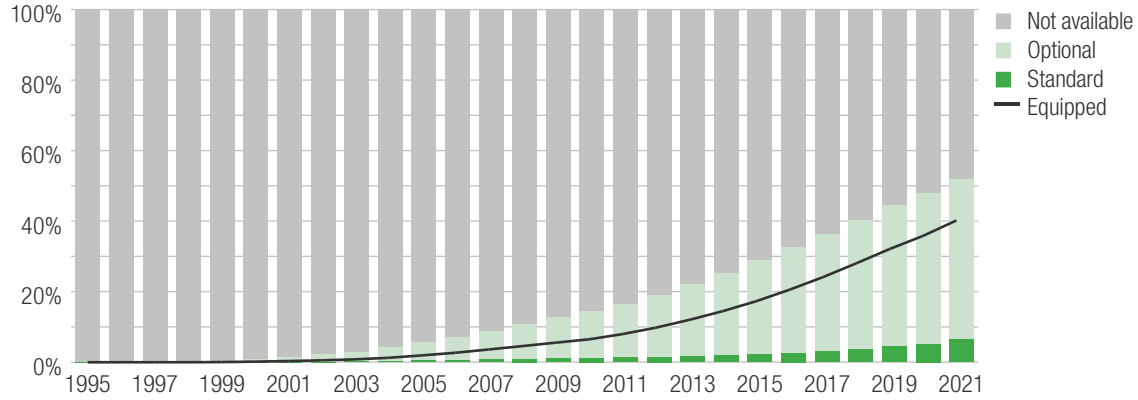


Figure 6 shows the percentage of registered vehicles with either standard or optional rear parking sensors by calendar year. In 2004, rear parking sensors had become standard on less than 1 percent and optional on 4 percent of registered vehicles. By 2021, rear parking sensors were standard or optional on 52 percent of registered vehicles, but only 41 percent of registered vehicles were estimated to be equipped with the feature.

Figure 7: Predicted percentage of registered vehicles with rear parking sensors by calendar year

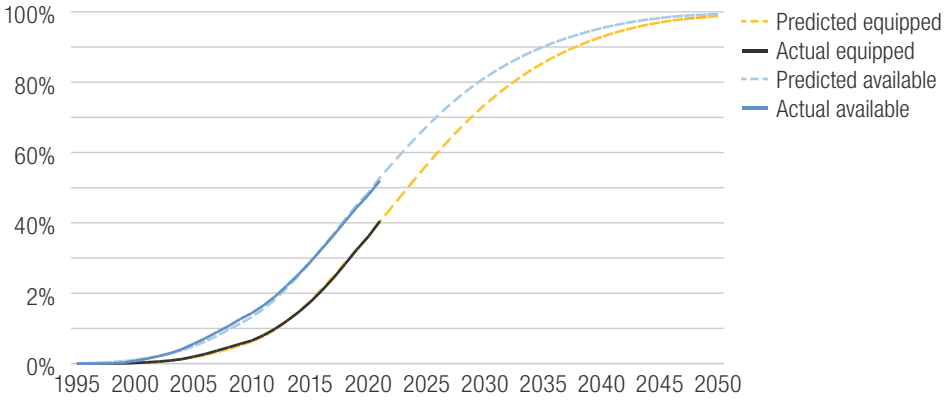


Figure 7 shows the percentage of predicted registered vehicles with rear parking sensors by calendar year. One set of predictions is for vehicles with rear parking sensors available (standard or optional) and the other set of predictions is for vehicles equipped (either standard or optionally equipped) with the sensors. It is predicted that 95 percent of registered vehicles will be equipped with rear parking sensors in 2043.

Figure 8: Percentage of new vehicle series with front crash prevention by model year

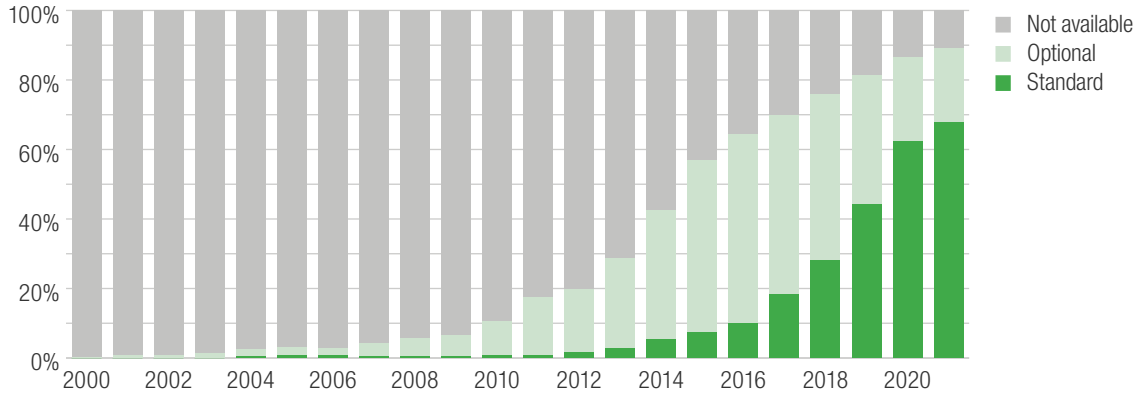


Figure 8 shows the percentage of vehicle series with either standard or optional front crash prevention by model year. It includes vehicles that warn and/or automatically brake. Front crash prevention was introduced in model year 2000 and by the 2009 model year it had become standard on 1 percent and optional on 6 percent of vehicle series. For the 2021 model year, front crash prevention was standard on 68 percent and optional on 21 percent of vehicle series.

