State of Highway Safety Summary Report

Commonwealth of Pennsylvania

15th Edition – 2018

TOWARD ZERO DEATHS

PREPARED BY: Highway Safety Section
Department of Transportation
Bureau of Maintenance and Operations
400 North Street | Harrisburg PA 17105

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Letter from the Secretary of Transportation

We continue to make progress in our goal of reaching Zero Fatalities on our highways in Pennsylvania. In 2017, we continued our downward trend in fatalities and hit a new low of 1,137 -- 51 fewer than in 2016 and the lowest since record keeping began in 1928. We saw decreases in impaired driver, pedestrian and unrestrained fatalities.

Amid this good news, however, there still were some troubling trends. Crashes involving drivers aged 75 and over were up as were crashes involving red light running and work zones.

Hence, we move forward, ever committed to our goal of keeping our highways free of crashes, injuries and fatalities. We invest roughly $100 million a year for upgraded infrastructure, ongoing law enforcement and safety education and outreach. Our aim is to persuade drivers to always do the right thing behind the wheel: avoid distractions, wear seat belts, obey speed limits, and not drive aggressively or impaired.

This annual State of Highway Safety Summary report provides the details of the challenges and progress we are making. We never forget that even one life lost in a vehicle crash is tragic and represents an individual and their potential to make a difference in our society gone forever. While we will be relentless in pursuing our safety mission, we need every driver to understand how critical it is that individual actions behind the wheel are a matter of life and death.

Thank you.

Leslie S. Richards
PennDOT Secretary

Executive Summary

The State of Highway Safety Summary Report is intended to provide a snapshot of current trends, future goals, and the strategies needed to improve highway safety in the Commonwealth. Contained within this report are safety statistics tracked internally and by national safety partners, information on several safety focus areas, information on the effectiveness of safety countermeasures, and comparisons to the progress of several benchmarking states.

The fatality and suspected serious injury goals presented on the following pages were developed in line with our statewide vision, mission, and goal statements (using 2012-2016 as a baseline year):

Vision

Proactively work toward zero deaths on our roads while fostering an environment that encourages safe behavior.

Mission

Our mission is to improve highway safety by developing and implementing education, enforcement, engineering and emergency medical service strategies.

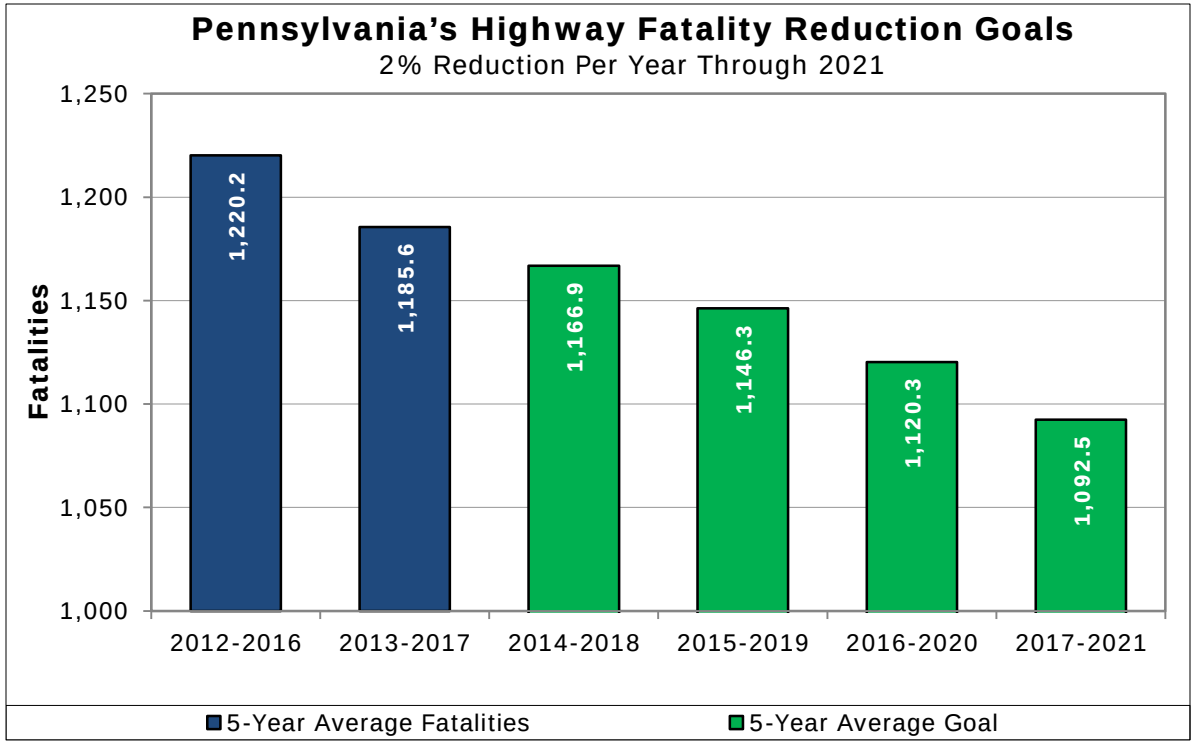
Goal

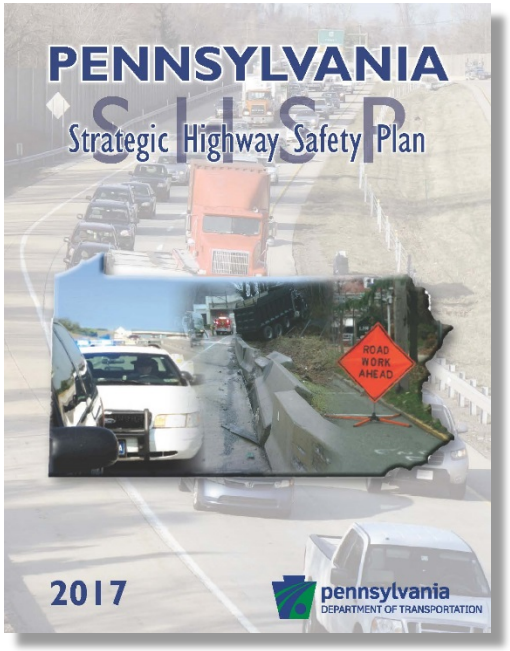
Reduce average fatalities and serious injuries to support the national effort of ending fatalities on our nation's roads within the next 30 years.

Reaching Our Goals

Our goal is to reduce the five-year average number of fatalities from 2012-2016 (1,220.2 average per year) through 2017-2021 (1092.5 average per year).

PennDOT has developed a 2017 **Strategic Highway Safety Plan (SHSP)** to help reach this goal. The SHSP targets priority Safety Focus Areas and strategies/actions to reduce highway fatalities on Pennsylvania's roadways. For each recommended strategy, action items have been established to identify measures necessary to successfully improve safety in each Safety Focus Area.





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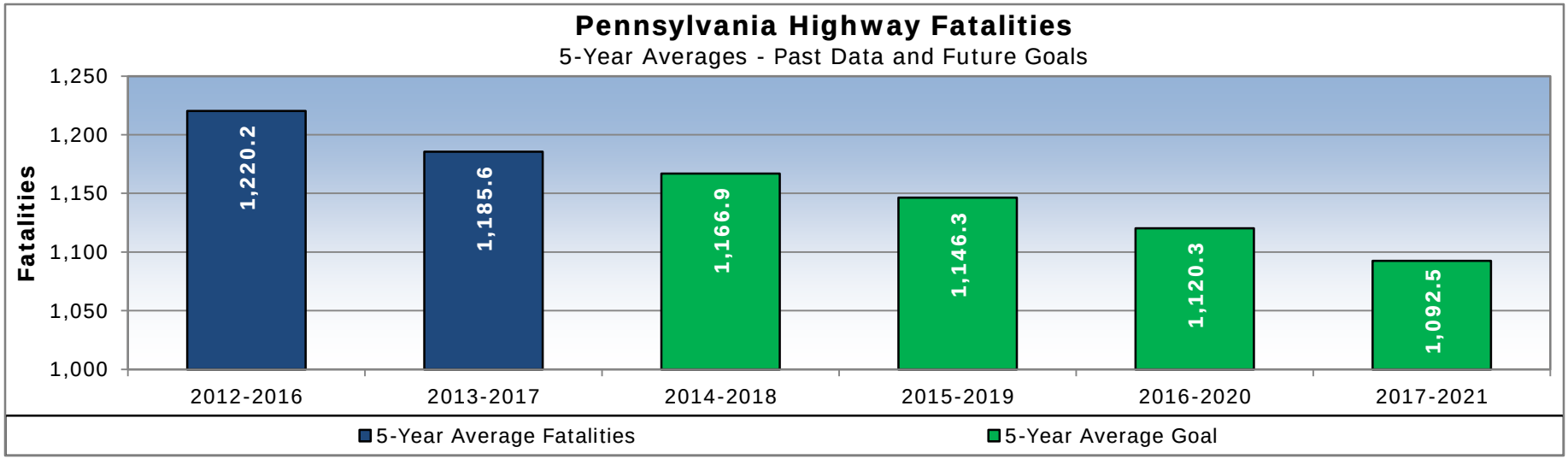
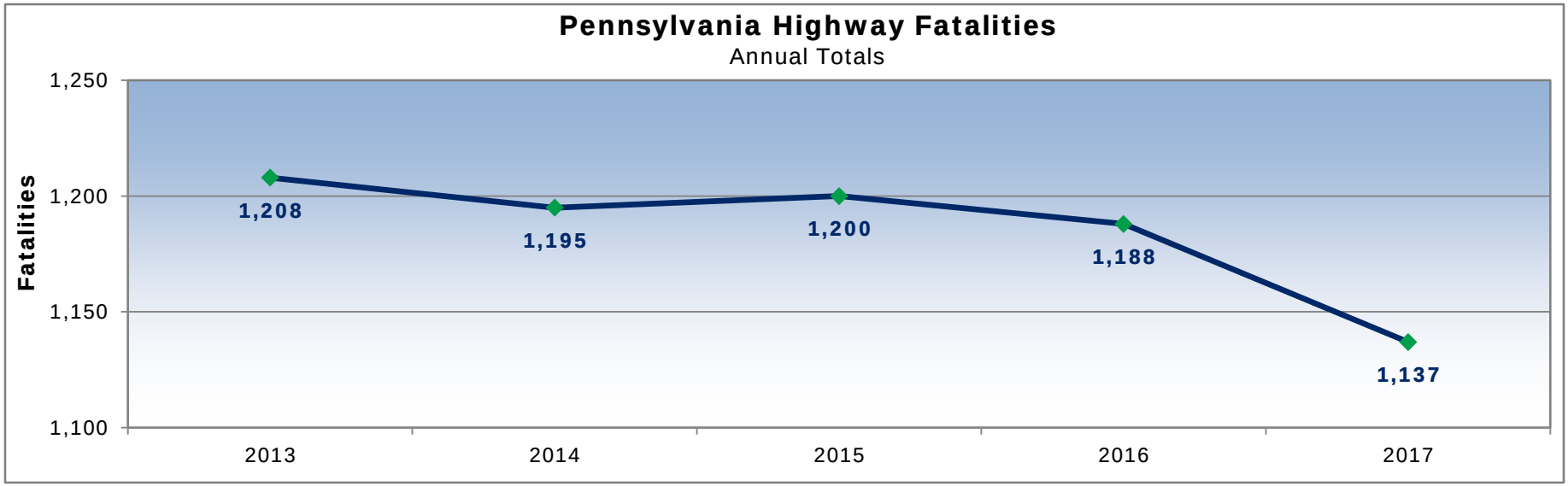
Fatality and Crash Trends





