U.S. Department of Transportation
National Highway Traffic Safety Administration

TRAFFIC SAFETY FACTS
Research Note

NHTSA

DOT HS 812 277

May 2016

Estimating Lives Saved by Electronic Stability Control, 2010–2014

Summary

In 2014 an estimated 1,580 lives were saved by electronic stability control (ESC) among passenger vehicle (PV) occupants. These lives saved consisted of 681 passenger car (PC) occupants and 899 light-truck and van (LTV) occupants.

The estimated 1,580 lives saved in 2014 is an increase over the estimated lives saved in previous years, 1,366 lives saved in 2013, 1,225 lives saved in 2012, 896 lives saved in 2011, and 682 lives saved in 2010. Added together ESC has saved more than 4,100 lives during the 5-year period from 2010 to 2014. NHTSA's estimates of effectiveness for ESC have been updated in the technical report, *Updated Estimates of Fatality Reduction by Electronic Stability Control* (Kahane, 2014) which is discussed in the Background section of this Research Note.

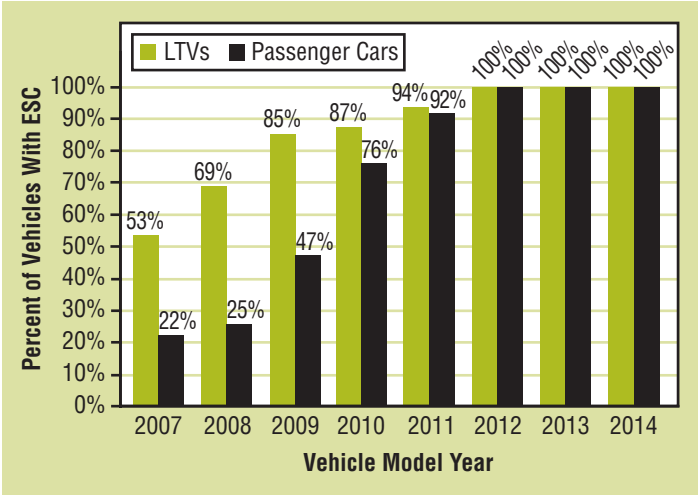
Introduction

NHTSA's National Center for Statistics and Analysis (NCSA) produces annual estimates of the number of lives saved by various occupant protection devices and laws. These estimates are produced to quantify the benefits of ESC, as well as seat belts, frontal air bags, motorcycle helmets, child restraints, and minimum-legal-drinking-age laws.

In order to minimize single-vehicle crashes, primarily due to loss-of-control, Federal Motor Vehicle Safety Standard (FMVSS) No. 126 was required to be enforced by September 1, 2011. As such, all new passenger cars, light trucks, and vans must be equipped with ESC systems. As more of the PV fleet becomes equipped with ESC, the estimates of lives saved will continue to rise. In addition to providing the details of the methodology for estimating the number of lives saved by ESC, this report updates the annual estimates of lives saved by ESC in 2014.

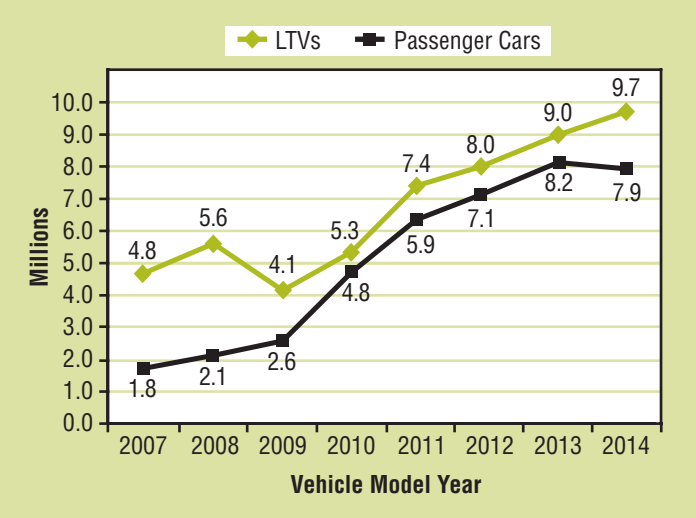
Figure 1 shows the percentage of PVs manufactured with ESC, by vehicle type (PC or LTV) and vehicle model years 2007 to 2014. It can be seen that in past model years (MYs), a higher percentage of LTVs were equipped with ESC as compared to PCs. However, these percentages have been at 100 percent since 2012, as manufacturers comply with FMVSS No. 126. Figure 2 shows the number of PVs manufactured with ESC, by vehicle type and vehicle MY. The penetration of ESC into the vehicle fleet can be seen in Figure 3. The percentages are conservative as they only include passenger vehicles of MY 2006 and later. As the proportion of vehicles equipped with ESC increases, the number of lives saved due to ESC increases as well. By 2014, approximately 99 million PVs of MY 2006 or later were manufactured with ESC; this represents 38.8 percent of the 255 million PVs registered in the United States in that year. This estimate of 99 million PVs with ESC does not account for two opposing trends for which data does not exist: the decrease due to vehicle attrition among ESC vehicles MY 2006 or later and the increase that would be seen by including vehicles of MY 2005 or earlier that have ESC.