Figure 9: Percentage of registered vehicles with front crash prevention by calendar year

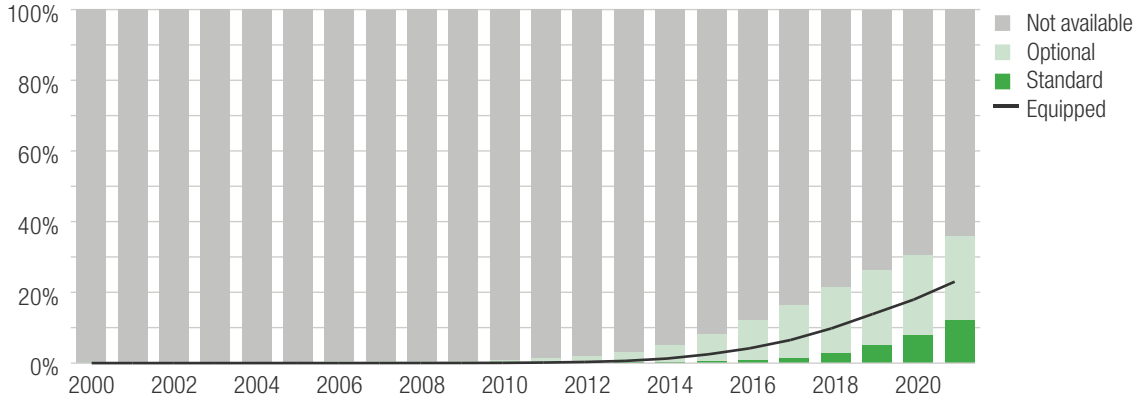


Figure 9 shows the percentage of registered vehicles with either standard or optional front crash prevention by calendar year. In 2009, front crash prevention was available on less than 1 percent of registered vehicles. By 2021, front crash prevention was standard or optional on 36 percent of registered vehicles, with about 23 percent of registered vehicles estimated to be equipped with the feature.

Figure 10: Predicted percentage of registered vehicles with front crash prevention by calendar year

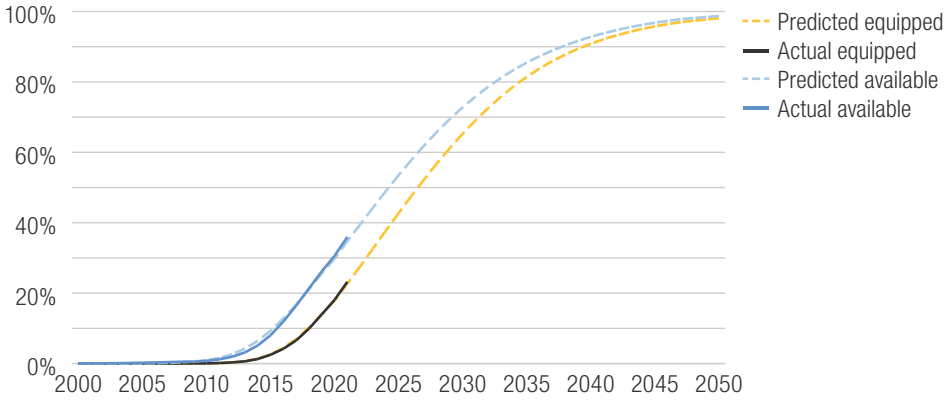


Figure 10 takes into account a voluntary commitment by many manufacturers to make AEB standard on most of their vehicles by 2022. It is predicted that 95 percent of registered vehicles will be equipped with the feature by 2044.

Figure 11: Percentage of new vehicle series with front automatic emergency braking by model year

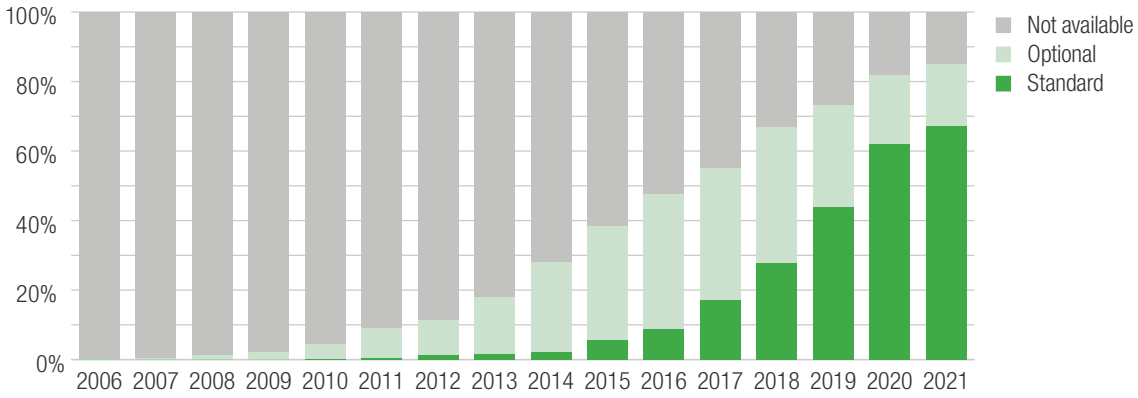


Figure 11 shows the percentage of vehicle series with either standard or optional front AEB by model year. These systems may also issue warnings. AEB was introduced in model year 2006 and by the 2015 model year had become standard on 6 percent and optional on 33 percent of vehicle series. For the 2021 model year, AEB was standard on 67 percent and optional on 18 percent of vehicle series.

Figure 12: Percentage of registered vehicles with front automatic emergency braking by calendar year

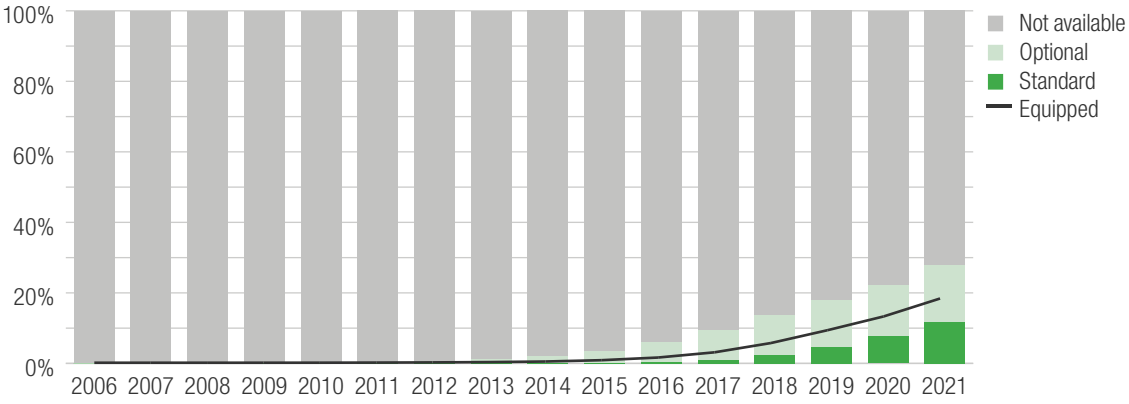


Figure 12 shows the percentage of registered vehicles with either standard or optional AEB by calendar year. In 2015, AEB was available on about 4 percent of registered vehicles. By 2021, AEB was standard or optional on 28 percent of registered vehicles but estimated to be present only on 18 percent.