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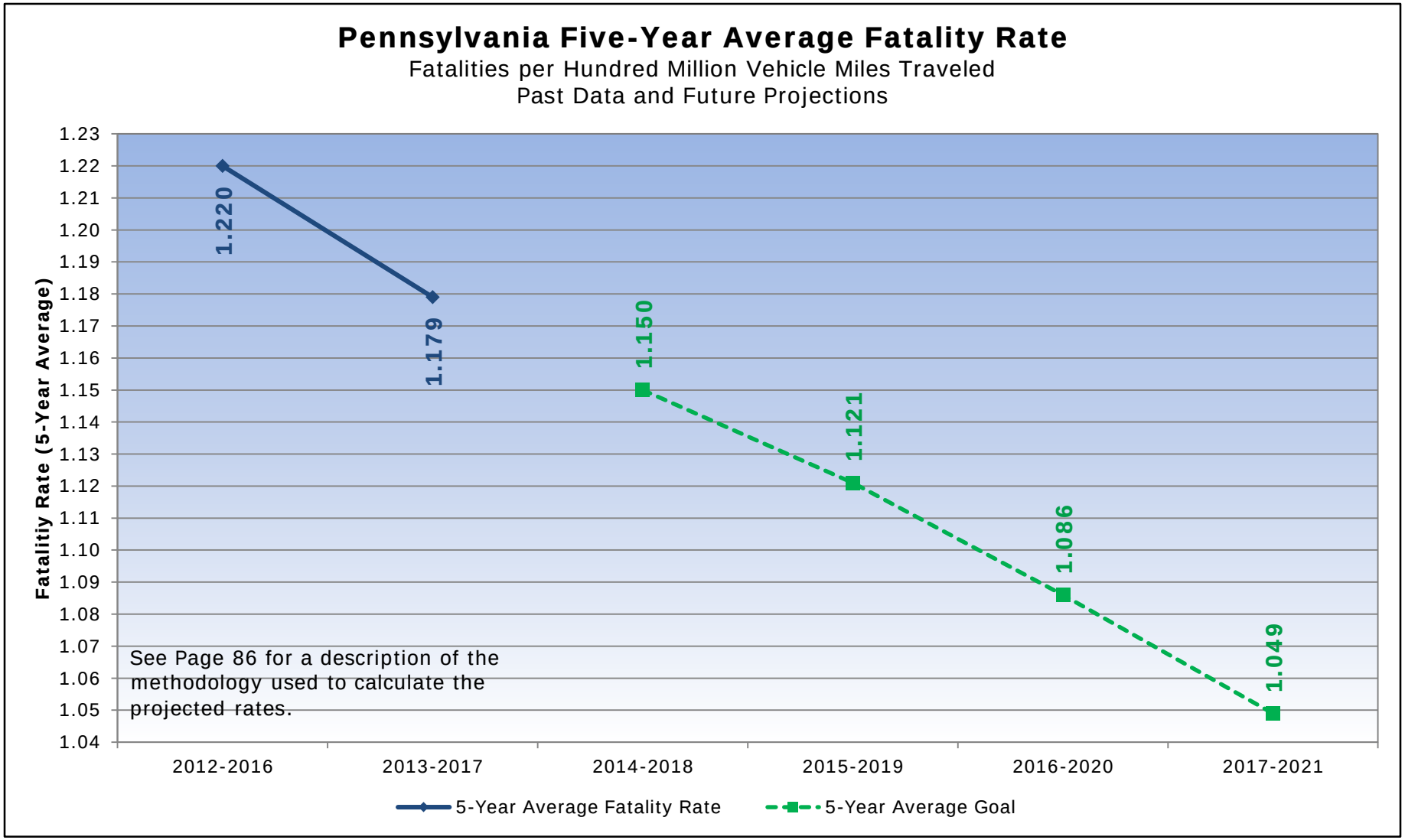
Fatality and Crash Trends



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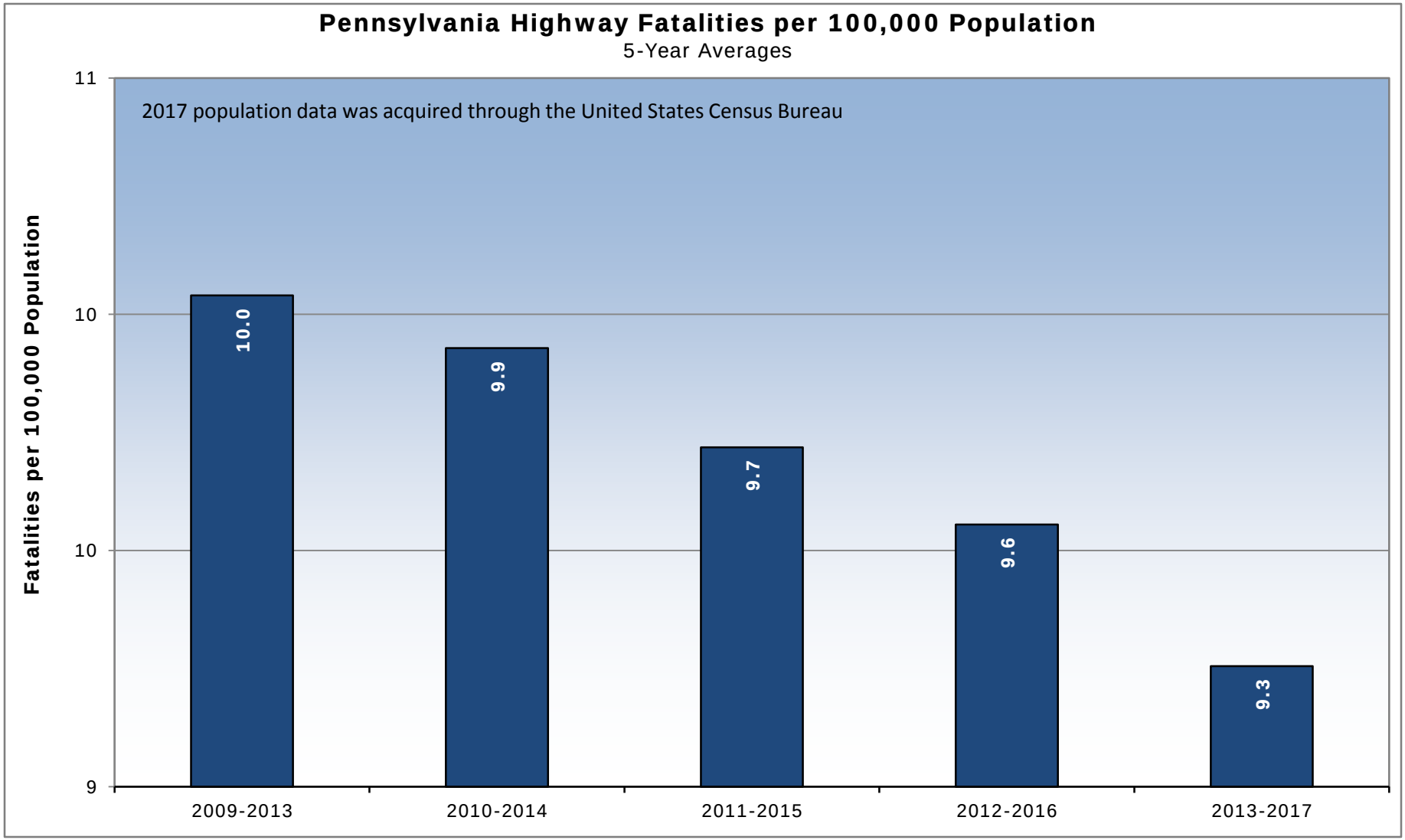
Fatality and Crash Trends



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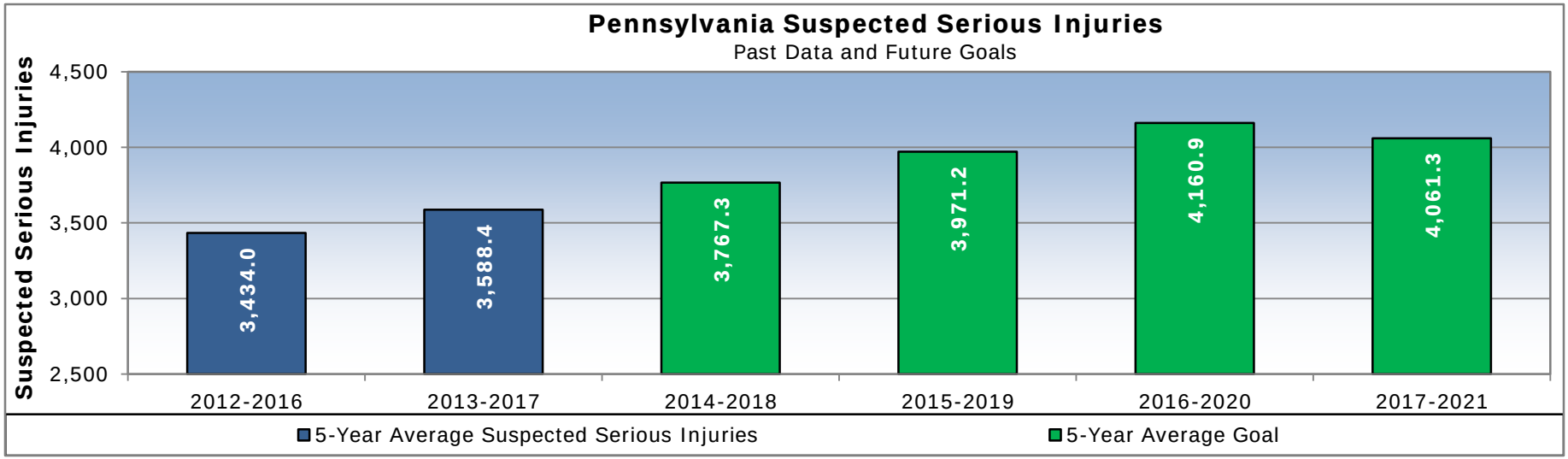
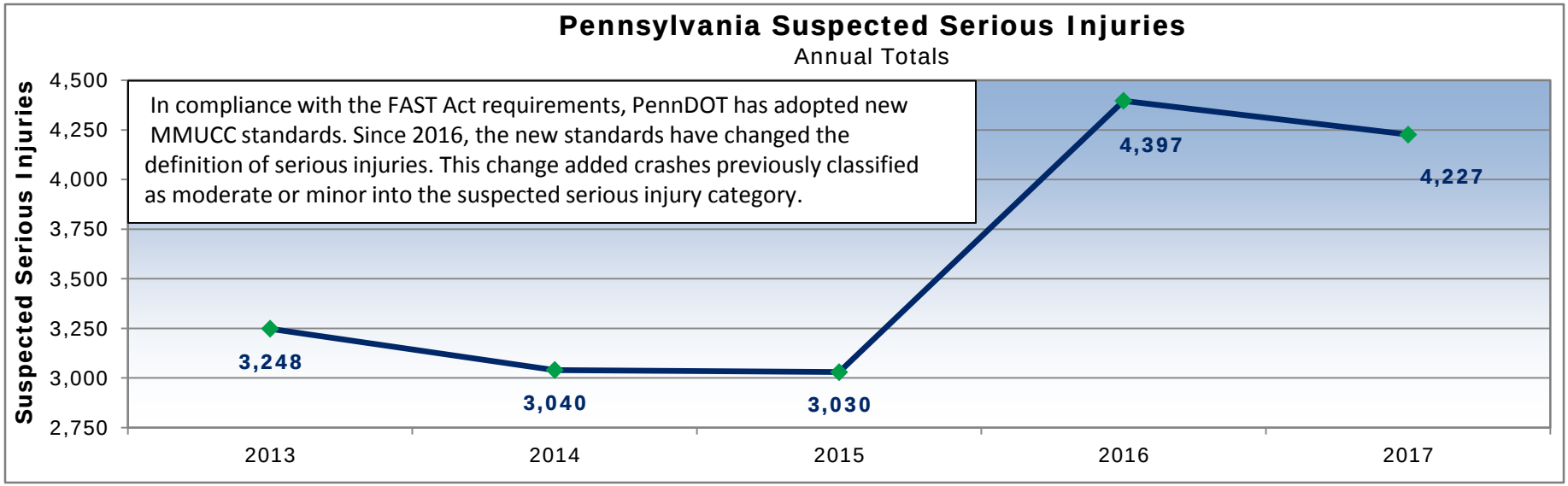
Fatality and Crash Trends