Figure 1
Percentage of Vehicles Manufactured With ESC, by Vehicle Type and Model Year



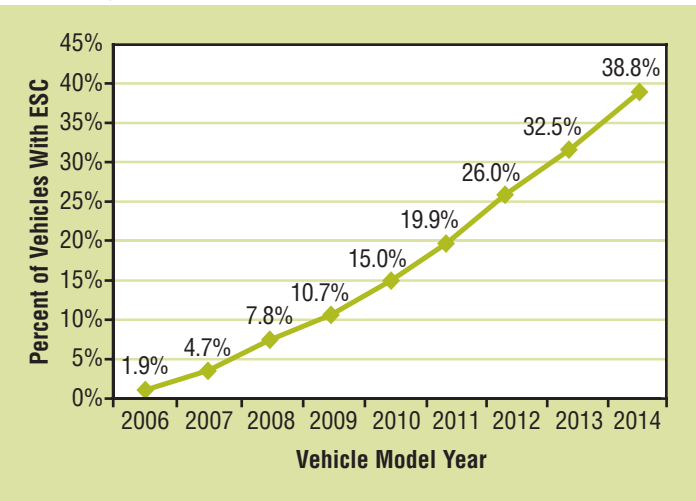
Source: Ward's Automotive Yearbook 2008–2015

Figure 2
Number of Vehicles Manufactured With ESC, by Vehicle Type and Model Year, in Millions



Source: Ward's Automotive Yearbook 2008–2015

Figure 3
Percent of Passenger Vehicle Fleet Produced With ESC Standard, Model Year 2006 or Later



Source: R.L. Polk & Company, Federal Highway Administration, Ward's Automotive Yearbook 2007–2015

Background

In 2014, NHTSA published the report, *Updated Estimates of Fatality Reduction by Electronic Stability Control* (Kahane, 2014), which updated the ESC effectiveness estimates for PCs and LTVs. The report used recent years of aggregated data to re-analyze ESC's role in saving lives in fatal motor vehicle crashes. This report was an update of the report, *Crash Prevention Effectiveness of Light Vehicle Electronic Stability Control: An Update of the 2007 NHTSA Evaluation* (Sivinski, 2011). As of 2014 the ESC effectiveness estimates are 37.8 percent for PCs (down from 55%) and 55.9 percent for LTVs (up from 50%). The estimates of the ESC effectiveness reported in this research note are based on these updated estimates.

The 2011 report (Sivinski, 2011) describes in detail the methodology used to estimate the effectiveness of ESC. According to this report, ESC technology is expected to reduce the number of crashes due to driver error and loss of control. ESC systems use automatic computer controlled braking of individual wheels to help the driver maintain control in risky driving scenarios. Such a scenario occurs when the vehicle begins to lose directional stability at the rear wheels (spin out) or directional control at the front wheels (plow out). The biggest benefit of ESC lies in reduction of single-vehicle crashes in which the driver tends to lose control and the vehicle runs off the road.

The 2011 report used NHTSA's Fatality Analysis Reporting System (FARS) data on fatal crashes to estimate the effectiveness of ESC. Since only vehicle models that transitioned from "ESC not available" to "ESC standard" were included in the analysis, estimates were based on a small sample size. Effectiveness of ESC was measured by the difference in the ratio of crashes predicted to be affected by ESC (single-vehicle crashes, rollovers, etc.), to control crashes in vehicles with and without ESC. A control crash included a crash in which a vehicle (1) was stopped, parked, backing up, or entering/leaving a parking space prior to the crash, or (2) traveled at a speed less than 10 mph, (3) was struck in the rear by another vehicle, or (4) was a non-culpable party in a multivehicle crash on a dry road.

The previously updated estimates of the ESC effectiveness (37.8% for PCs and 55.9% for LTVs) were used to estimate lives saved in this report. These estimates apply exclusively to fatal single-vehicle crashes that did not involve pedestrians, pedalcyclists, or animals in the first harmful event. For additional ESC effectiveness estimates that are further stratified by crash type, refer to the 2014 report.

The estimates of ESC effectiveness represent the decrease in probability that a vehicle is involved in a crash that results in an occupant fatality. Estimates of effectiveness are also produced for seat belts, frontal air bags, and other devices and laws. For more information about how NHTSA produces estimates of lives saved, refer to Lives Saved FAQs, published in December 2009 (Report No. DOT HS 811 105, available at www-nrd.nhtsa.dot.gov/Pubs/811105.pdf).