Figure 13: Predicted percentage of registered vehicles with front automatic emergency braking by calendar year

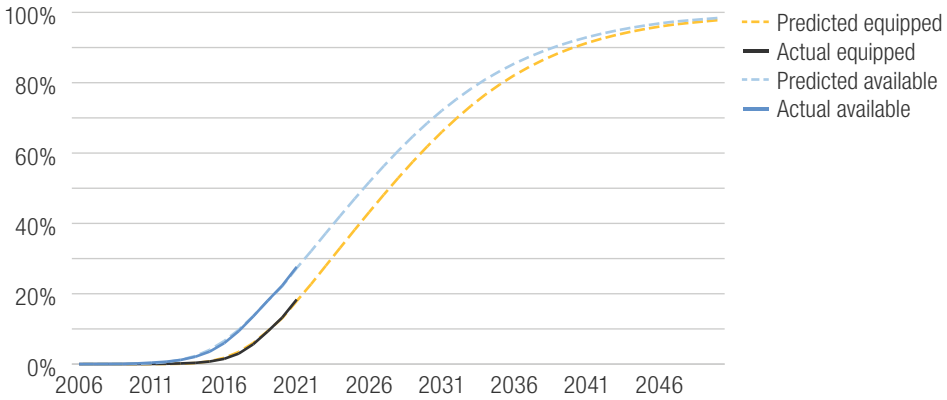


Figure 13 takes into account the voluntary commitment and shows the predicted registered vehicles with AEB by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with AEB in 2045.

Figure 14: Percentage of new vehicle series with rear cameras by model year

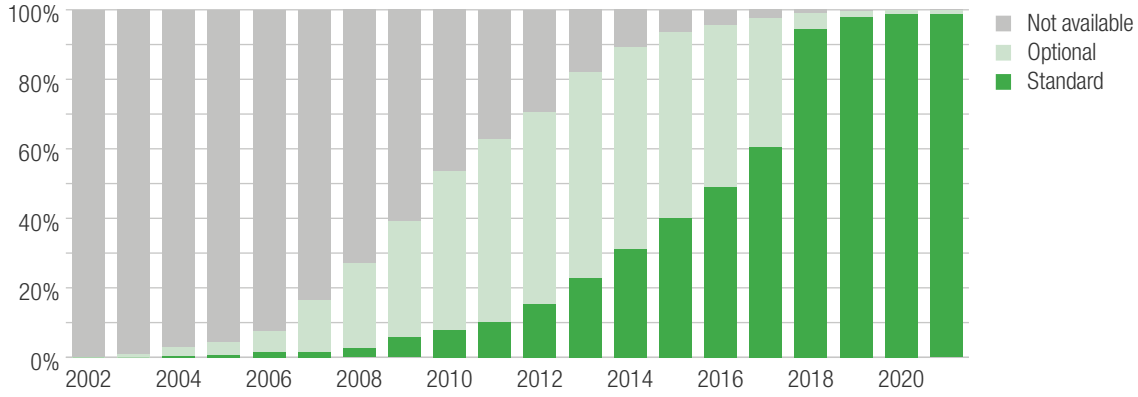


Figure 14 shows the percentage of vehicle series with either standard or optional rear cameras by model year. Rear cameras were introduced in model year 2002 and by the 2011 model year had become standard on 10 percent and optional on 53 percent of vehicle series. **Rear cameras are required on all new vehicles with a gross vehicle weight rating under 10,000 lbs produced after May 1, 2018.** For the 2021 model year, rear cameras were standard on 99 percent and optional on 1 percent of vehicle series.

Figure 15: Percentage of registered vehicles with rear cameras by calendar year

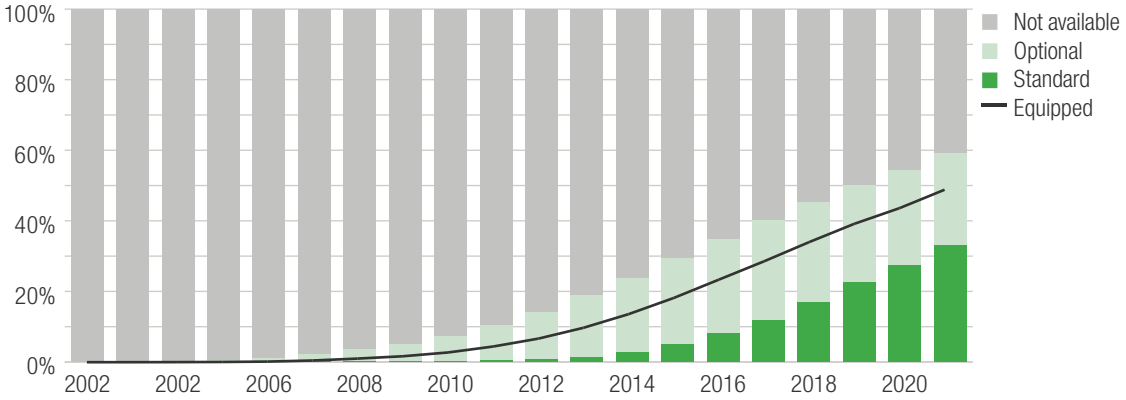


Figure 15 shows the percentage of registered vehicles with either standard or optional rear cameras by calendar year. In 2012, rear cameras were available on 14 percent of registered vehicles. By 2021, rear cameras were standard or optional on 59 percent of registered vehicles. It was estimated that 49 percent of registered vehicles were equipped with the feature.