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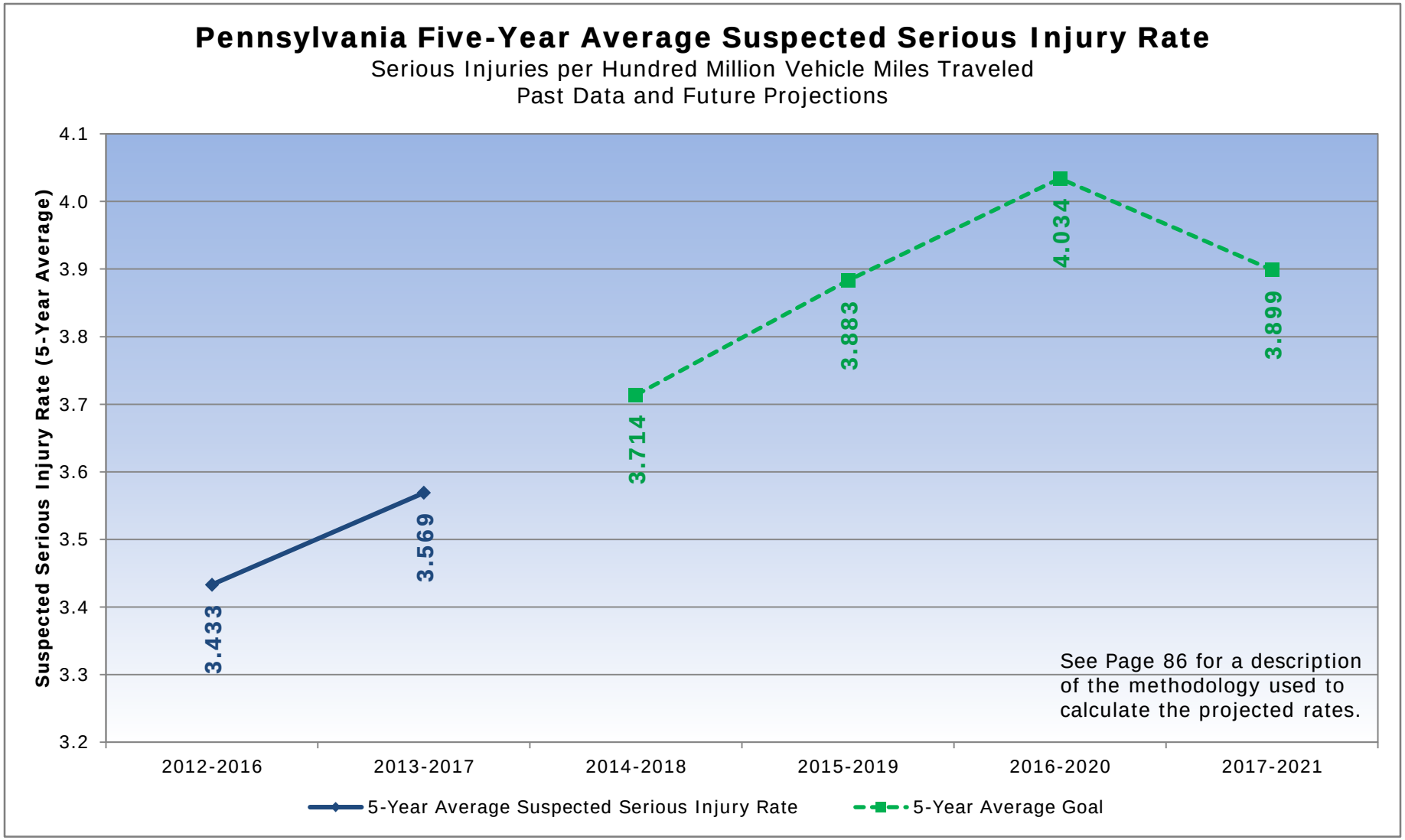
Fatality and Crash Trends



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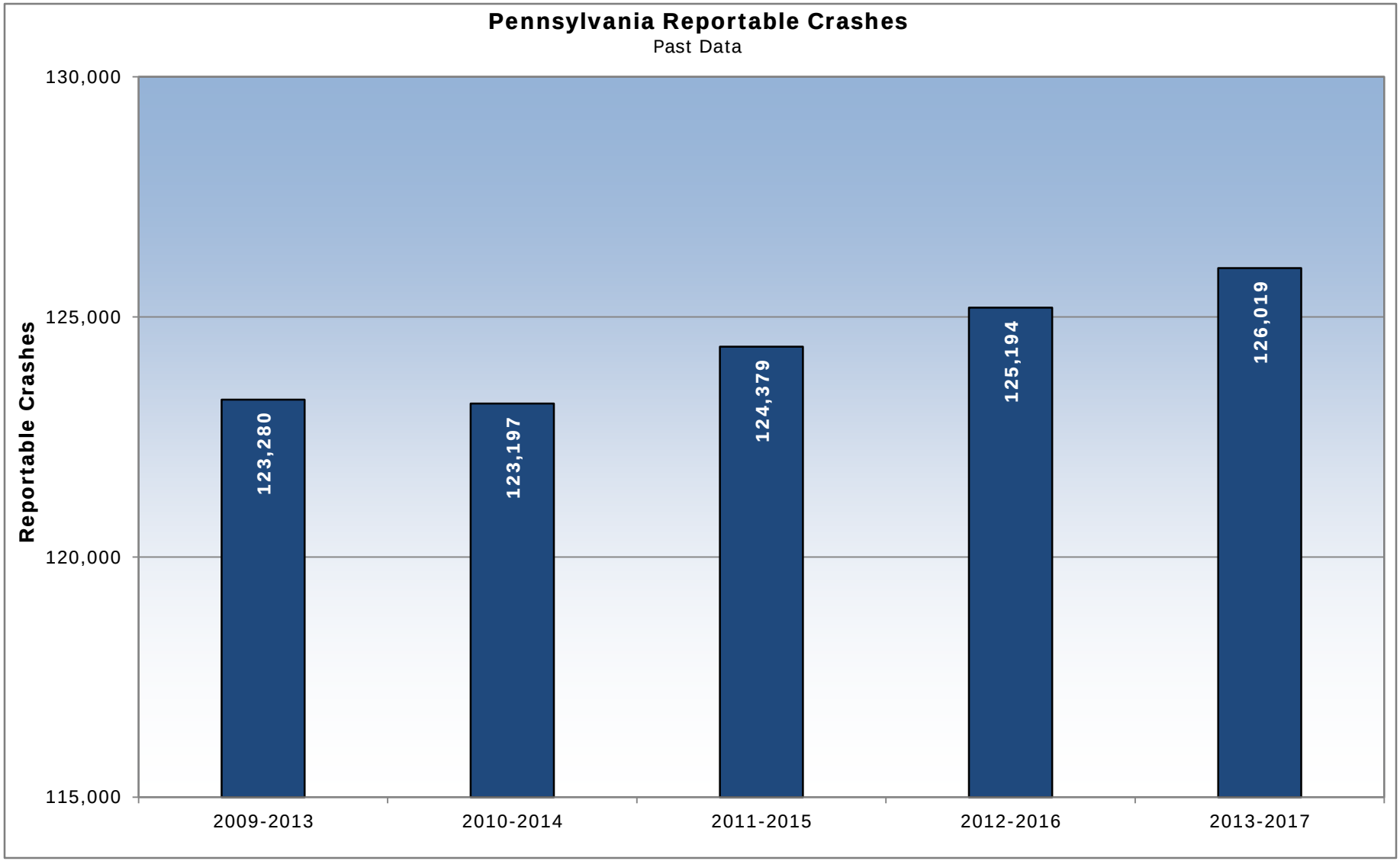
Fatality and Crash Trends



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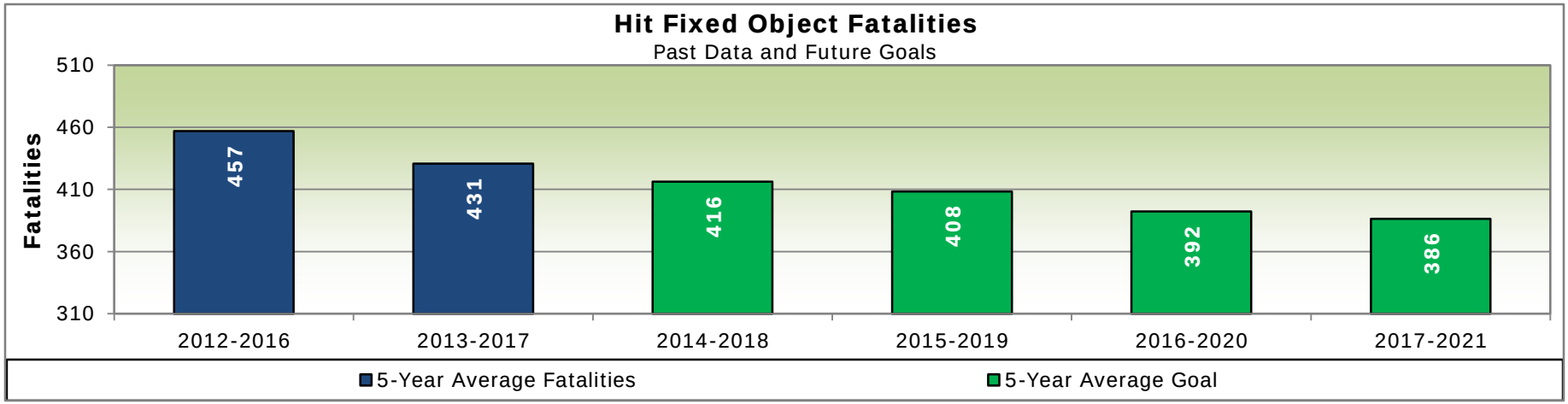
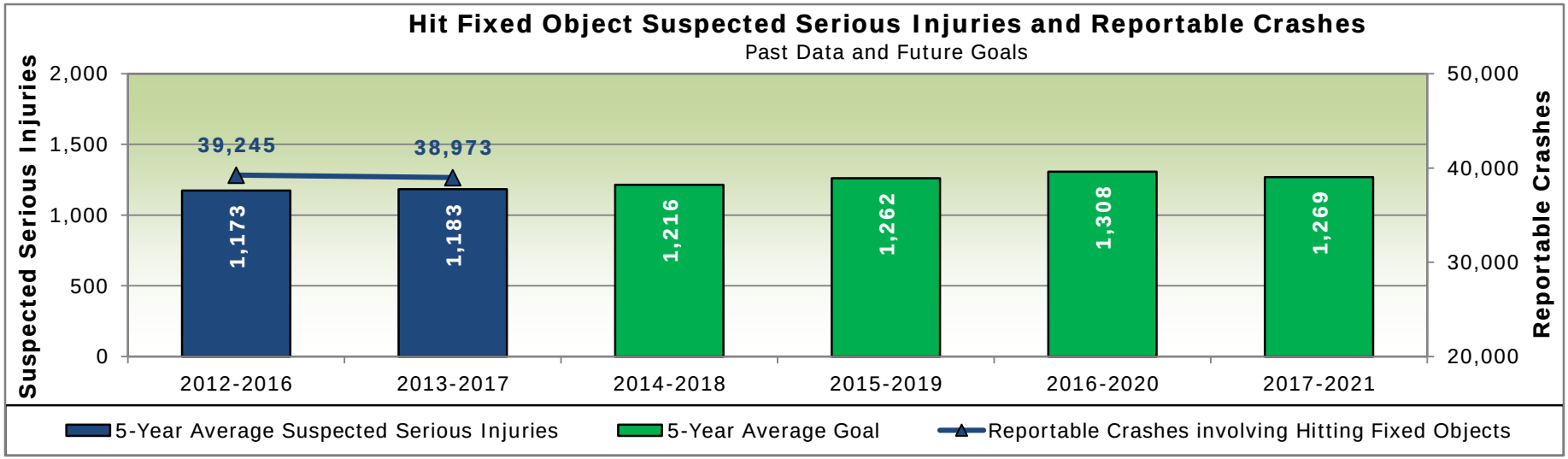
Hit Fixed Object Trends and Goals

Indicates that the crash took place with a fixed object such as an embankment, a utility pole, a tree, guide rail, etc.