Methodology

The Insurance Institute for Highway Safety (IIHS) lists ESC-equipped vehicles among vehicles of MY 1996 to MY 2016. This information was used to determine whether each make/model of vehicle in FARS data had (1) ESC standard, (2) ESC optional, or (3) ESC not available. This list was updated in 2015, which contributed to minor shifts in the annual fatality counts among occupants of vehicles with ESC standard.

The vehicle identification number (VIN) for each vehicle recorded in FARS, in conjunction with the list of ESC equipped vehicles, was used to classify each vehicle into one of the following categories:

i. ESC standard, where it was guaranteed to have ESC;

ii. ESC optional, where manufacturers preselected a subset of these vehicles to have ESC, thus giving buyers an option to pay extra to purchase vehicles with ESC; and

iii. ESC not available, where the vehicle did not have ESC.

The lives saved estimates in this report are limited to PVs that had ESC standard. See the Limitations section of this report for more details regarding ESC classification of a vehicle.

The formula used to calculate the estimate of lives saved (LS) from ESC depends on: (1) the number of single-vehicle crash fatalities (F) that did not involve pedestrians, pedalcyclists, or animals in the first harmful events, and (2) the effectiveness (E) of the ESC in the involved single-vehicle with ESC standard. Specifically, the LS estimate was computed by the formula: LS = F * E / (1-E). The number of single-vehicle crash fatalities was separated into two counts: PC occupants (1,120 in 2014) and LTV occupants (709 in 2014). The effectiveness of ESC that was inserted into this formula for LS is 0.378 for PC occupants and 0.559 for LTV occupants (Kahane, 2014).

Table 1 presents the lives saved estimates for PCs and LTVs equipped with ESC standard. In 2014 of an estimated total of 1,580 lives saved by ESC, 681 lives were of PC occupants and 899 lives were of LTV occupants. These estimates of lives saved were produced using the formula mentioned in the above paragraph, along with the fatality counts for the appropriate year. Specifically, a fatality count of 1,120 and an effectiveness of 0.378 were used to produce an estimate of 681 lives saved for PCs in 2014 [681 = 1,120*0.378 / (1-0.378)]. Similarly, a fatality count of 709 and an effectiveness of 0.559 were used to produce an estimate of 899 lives saved for LTVs in 2014 [899 = 709 *0.559 / (1-0.559)].

A new variable was defined that indicated which PVs were coded to have ESC standard and which did not have ESC standard. This ESC variable was used to produce counts of ESC-equipped PVs in fatal crashes, as well as the fatality counts from occupants of those vehicles. The fatality counts in this report reflect occupant fatalities in PVs with ESC standard that were involved in single-vehicle crashes, as recorded in FARS 2010-2014. The number of vehicles with ESC standard declines significantly among older MY vehicles. As more vehicles on the road are equipped with ESC, the number of lives saved by ESC will continue to rise. See Figures 1, 2, and 3 above for information on the percentage and count of PVs manufactured with ESC, for each vehicle MY.

This report examines ESC in PCs and LTVs. Accordingly, the following motor vehicle fatalities that occurred in 2014 were not used in producing the 2014 ESC lives saved estimates: single-vehicle fatalities in PVs that did not have ESC standard, multi-vehicle crash fatalities, motorcycle fatalities, large-truck fatalities, bus fatalities, pedestrian fatalities, and pedalcyclist fatalities. Since the effectiveness estimates for ESC do not apply to single-vehicle fatalities that involved pedestrians, pedalcyclists, or animals in the first harmful event, such fatalities are not included in the 2014 count of 1,829 single-vehicle crash fatalities in PVs equipped with ESC standard.

Results

In 2014 there were 21,022 PV occupant fatalities. Only 1,829 (8.7%) of these fatalities were in PVs with ESC standard that were involved in single-vehicle crashes and did not involve pedestrians, pedalcyclists or animals in the first harmful events. These included 1,120 PC occupants and 709 LTV occupants. These 1,829 fatalities were used to produce an estimate of lives saved by ESC in 2014.

This 2014 ESC lives saved estimate of 1,580 is a substantial increase over ESC lives saved estimates for the previous years (1,366 ESC lives saved in 2013, 1,225 ESC lives saved in 2012, 896 lives saved in 2011, and 682 lives saved in 2010). This increase is due to an increase in the number of PVs that were equipped with ESC standard. It is important to note that as the overall PV fleet becomes more equipped with ESC, estimates of lives saved for both PC and LTV occupants will continue to rise.