Figure 16: Predicted percentage of registered vehicles with rear cameras by calendar year

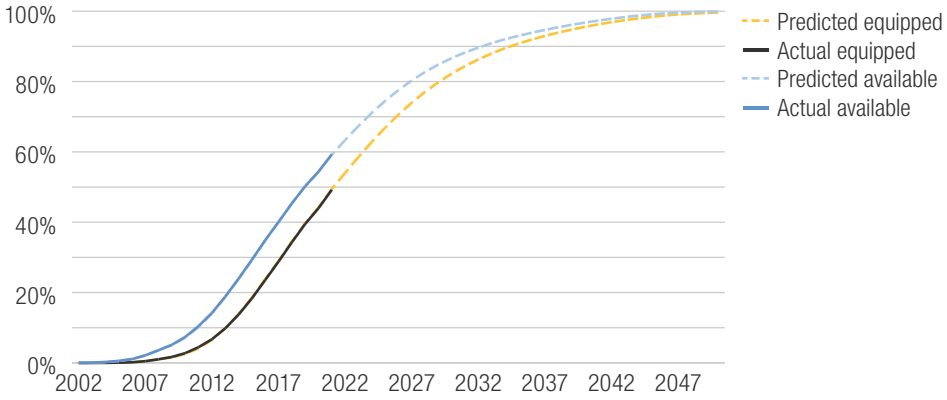


Figure 16 takes into account the 2018 mandate and shows the predicted registered vehicles with rear cameras by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with rear cameras in 2040.

Figure 17: Percentage of new vehicle series with curve adaptive headlights by model year

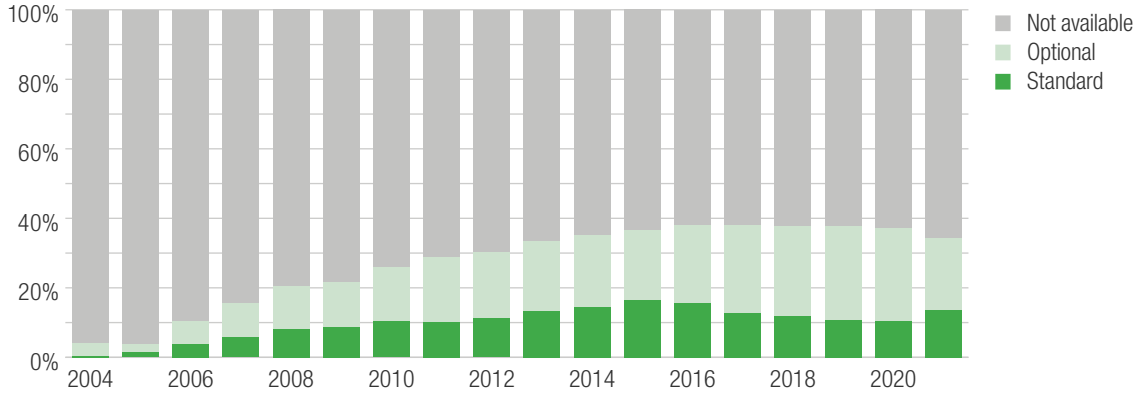


Figure 17 shows the percentage of vehicle series with either standard or optional curve adaptive headlights by model year. Curve adaptive headlights were introduced in model year 2004 and by the 2013 model year had become standard on 13 percent and optional on 20 percent of vehicle series. The percentage of vehicle series with curve adaptive headlights as standard peaked at 17 percent in the 2015 model year and then declined through the model year 2020. However, in the 2021 model year, it increased again, as curve adaptive headlights were installed on 14 percent of vehicle series as standard equipment and 21 percent of vehicle series as optional equipment.

Figure 18: Percentage of registered vehicles with curve adaptive headlights by calendar year

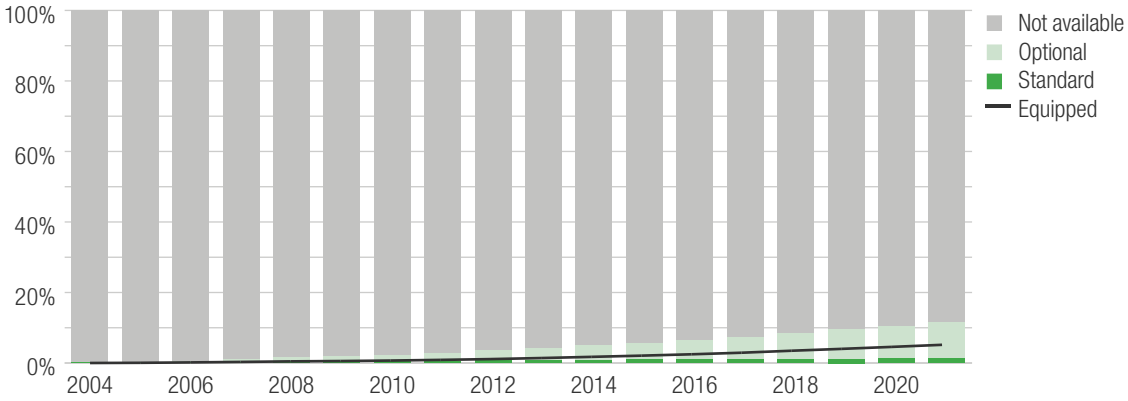


Figure 18 shows the percentage of registered vehicles with either standard or optional curve adaptive headlights by calendar year. In 2013, curve adaptive headlights were available on 4 percent of registered vehicles. By 2021, curve adaptive headlights were standard or optional on 12 percent of registered vehicles, but only 5 percent of registered vehicles were estimated to be equipped with the feature.