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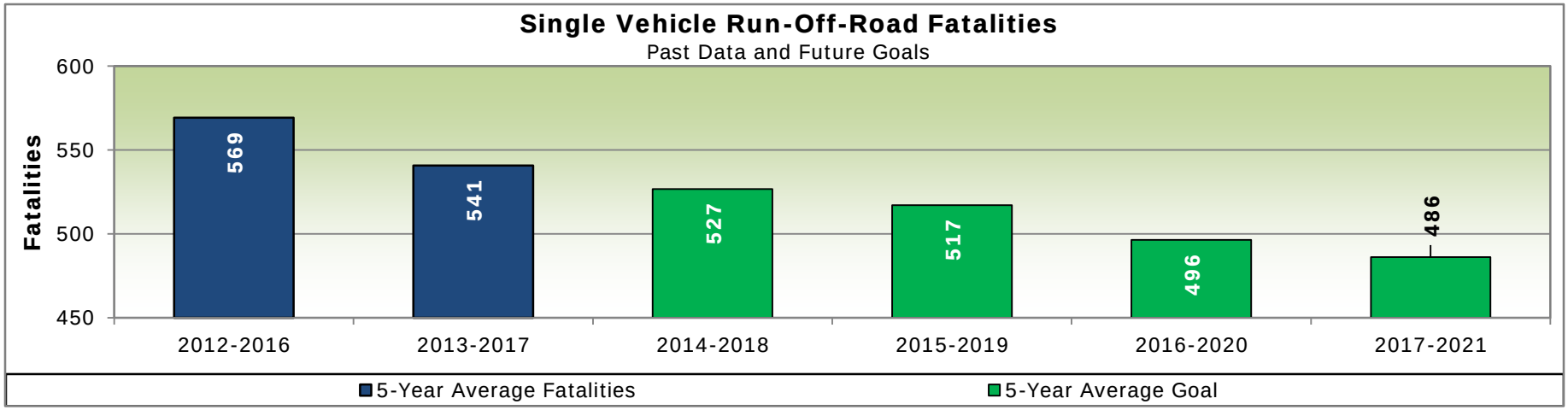
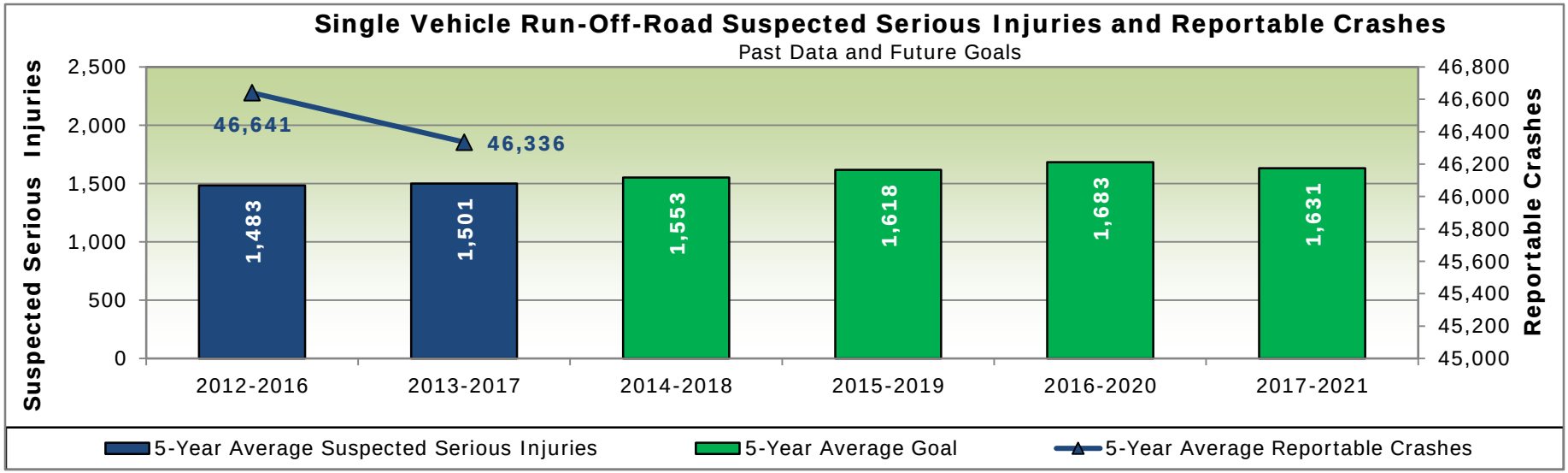
Single Vehicle Run-Off-Road Trends and Goals

Indicates that a single vehicle crash occurred on the shoulder, in the median, on the roadside, or outside of the traffic way.





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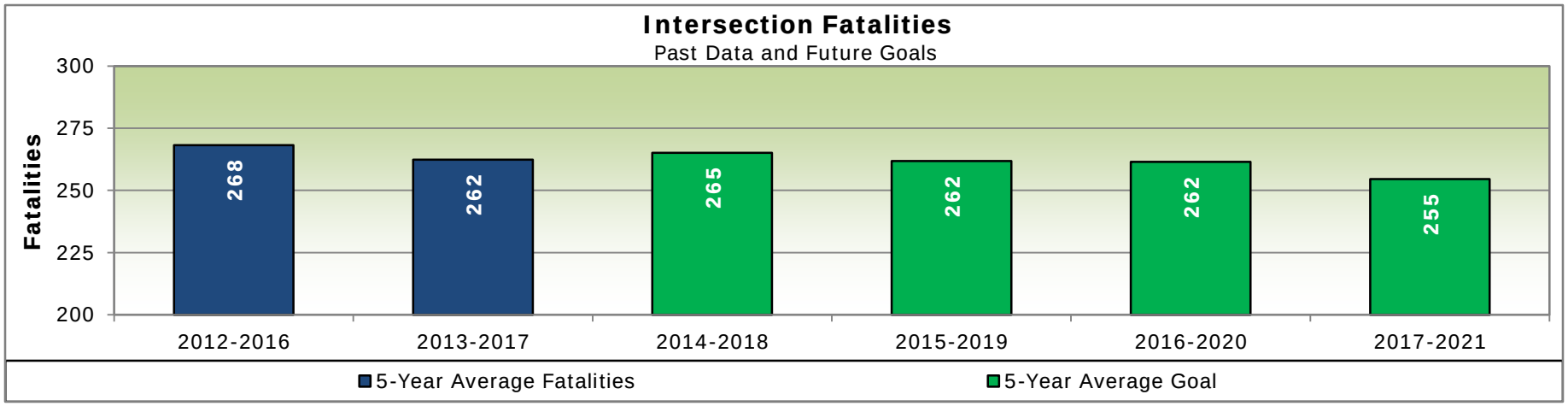
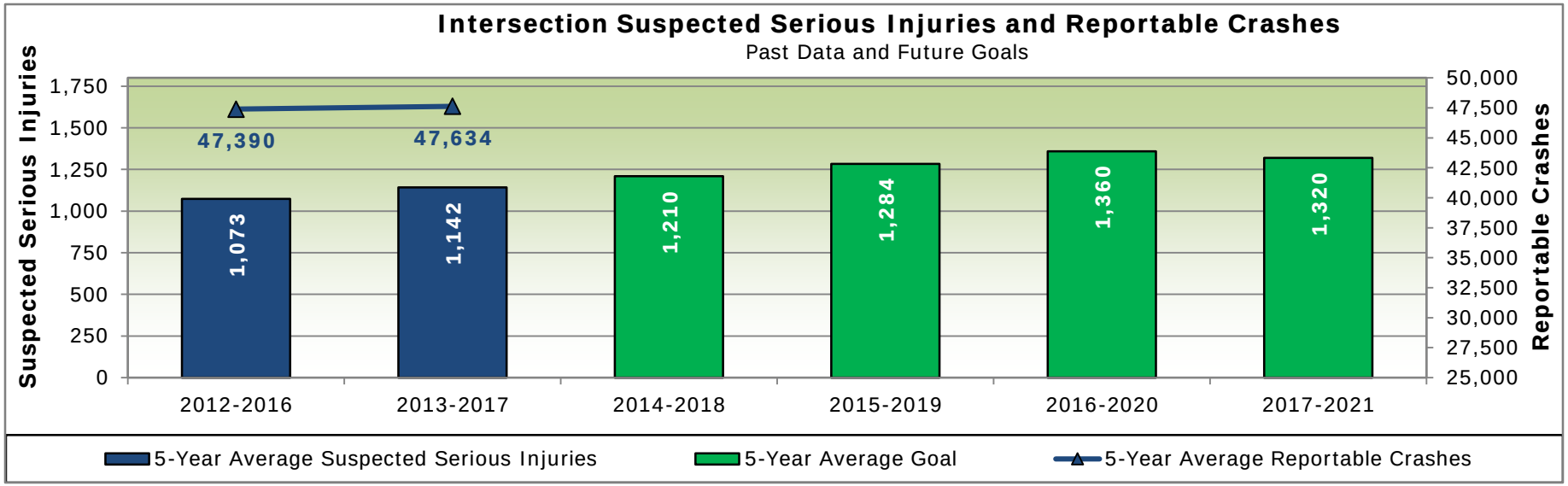
Intersection Trends and Goals

Indicates that the crash occurred at an intersection, including ramps, crossovers, and rail crossings.