Table 1
ESC Lives Saved Estimates, by Year and Vehicle Type, 2010-2014

Year	Passenger Cars With ESC Standard (1)	Light Trucks/ Vans With ESC Standard (2)	Passenger Vehicles With ESC Standard Total = (1) + (2)
2014	681	899	**1,580**
2013	579	787	**1,366**
2012	466	759	**1,225**
2011	329	567	**896**
2010	236	446	**682**
TOTAL	**2,291**	**3,458**	**4,169**

Source: NHTSA, NCSA, 2010–2013 FARS Final File, FARS 2014 Annual Report File and IIHS list of ESC-equipped vehicles.
Note: Fatality counts used to estimate ESC lives saved are limited to single-vehicle crash fatalities, where the crash did not involve a pedestrian, pedalcyclist, or animal in the first harmful event.

Limitations

It is important to note that there are certain limitations in calculating estimates of the number of lives saved by ESC, as discussed below.

Limitation #1 – Some vehicle make/models have ESC standard, where all of those vehicles were manufactured with ESC; while others have ESC optional, where manufacturers pre-selected which subset of these vehicles will have ESC and which will not; thus giving the buyer an option of paying extra to purchase a vehicle with ESC.

In FARS single-vehicle crashes in 2014 a total of 1,829 fatalities occurred in PVs which had ESC standard while 1,310 fatalities occurred in PVs which had ESC optional. This indicates that there are approximately 39.6 percent more passenger vehicles with ESC standard than ESC optional, this percentage is up 22.5 percent in 2014 from 17.1 percent in 2013. Among PCs, 1,120 fatalities occurred in vehicles which had ESC standard and 850 in vehicles which had ESC optional. By comparison, among LTVs there were 709 ESC standard and 460 ESC optional fatalities. Unfortunately, information is limited regarding which vehicles were actually equipped with ESC, when classified as optional.

The estimates of ESC lives saved reported in this research note are limited to vehicles with ESC standard. This makes the lives saved estimates conservative. These estimates would be higher if the number of vehicles with ESC could be determined exactly from the VIN. However, the VIN does not contain information on the status of ESC in vehicles.

Limitation #2 – Based on the opinion of NHSTA experts, in producing annual ESC lives saved estimates for this report, ESC effectiveness estimates were only used for occupants of PC and LTV single-vehicle crashes. Due to the smaller sample size that was available to produce these effectiveness estimates, other ESC effectiveness estimates (i.e., multivehicle crashes, rollovers) were not used to produce individual ESC lives saved estimates.

Limitation #3 – The effectiveness estimates from Kahane's 2014 report and Sivinski's 2011 report are based at the vehicle level only. The lives-saved estimates reported in this research note assume that an effectiveness estimate, such as 37.8 percent for PCs, based on reducing vehicle involvement in fatal crashes, can also be used in estimating a percent reduction in fatalities. All other effectiveness estimates produced by NCSA are at the person level, such as seat belts, air bags, motorcycle helmets, child seats, and minimum legal drinking age.

Limitation #4 – The ESC effectiveness estimates are weighted toward the performance of ESC in newer vehicles, as relatively fewer older vehicles have ESC. As the vehicles with ESC continue to age, and all new vehicles are manufactured with ESC, we expect that years from now, ESC will eventually be in all vehicles on the road, including older vehicles. Due to this increasing availability of ESC throughout the vehicle fleet, ESC effectiveness estimates will continue to change.

References

Kahane, C. J. (2014, May). *Updated estimates of fatality reduction by electronic stability control* (Evaluation Note. Report No. DOT HS 812 020). Washington, DC: National Highway Traffic Safety Administration.

Sivinski, R. (2011, June). *Crash prevention effectiveness of light-vehicle electronic stability control: An update of the 2007 NHTSA evaluation* (Report No. DOT HS 811 486). Washington, DC: National Highway Traffic Safety Administration.

Starnes, M. (2014, June). *Estimating lives saved by electronic stability control, 2008–2012* (Traffic Safety Facts Research Note. Report No. DOT HS 812 042). Washington, DC: National Highway Traffic Safety Administration.

For More Information

This Research Note was written by Caitlin Webb, statistician, Bowhead Logistics Solutions, LLC., working with the Mathematical Analysis Division, National Center for Statistics and Analysis, NHTSA. For questions regarding the information presented in this document, please contact ncsawebb@dot.gov.

Suggested APA Format Citation for This Report:

Webb, C. (2016, May). *Estimating lives saved by electronic stability control, 2010–2014* (Traffic Safety Facts Research Note. Report No. DOT HS 812 277). Washington, DC: National Highway Traffic Safety Administration.

U.S. Department of Transportation

National Highway Traffic Safety Administration

This research note and other general information on highway traffic safety may be accessed by Internet users at: www-nrd.nhtsa.dot.gov/CATS/index.aspx