



# Estimating Lives Saved by Electronic Stability Control, 2008–2012

## Summary

In 2012, electronic stability control (ESC) saved an estimated 446 lives among passenger car (PC) occupants, and 698 lives among light truck and van (LTV) occupants, for a total of 1,144 lives saved among passenger vehicle (PV) occupants. PVs consist of PCs and LTVs.

This estimate of 1,144 lives saved in 2012 is a substantial increase over the estimated 859 lives saved in 2011, 736 lives saved in 2010, 598 lives saved in 2009, and 551 lives saved in 2008. Combining these annual counts shows that ESC has saved close to 4,000 lives during the 5-year period from 2008 to 2012. Note: The NHTSA effectiveness estimates for ESC have been updated in “Updated Estimates of Fatality Reduction by Electronic Stability Control” (Kahane, in review) and this update is discussed in the Background section of this research note.

## Introduction

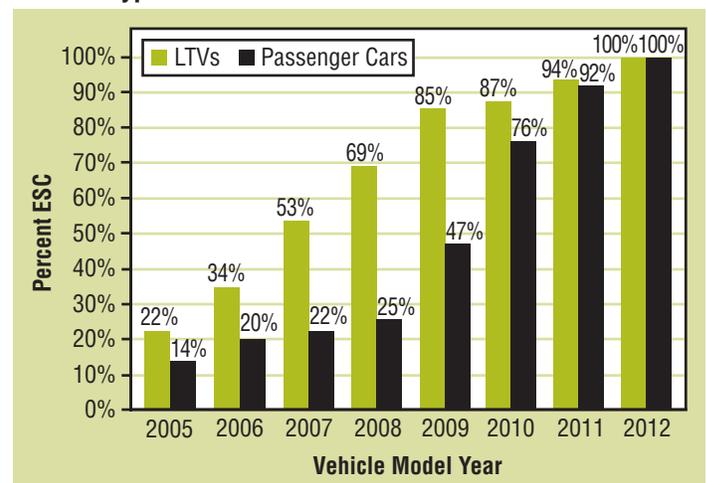
NHTSA’s National Center for Statistics and Analysis (NCSA) produces annual estimates of the number of lives saved by various occupant protection devices and laws. These estimates of the number of lives saved are produced in order to quantify the benefits of seat belts, frontal air bags, motorcycle helmets,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

In recent years, the percentage of PVs equipped with ESC systems has increased significantly. Federal Motor Vehicle Safety Standard (FMVSS) No. 126 was required to be in place and in force by September 1, 2011. As such, all new PCs and LTVs must be equipped with ESC and comply with this standard. It is important to note that as more of the overall PV fleet becomes equipped with ESC, the lives-saved estimate will continue to rise. This report updates the progress and details the methodology for estimating the number of lives saved annually by ESC systems.

Figure 1 below shows the *percentage* of PVs manufactured with ESC, by vehicle type (PC or LTV), and vehicle model year (MY 2005 to MY 2012). Figure 2 shows the *number* of

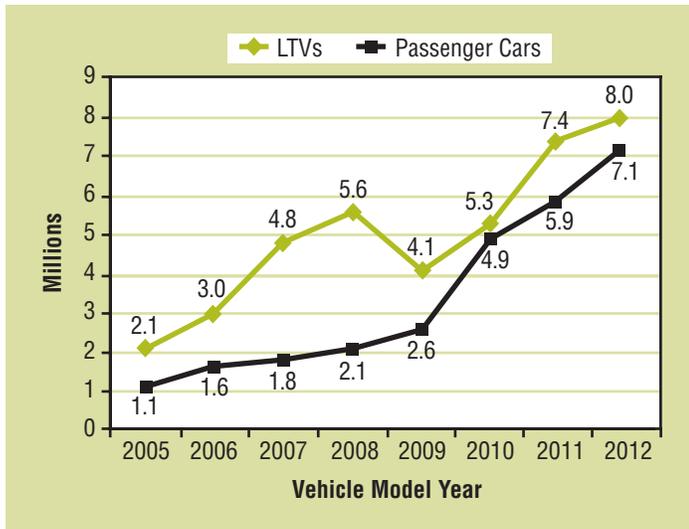
PVs manufactured with ESC, by these vehicle types and vehicle MYs. Figure 1 shows that in past MYs, a higher percentage of LTVs have ESC compared to PCs, but both these percentages are now at 100 percent as manufacturers comply with FMVSS No. 126. The decline in LTVs manufactured with ESC, from 5.6 million in MY 2008 to 4.1 million in MY 2009, was due to the large reduction in overall vehicles manufactured in 2009 associated with economic factors. The penetration of ESC into the vehicle fleet can best be seen by combining the information from Figures 1 and 2. As the proportion of vehicles on the road that are equipped with ESC increases, the number of lives saved by ESC will continue to increase. In 2012, approximately 70 million PVs of MY 2004 or later had ESC; this represents 28.4 percent of the 246 million PVs in the country in 2012. This estimate of 70 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 2004 or later, and the increase that would be seen by including vehicles of MY 2003 or before that have ESC.