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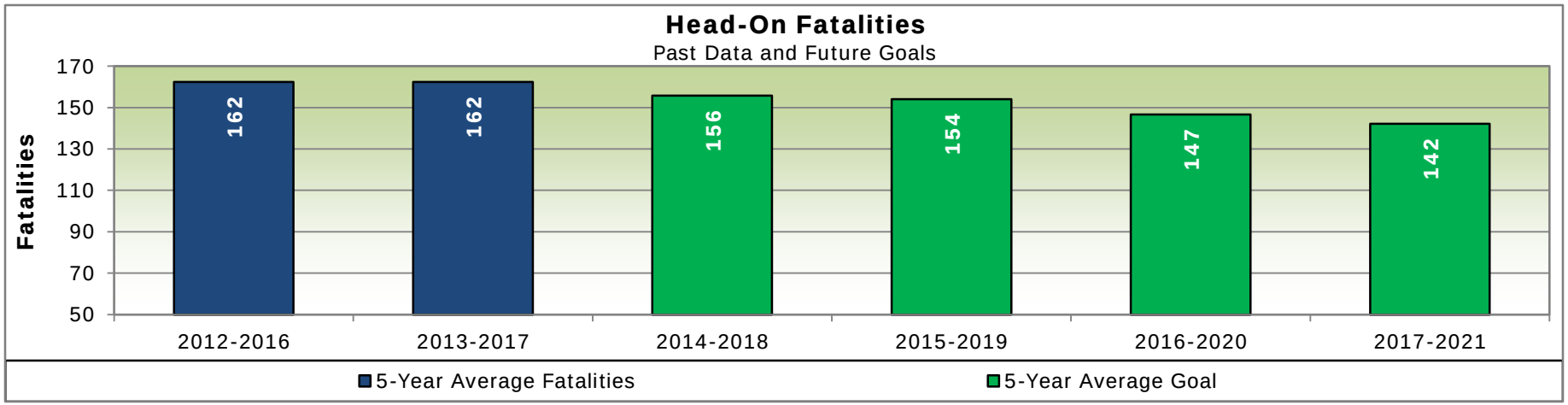
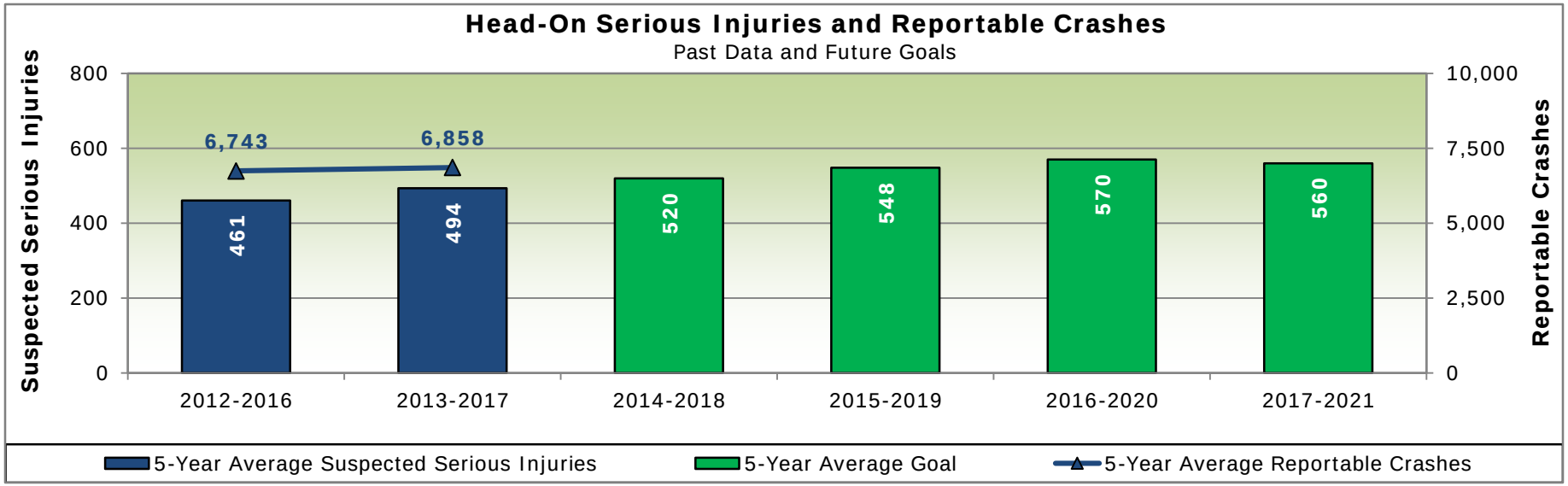
Head-On Trends and Goals

Indicates that the crash type was a head-on or opposite direction side swipe.





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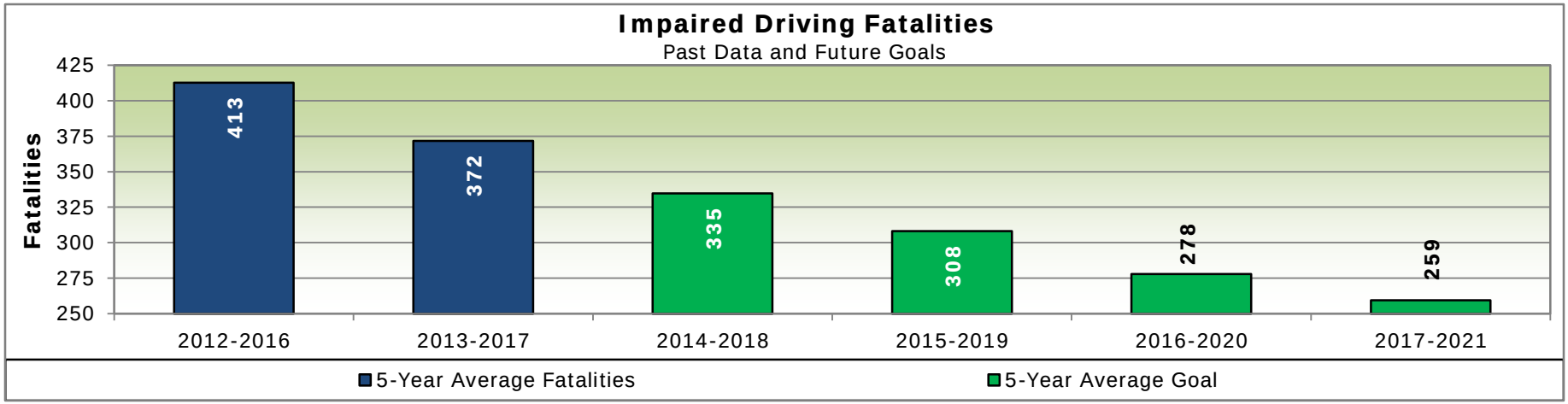
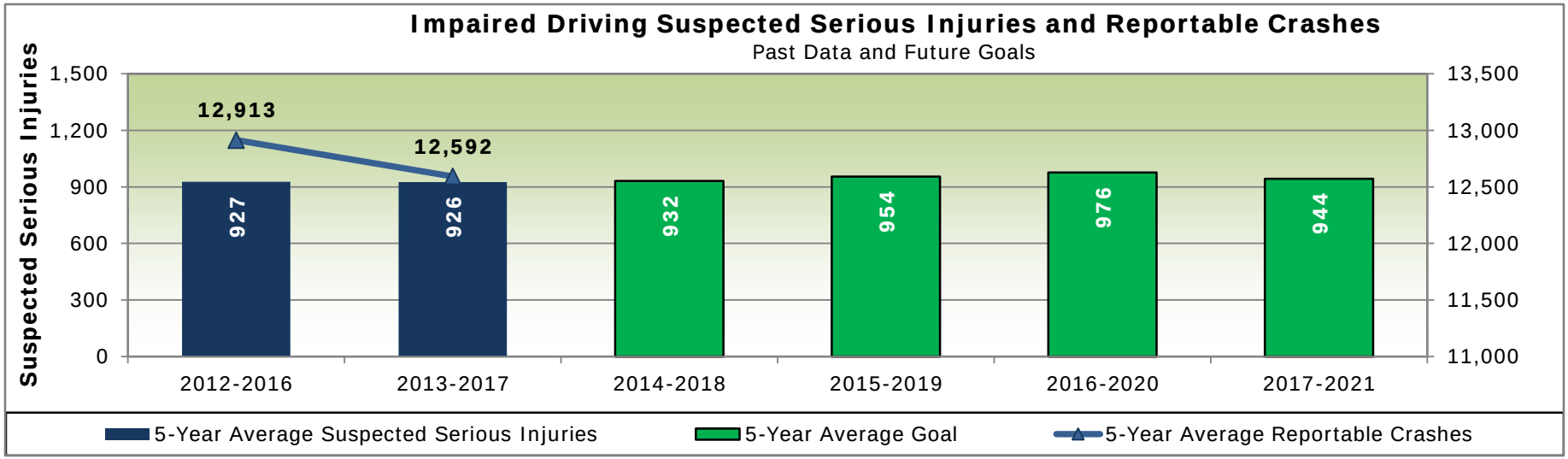
Impaired Driving Trends and Goals

Includes crashes involving any driver which was suspected of drinking by police or had a measured BAC of 0.01% or greater. These crashes could also include those which involved any driver suspected of illegal drug or medication use.





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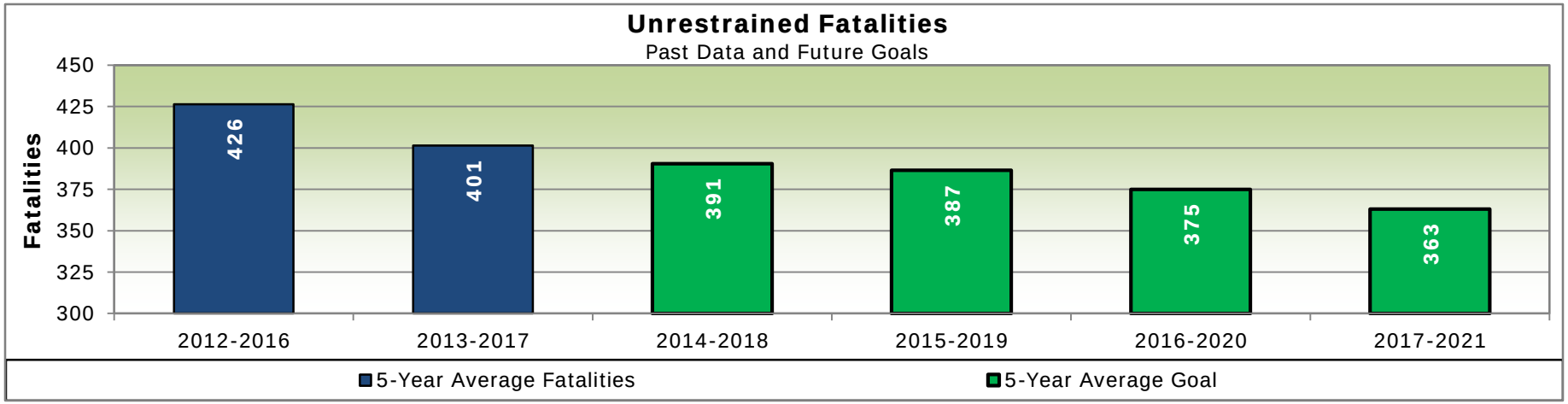
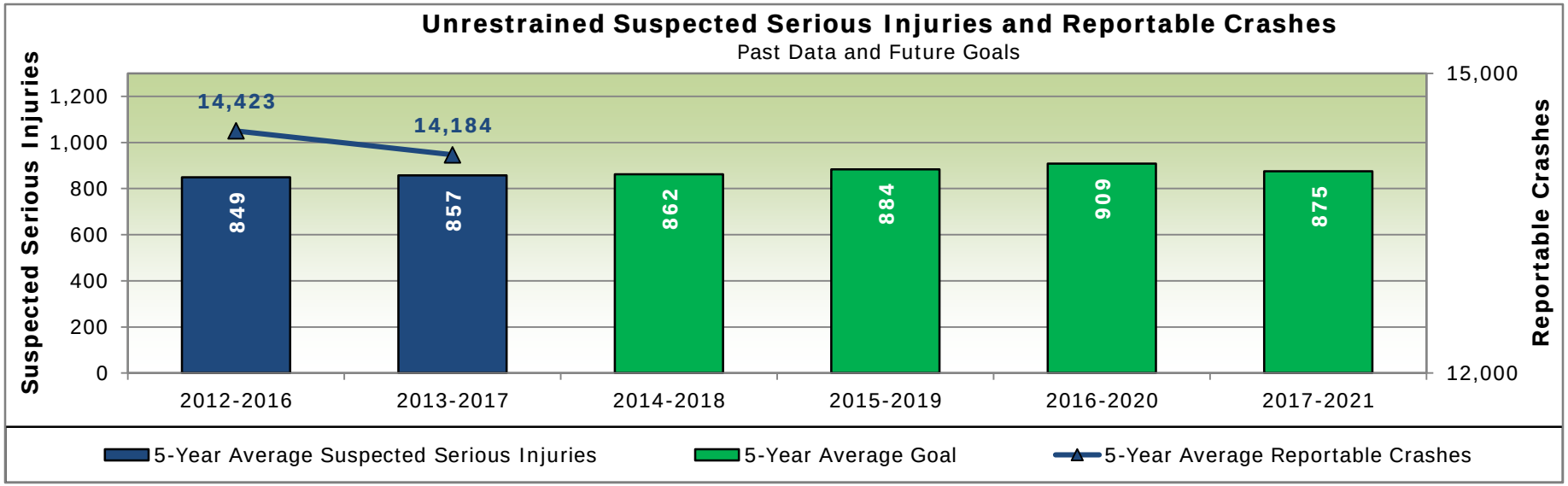
Unrestrained Trends and Goals

Indicates that any person in a passenger car, van, SUV, or small or large truck was not wearing a seat belt.