Figure 19: Predicted percentage of registered vehicles with curve adaptive headlights by calendar year

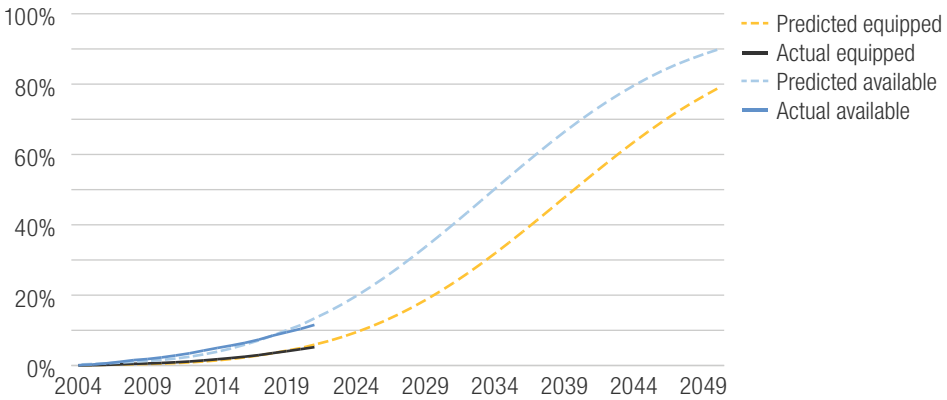


Figure 19 shows the predicted registered vehicles with curve adaptive headlights by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with curve adaptive headlights sometime after 2050.

Figure 20: Percentage of new vehicle series with lane departure warning by model year

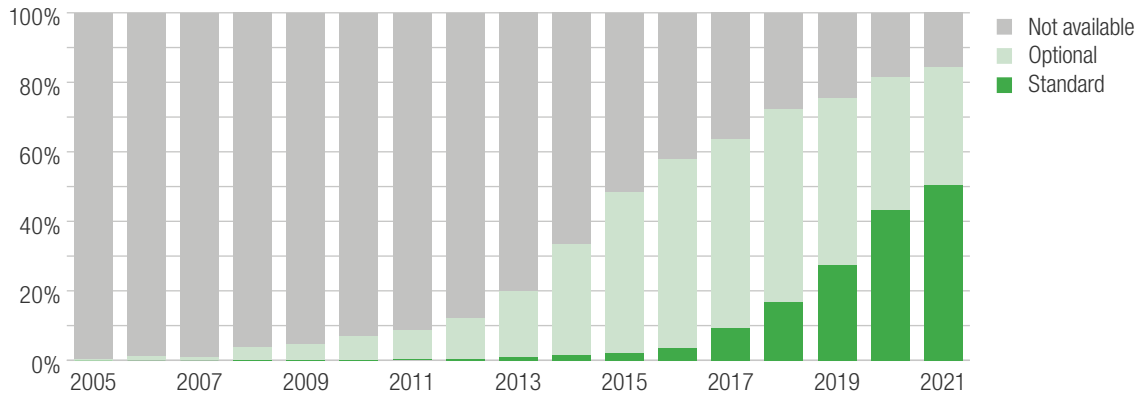


Figure 20 shows the percentage of vehicle series with either standard or optional lane departure warning by model year. Vehicles with systems that only warn drivers when they depart a lane and those with systems that both warn and provide lane keeping are included. Lane departure warning was introduced in model year 2005 and by the 2014 model year had become standard on about 2 percent and optional on 32 percent of vehicle series. For the 2021 model year, lane departure warning was standard on 51 percent and optional on 34 percent of vehicle series.

Figure 21: Percentage of registered vehicles with lane departure warning by calendar year

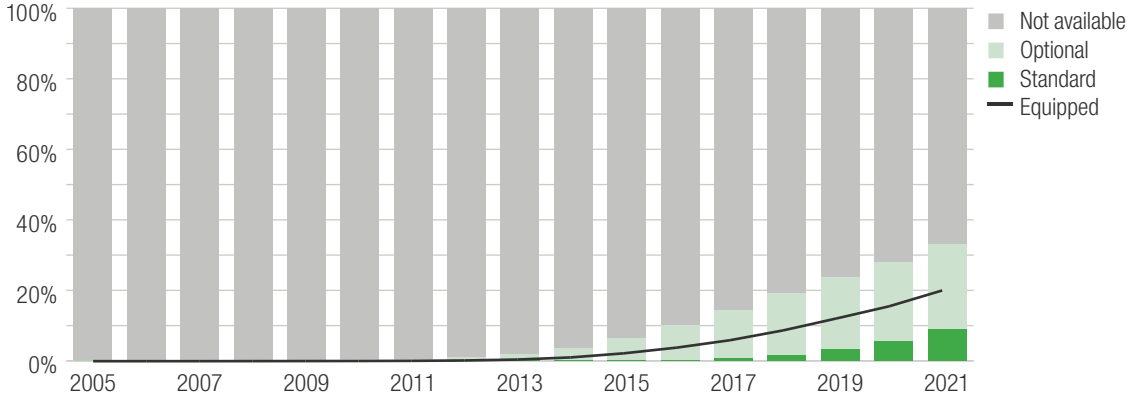


Figure 21 shows the percentage of registered vehicles with either standard or optional lane departure warning by calendar year. In 2014, lane departure warning was available on 4 percent of registered vehicles. By 2021, lane departure warning was standard or optional on 33 percent of registered vehicles, but only 20 percent of registered vehicles were estimated to be equipped with the feature.

Figure 22: Predicted percentage of vehicles with lane departure warning by calendar year

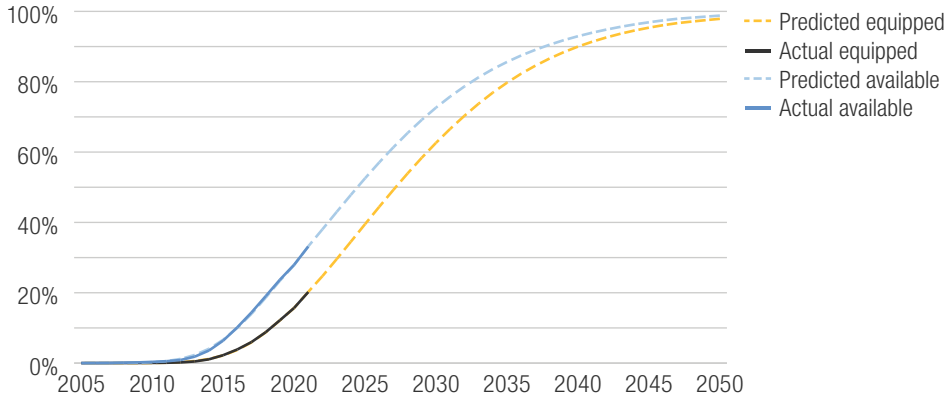


Figure 22 shows the predicted registered vehicles with lane departure warning by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with lane departure warning in 2045.