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



Source: Ward’s Automotive Yearbook

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



Source: Ward's Automotive Yearbook

## Background

In 2014, NHTSA published the report, "Updated Estimates of Fatality Reduction by Electronic Stability Control" (DOT HS 812 020), written by Chuck Kahane, which updated ESC effectiveness estimates for PCs and LTVs. Kahane's report is based on the addition of several years of recent data used to re-analyze ESC's role in fatal crashes, and updates the lengthy August 2011 NHTSA report (DOT HS 811 486) titled, "Crash Prevention Effectiveness of Light-Vehicle Electronic Stability Control: An Update of the 2007 NHTSA Evaluation," written by Robert Sivinski. 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%), and these updated effectiveness estimates are used to produce the lives saved estimates in this research note.

The 2011 technical report describes in detail the methodology used to estimate the effectiveness of ESC. It states that the 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 situations in which the vehicle is beginning to lose directional stability at the rear wheels (spin out) or directional control at the front wheels (plow out). The largest benefit is focused on the reduction of single-vehicle crashes where a vehicle lost control and ran off the road.

The 2011 report looked at NHTSA's Fatality Analysis Reporting System (FARS) data on fatal crashes in order to estimate the effectiveness of ESC. Only vehicle models that transitioned from "ESC not available" to "ESC standard" could be included in that report, which resulted in 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. Control crashes were those 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, or (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 updated ESC effectiveness estimates (37.8 percent for PCs, 55.9 percent for LTVs) used to estimate lives saved in this report 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.

Effectiveness estimates represent the decrease in probability that a vehicle is involved in a crash that results in an occupant fatality. Effectiveness estimates are also produced for seat belts, frontal air bags, and other devices and laws. For more information about how NHTSA produces lives saved estimates, 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](http://www-nrd.nhtsa.dot.gov/Pubs/811105.pdf)).

## Methodology

The Insurance Institute for Highway Safety's list of ESC-equipped vehicles among vehicles of MY 1996 to MY 2014 was used to determine whether or not each make/model of vehicle in FARS data had (1) ESC standard, or (2) ESC optional, or (3) ESC not available. This list was updated in 2014, and this update contributed to minor shifts in the annual fatality counts among occupants of vehicles with ESC standard.

The vehicle identification number (VIN) for each vehicle reported to FARS, in conjunction with the list of ESC-equipped vehicles, was used to determine whether the vehicle was ESC standard, where it was guaranteed to have ESC; or ESC optional, where manufacturers pre-selected which subset of these vehicles had ESC and which subset did not have ESC, thus giving buyers an option of paying extra if they chose to purchase vehicles with ESC; or 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, and thus were known to have ESC in the vehicle. See the Limitations section of this report for more details.

A variable was established that showed which PVs were coded to have ESC standard or not have ESC standard. This ESC variable was used to produce counts of ESC-equipped PVs in fatal crashes, and the fatality counts from occupants of those vehicles. The fatality counts in this report reflect

occupant fatalities in PVs with ESC standard involved in single-vehicle crashes, from FARS 2008-2011 Final files, and FARS 2012 Annual Report File (ARF). 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 increase. See Figures 1 and 2 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. The following motor vehicle fatalities that occurred in 2012 were not used in producing the 2012 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. Single-vehicle fatalities that involved pedestrians, pedalcyclists, or animals in the first harmful event are not included in the 2012 count of 1,285 single-vehicle crash fatalities in PVs with ESC standard, since the effectiveness estimates for ESC do not apply to these fatalities.

## Results

In 2012, there were 21,667 PV occupant fatalities. Only 2,732 of these fatalities were in PVs with ESC standard. Those 2,732 fatalities include 1,285 fatalities in single-vehicle crashes and 1,447 fatalities in multivehicle crashes. The 1,285 single-vehicle fatalities in vehicles with ESC standard include 734 PC occupants and 551 LTV occupants. These 1,285 fatalities are used below to produce an estimate of lives saved by ESC in 2012.

The formula used to calculate the estimate of lives saved (LS) from ESC is dependent 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. This LS formula is:  $LS = F * E / (1-E)$ . The number of single-vehicle crash fatalities is stratified into two counts: PC occupants (734 in 2012) and LTV occupants (551 in 2012). The effectiveness of ESC that is inserted into this formula for LS is 0.378 for PC occupants and 0.559 for LTV occupants (Kahane, in review).