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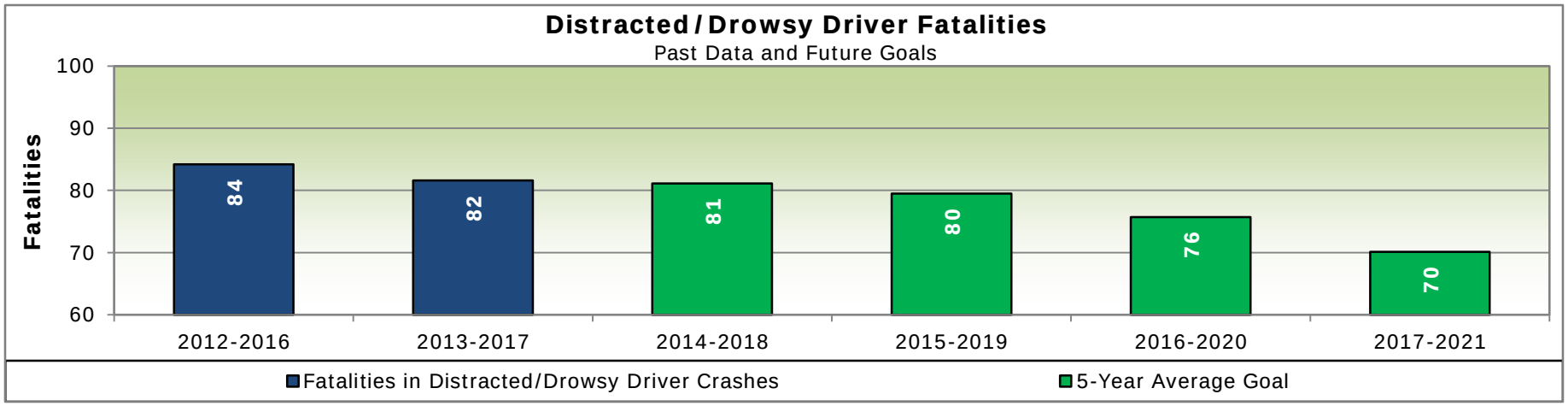
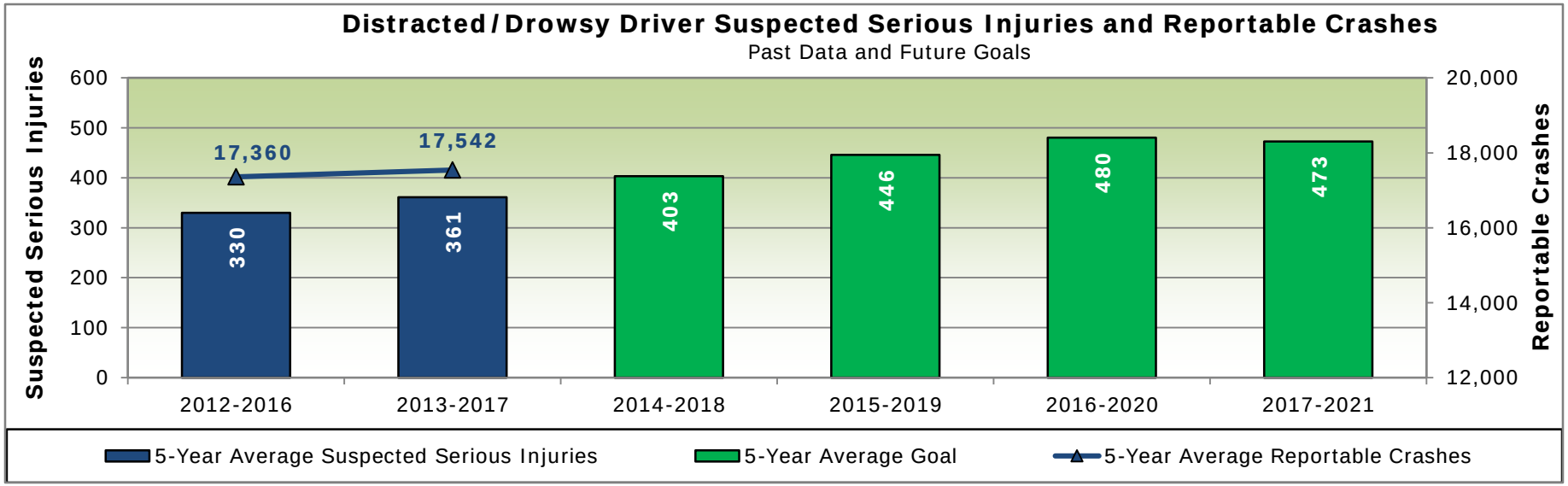
Distracted/Drowsy Driver Trends and Goals

Indicates that any driver involved in the crash was distracted, using a phone, fatigued, or asleep.





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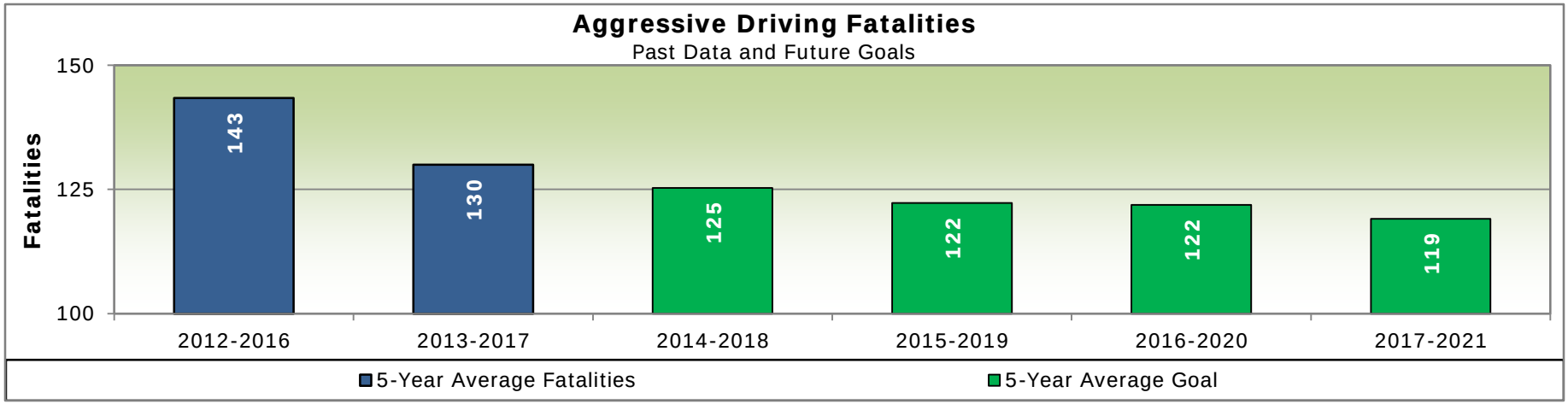
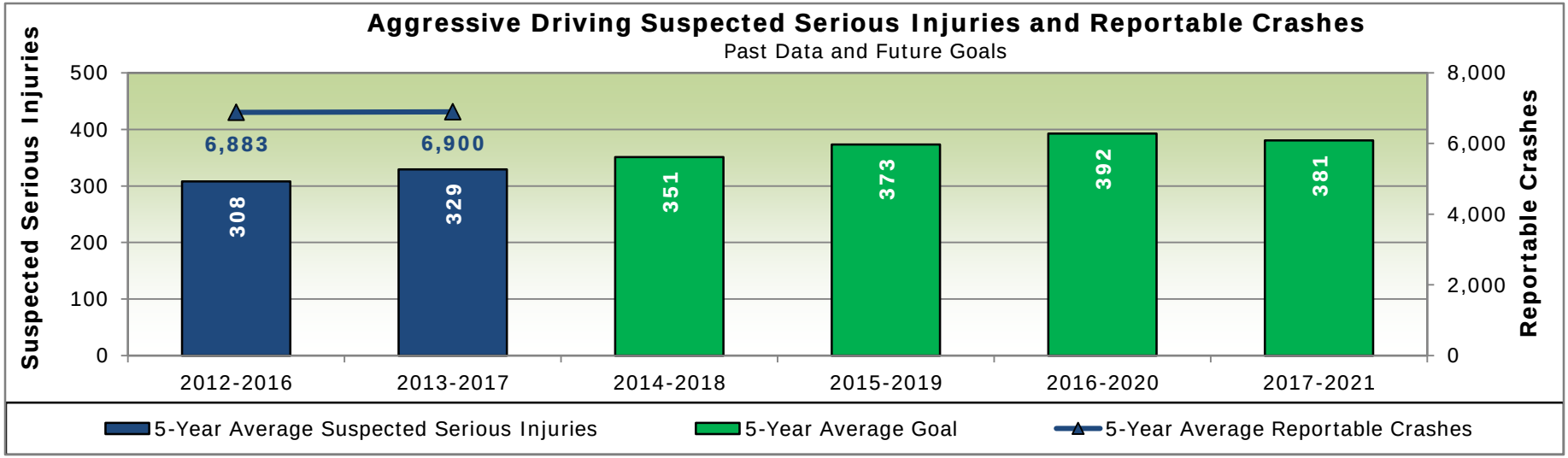
Aggressive Driving Trends and Goals

Indicates that any driver action was classified as aggressive driving under the NHTSA definition (two or more of the factors shown on Page 33).