Figure 23: Percentage of new vehicle series with blind spot monitoring by model year

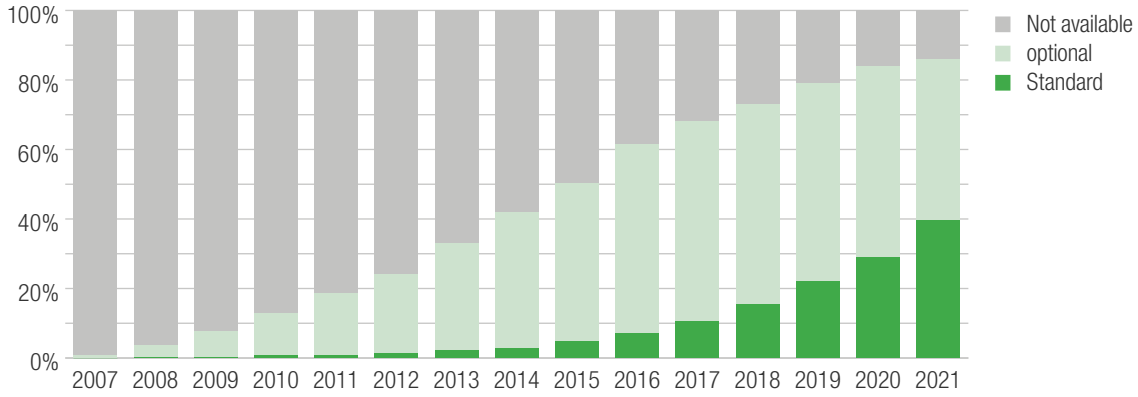


Figure 23 shows the percentage of vehicle series with either standard or optional blind spot monitoring by model year. Blind spot monitoring was introduced in model year 2007 and by the 2016 model year had become standard on 7 percent and optional on 54 percent of vehicle series. For the 2021 model year, blind spot monitoring was standard on 40 percent and optional on 46 percent of vehicle series.

Figure 24: Percentage of registered vehicles with blind spot monitoring by calendar year

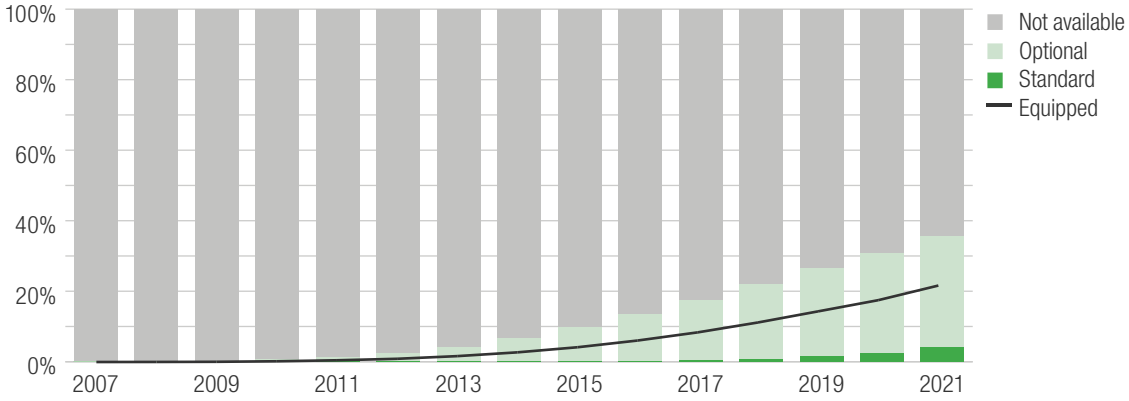


Figure 24 shows the percentage of registered vehicles with either standard or optional blind spot monitoring by calendar year. In 2016, blind spot monitoring was available on 14 percent of registered vehicles. By 2021, blind spot monitoring was standard or optional on 36 percent of registered vehicles, but only 22 percent of registered vehicles were estimated to be equipped with the feature.

Figure 25: Predicted percentage of registered vehicles with blind spot monitoring by calendar year

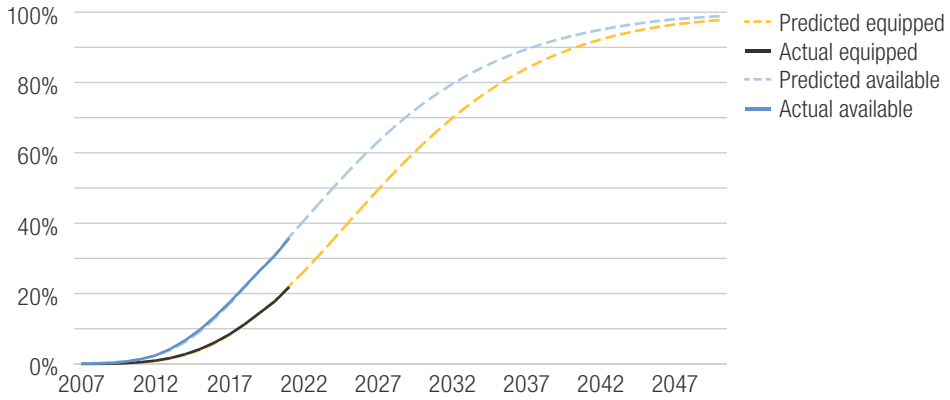


Figure 25 shows the predicted registered vehicles with blind spot monitoring by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with blind spot monitoring in 2045.