Table 1 below shows the lives saved estimates for PCs and LTVs equipped with ESC standard. In 2012, ESC saved an estimated 446 lives among PC occupants, and 698 lives among LTV occupants, for a total of 1,144 lives saved. These lives saved estimates were produced using the lives saved formula in the above paragraph, along with the fatality counts for the appropriate year. For example, a fatality count of 734 and an effectiveness of 0.378 were used to produce the lives saved estimate of 446 for PCs in 2012 [ $446 = 734 * 0.378 / (1-0.378)$ ]. A fatality count of 551 and

an effectiveness of 0.559 were used to produce the lives saved estimate of 698 for LTVs in 2012 [ $698 = 551 * 0.559 / (1-0.559)$ ].

This 2012 ESC lives-saved estimate of 1,144 is a substantial increase over ESC lives saved estimates for previous years (859 ESC lives saved in 2011, 736 lives saved in 2010, 598 lives saved in 2009, and 551 lives saved in 2008) and the increase is correlated 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, the lives saved estimates will continue to rise significantly.

The 2008-2011 lives saved estimates in this research note are produced using the FARS Final files for 2008-2011, while the 2012 lives saved estimates are based on the 2012 FARS Annual Report file. Note that this research note uses the updated ESC effectiveness estimates published in "Updated Estimates of Fatality Reduction by Electronic Stability Control" (Kahane, in review), and thus the ESC lives saved estimates in this research note differ significantly from prior estimates.

Table 1  
**ESC Lives Saved Estimates, by Year and Vehicle Type, 2008–2012**

	Year	Passenger Cars With ESC Standard	Light Trucks/Vans With ESC Standard	Passenger Vehicles With ESC Standard
ESC Lives Saved Estimates	2012	446	698	1,144
	2011	312	548	859
	2010	249	487	736
	2009	191	407	598
	2008	163	388	551
	<b>TOTAL</b>	<b>1,361</b>	<b>2,528</b>	<b>3,888</b>

Source: NHTSA, NCSA, FARS 2012 ARF and FARS 2008-2011 Final File, IIHS list of ESC-equipped vehicles

- 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
- Note: Totals may not equal sum of components due to independent rounding.

## Limitations

This section describes limitations regarding calculating estimates of the number of lives saved by ESC.

**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 had ESC and which subset did not have ESC, thus giving the buyer an option of paying extra if they chose to purchase a vehicle with ESC.

In FARS single-vehicle crashes in 2012, a total of 1,285 fatalities occurred in PVs which had ESC standard, while 1,309 fatalities occurred in PVs which had ESC optional. Among PCs, 734 fatalities occurred in vehicles which had ESC standard and 895 in vehicles which had ESC optional, or 45 percent ESC standard. By comparison, among LTVs it was 551 ESC standard and 414 ESC optional, or 57 percent ESC standard. Sixty-eight percent of the ESC optional fatalities occurred in PCs. Unfortunately, information is limited on which vehicles that were ESC optional had ESC installed on their vehicles.

The ESC lives saved estimates in this report are limited to vehicles with ESC standard, and thus the lives saved estimates are conservative. These estimates would rise if the number of vehicles with ESC was able to be determined exactly from the VIN; however, while the VIN contains much information about each vehicle, including vehicle make and model, unfortunately the VIN does not contain information on the status of ESC in a vehicle.

As the vehicle fleet becomes more equipped with ESC, the ESC lives saved estimates will continue to increase. This process will take 10 to 15 years before PVs with no ESC are rarely seen on America's roads.

**Limitation #2** – In producing annual ESC lives saved estimates for this report, ESC effectiveness estimates were

only used for the occupants of PC and LTV single-vehicle crashes, at the suggestion of NHTSA experts. Other ESC effectiveness estimates (i.e., multivehicle crashes, rollovers) were not used to produce individual ESC lives saved estimates, due to the smaller sample size that was available to produce these effectiveness estimates.

**Limitation #3** – The effective estimates from Kahane's 2014 report and Sivinski's 2011 report are based at the vehicle level, and not the person level. The lives-saved estimates made in this report 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 NCSA effectiveness estimates are at the person level, such as seat belts, air bags, motorcycle helmets, child seats, and minimum legal drinking age. While this assumption seems logical, it still needs to be made.

**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, then years from now ESC will eventually be in nearly all vehicles on the road, including older vehicles. Due to this gradual expansion of ESC throughout the vehicle fleet, ESC effectiveness estimates will likely continue to change.

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