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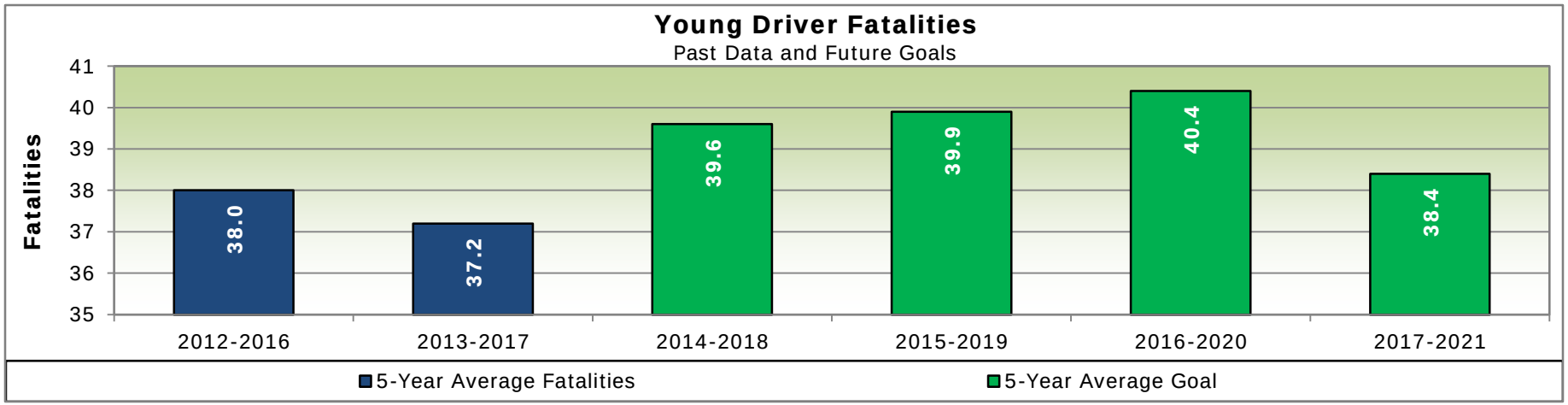
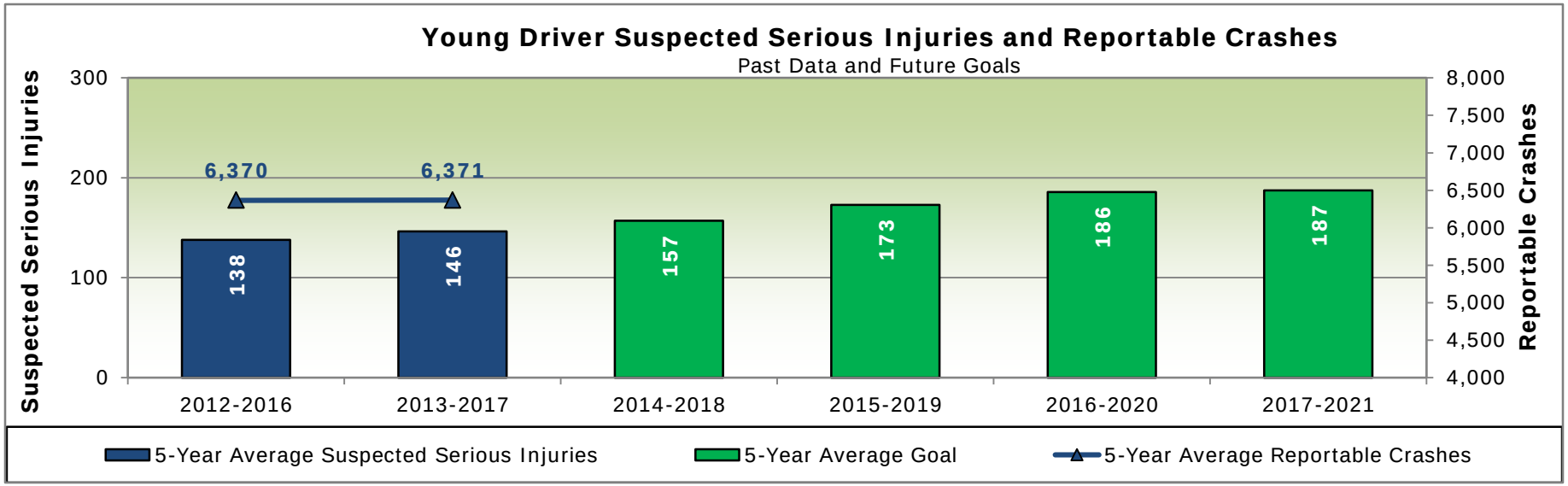
Young Driver Trends and Goals

Indicates that any driver involved in the crash was 16 or 17 years of age.





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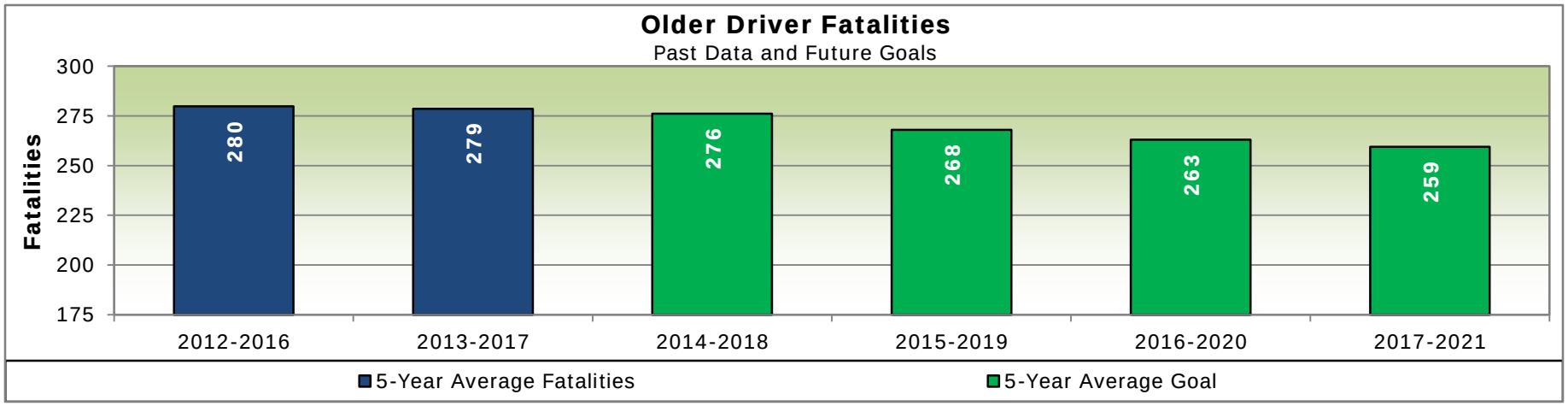
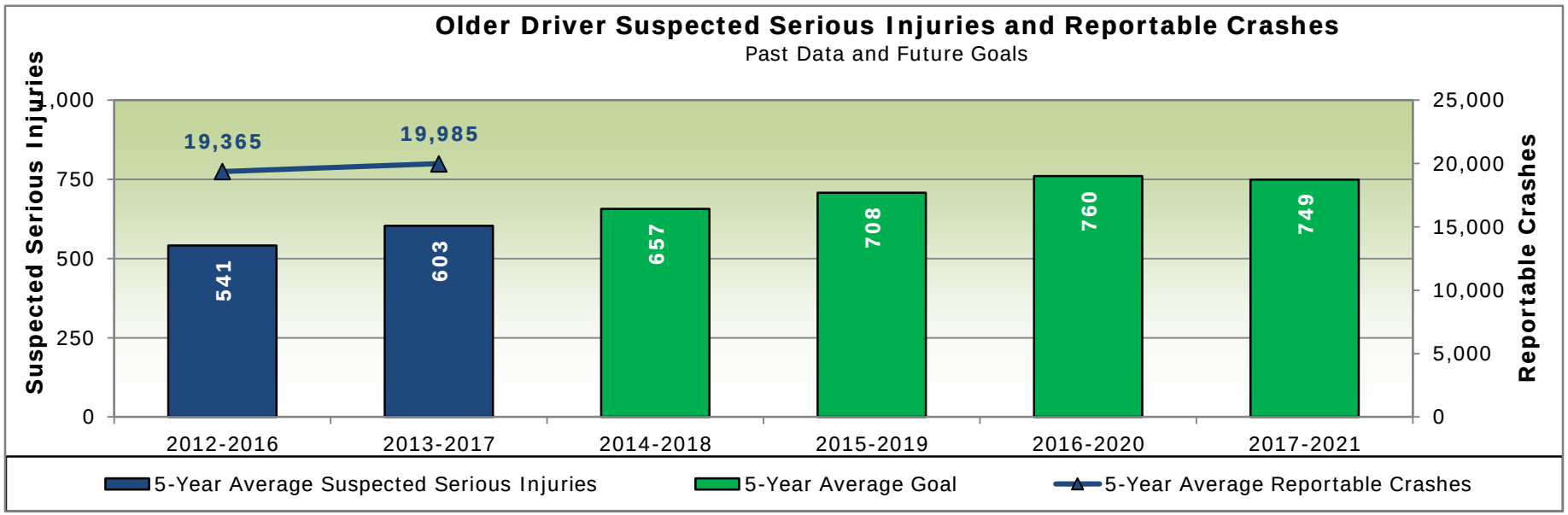
Older Driver Trends and Goals

Indicates that any driver involved in the crash was age 65 or older.





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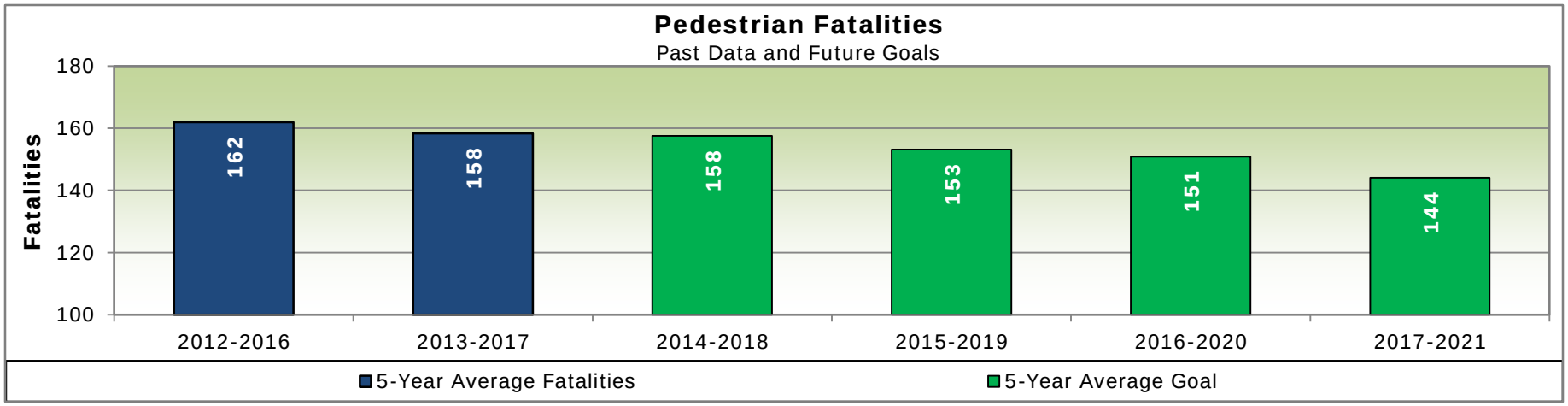
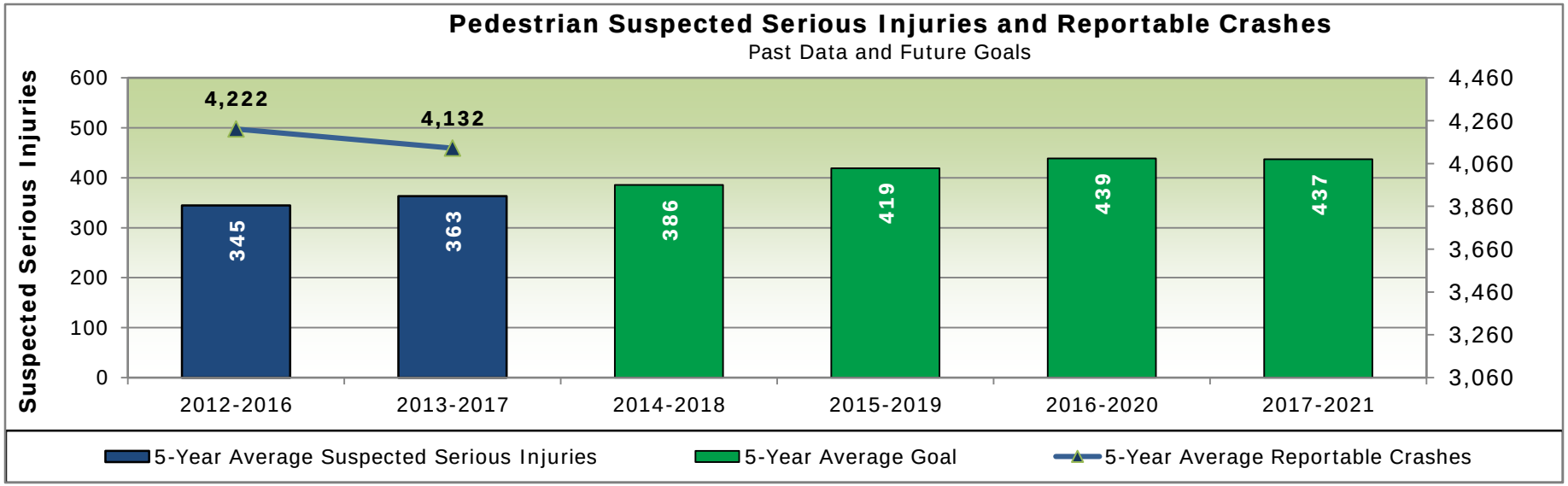
Pedestrian Trends and Goals

Indicates that any person involved in the crash was a pedestrian.