Figure 26: Percentage of new vehicle series with adaptive cruise control with lane centering by model year

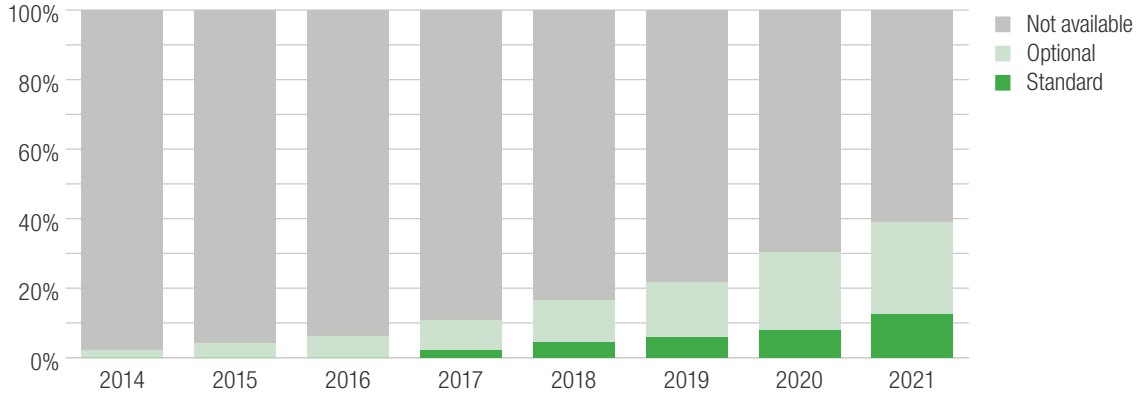


Figure 26 shows the percentage of vehicle series with either standard or optional adaptive cruise control with lane centering by model year. The systems include adaptive cruise control with some form of steering-based lane keeping and with complete stop capability. Adaptive cruise control with lane centering was introduced in model year 2014 and by the 2017 model year had become standard on 2 percent and optional on 9 percent of vehicle series. For the 2021 model year, adaptive cruise control with lane centering was standard on 12 percent and optional on 27 percent of vehicle series.

Figure 27: Percentage of registered vehicles with adaptive cruise control with lane centering by calendar year

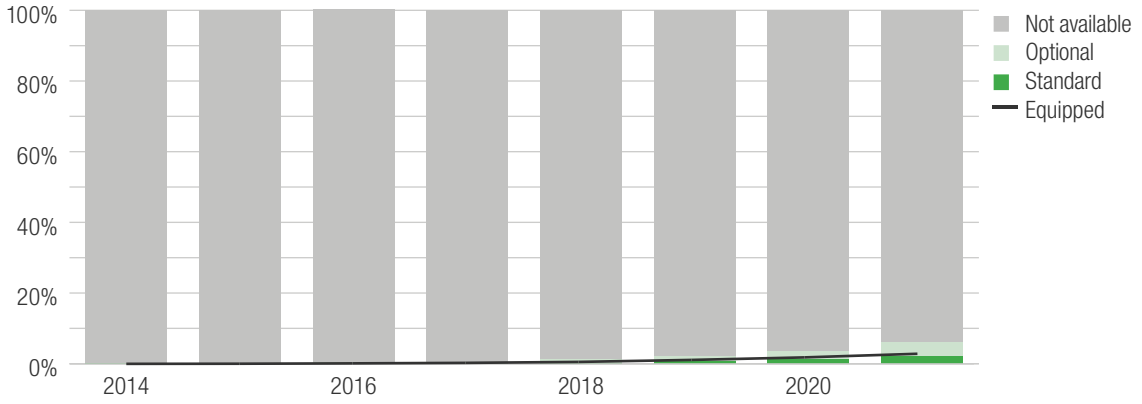


Figure 27 shows the percentage of registered vehicles with either standard or optional adaptive cruise control with lane centering by calendar year. In 2016, adaptive cruise control with lane centering was available on less than 1 percent of registered vehicles. By 2021, adaptive cruise control with lane centering was standard or optional on 6 percent of registered vehicles, but only 3 percent of registered vehicles were estimated to be equipped with the feature.

Figure 28: Predicted percentage of registered vehicles with adaptive cruise control with lane centering by calendar year

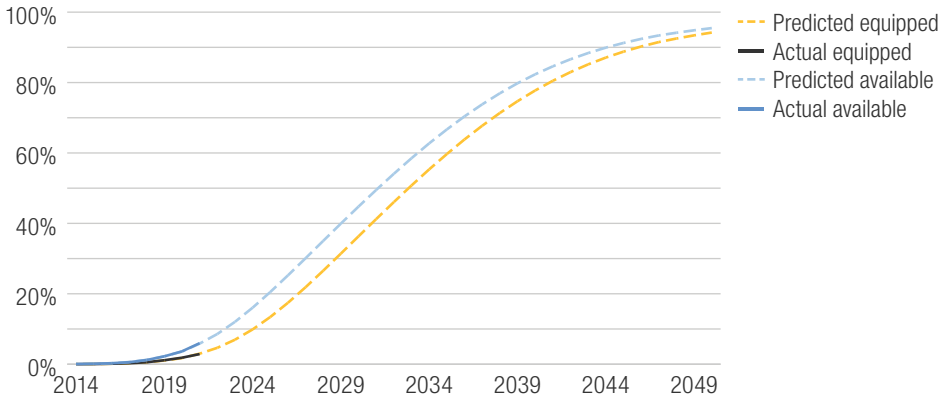


Figure 28 shows the predicted registered vehicles with adaptive cruise control with lane centering by calendar year. It is predicted that 95 percent of registered vehicles will be equipped with adaptive cruise control with lane centering sometime after 2050.

Figure 29: Predicted registered vehicles equipped with collision avoidance systems, 2021 and 2026 calendar years

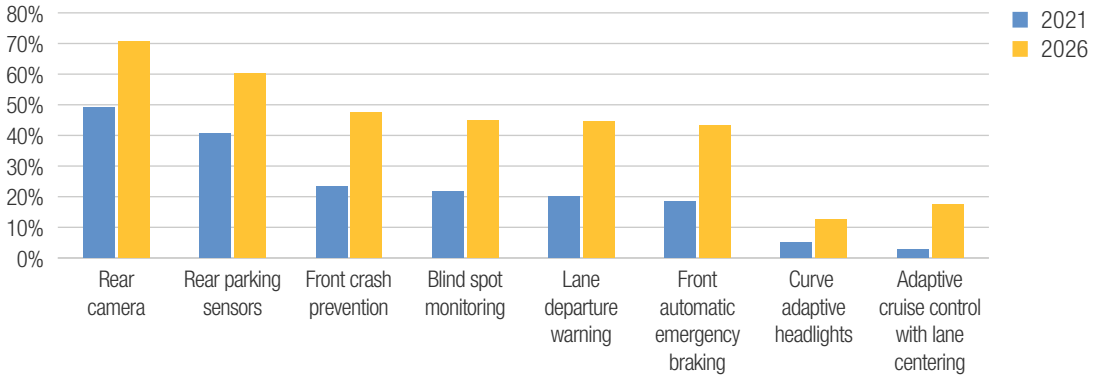


Figure 29 shows the percentage of registered vehicles estimated to be equipped with the features covered by this report in 2021 and 2026. The presence of all systems is estimated to increase by over 20 percent by 2026 except curve adaptive headlights and adaptive cruise control with lane centering, which are estimated to increase 7 percent and 15 percent by 2026, respectively. Rear cameras are estimated to be equipped on 71 percent of the registered vehicle population by 2026. Rear parking sensors are estimated to exceed a 60 percent fleet penetration by 2026. Front AEB is estimated to increase from 18 percent of the registered vehicle population in 2021 to 43 percent in 2026. This increase can be attributed to the voluntary commitment to equip vehicles with AEB by 2022.

Discussion

It takes many years for new vehicle features to spread through the registered vehicle fleet, even when they are required by the government. Among the collision avoidance features discussed in this report, only ESC and rear cameras have been mandated, while manufacturers have agreed to voluntarily equip vehicles with front automatic emergency braking by 2022.

With the exception of ESC, estimated take rates have been included for optional features. Although it is not known with absolute certainty how many of the optional features were purchased, estimates were made from VIN data supplied from several manufacturers. This provides a better estimate of the actual penetration of collision avoidance features in the vehicle fleet. Equipped rates varied considerably by feature. About 18 percent of the fleet was estimated to be equipped with front automatic emergency braking, even though it was available on 28 percent of vehicles in the 2021 fleet (12 percent standard and 16 percent optional). Rear cameras, however, were estimated to be present on 49 percent of the 2021 registered vehicle fleet, with 33 percent having it standard and 26 percent having it available as an option.

The percentage of new vehicle series with a given feature as standard has increased steadily for each feature except curve adaptive headlights since their introduction. Curve adaptive headlights were standard on fewer and fewer vehicles from model years 2015 to 2020. Consequently, curve adaptive headlights may not reach 95 percent availability in the fleet as soon as the other features, if they ever become so prevalent. The headlight evaluation program from the Insurance Institute for Highway Safety (IIHS) has found that headlights can provide sufficient levels of lighting without adaptive technology. For example, many vehicles including the 2021 Honda Insight and the 2021 Genesis G90 earn the highest rating of good in the IIHS test and are equipped with LED headlights that are not curve adaptive. This might have had an impact and slowed down the growth of curve adaptive headlights in the fleet.

Another feature predicted to reach 95 percent fleet penetration after 2050 is adaptive cruise control with lane centering, which used together represent Level 2 driving automation according to SAE International's recommended nomenclature (J3016). Introduced in the model year 2014, adaptive cruise control with lane centering was only available on a small number of vehicles. In the 2021 fleet, adaptive cruise control with lane centering was estimated to be available on only 6 percent of the vehicles, with 3 percent equipped with it. Although the percentage of new vehicle series with adaptive cruise control with lane centering as standard has increased since its introduction, it will still take decades until a majority of vehicles on the road are equipped with it.

Accounting for the optionally equipped vehicles in the analysis, we predict features will reach half of the registered vehicle fleet 1 to 5 years later than projections that assume all vehicles with an optional system were actually equipped with that system.

A prior HLDI study (2019a) found that Honda and Subaru vehicles equipped with effective collision avoidance systems persisted longer in the vehicle fleet. Another HLDI report on ESC also found that ESC-equipped vehicles last longer in the vehicle fleet than non-ESC equipped vehicles (HLDI, 2014a). This could lead to a slowdown in the turnover of the fleet, as vehicles are lasting longer. However, a sensitivity analysis on changes in the rate of attrition found that small changes in the rate of attrition over time had minimal impact on results. Consequently, the potential longer life span for collision avoidance-equipped vehicles was not accounted for in the predictions.

The global pandemic caused by COVID-19 has introduced a great deal of uncertainty. It has affected the economy, including new and used vehicle sales. Although a sharp decrease in new vehicle sales was observed in 2020, the U.S. economy was considered by some to be fully recovered from the COVID-19 pandemic as of June 2021 (Siegel & Dam, 2021). As a result, the 2020 data was not used to estimate the future in this study.

However, recent and future surges in COVID-19 cases could bring uncertainty, and the pandemic has changed the way we work and live. It is currently unclear what the short- and long-term effects of the pandemic will be. As many workers have shifted from office work to telecommuting, it is possible this will have a much more long-lasting effect on vehicle sales or fleet turnover. It may be years before the full implications of the pandemic are fully researched and understood. This study will be updated as new information and data are made available.

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 toward 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 because no feature has reached a 100 percent prevalence yet. The model was carefully chosen to fit the existing (past year) data well, and there is no reason to believe that it does not adequately describe the future data. It may be the case that 100 percent prevalence is never reached, as some people tend to keep old cars as collectable vehicles. 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.

Additionally, the work presented here was based on data from a limited number of vehicle manufacturers. The estimates for the optional-equipped rates were the best estimates possible with the available data. Sensitivity analysis was conducted by excluding an individual manufacturer from the dataset and using the remaining data for the analysis. For most safety features, the elimination resulted in only minimal changes in our feature-equipped estimates. However, for a few manufacturers, larger changes were observed. Additional data from manufacturers would likely result in better estimates.

Another limitation is that the prediction was based on the coarse calendar year/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 assumptions of 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 therefore it is reasonable to believe that our predictions for the future fleet are the best possible given the limitations.

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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. HH