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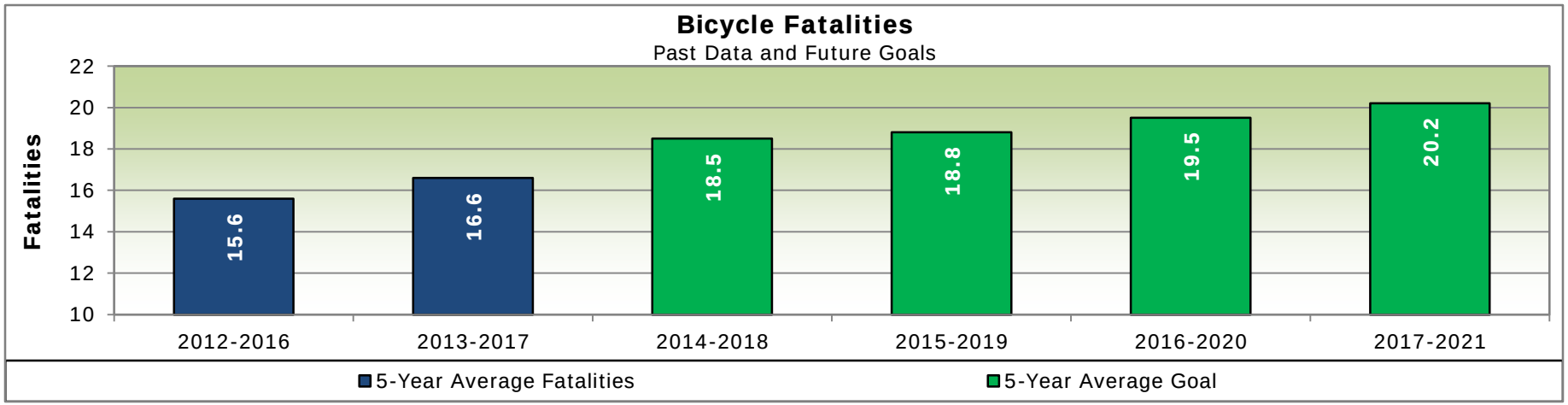
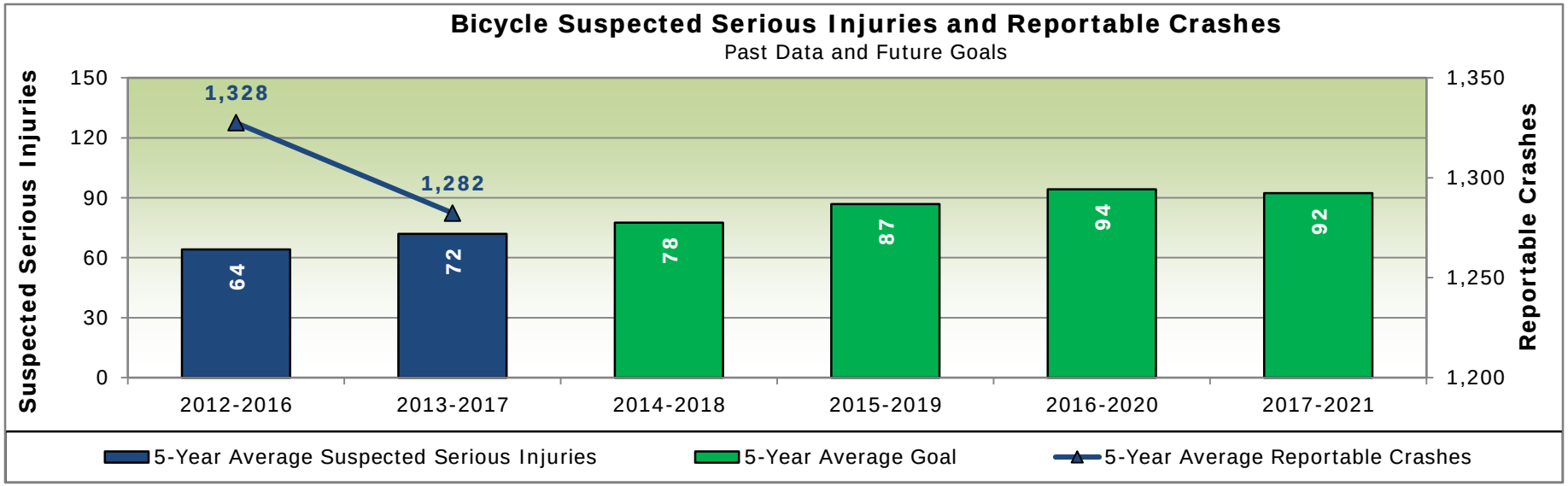
Bicycle Trends and Goals

Indicates that any vehicle involved in the crash was a bicycle.





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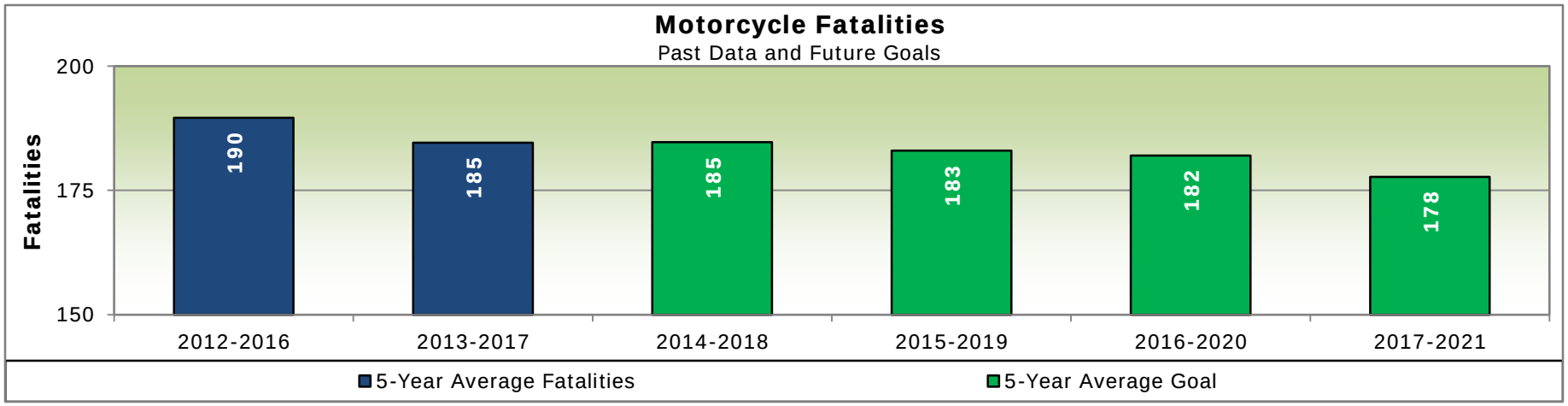
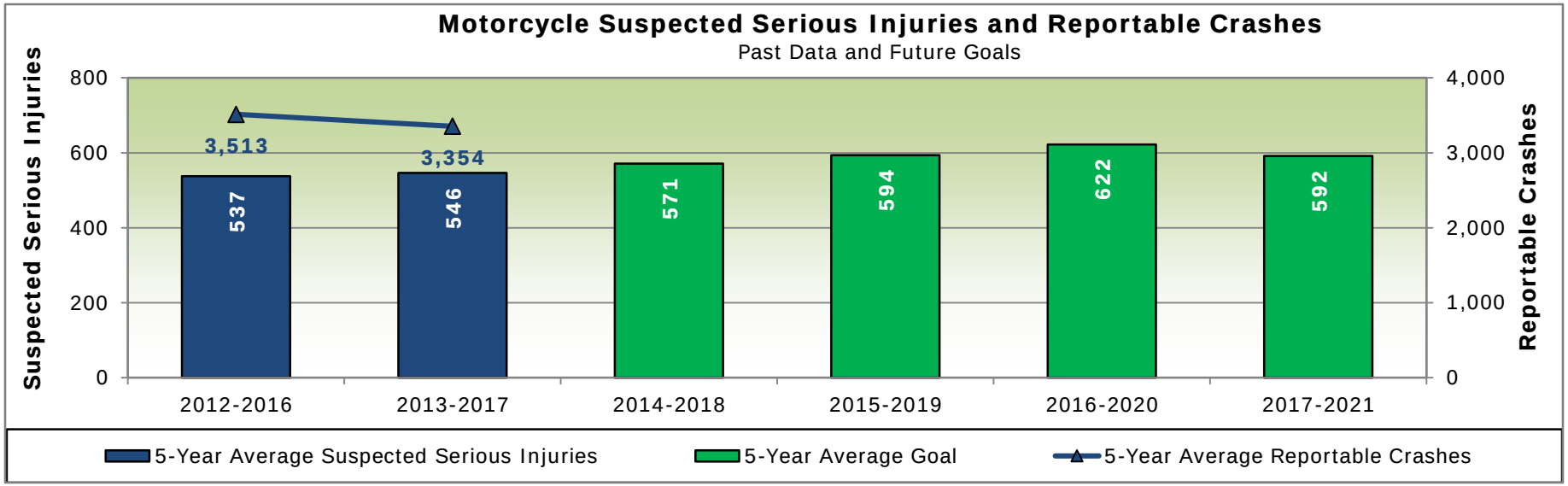
Motorcycle Trends and Goals

Indicates that any vehicle involved in the crash was a motorcycle.





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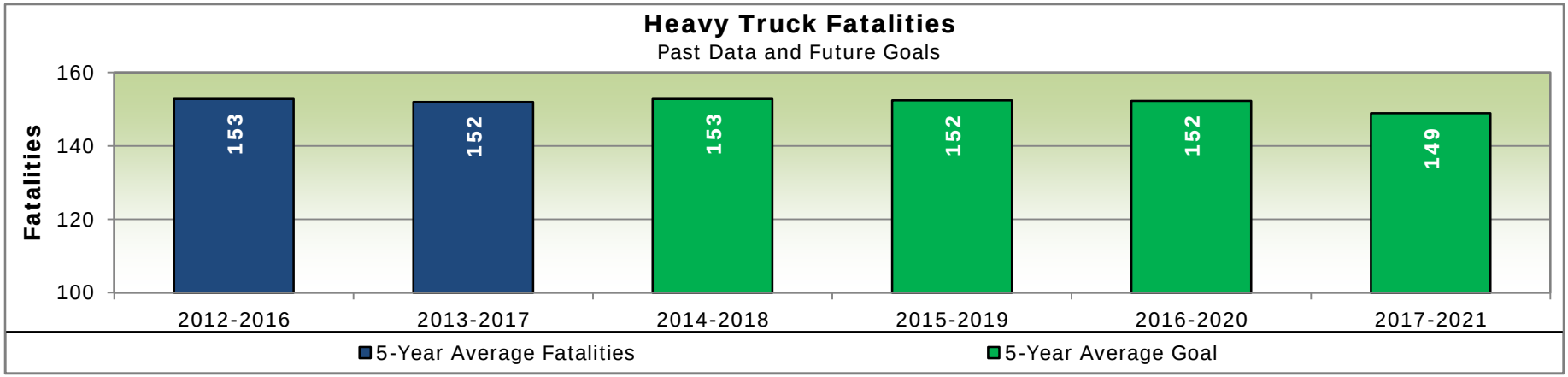
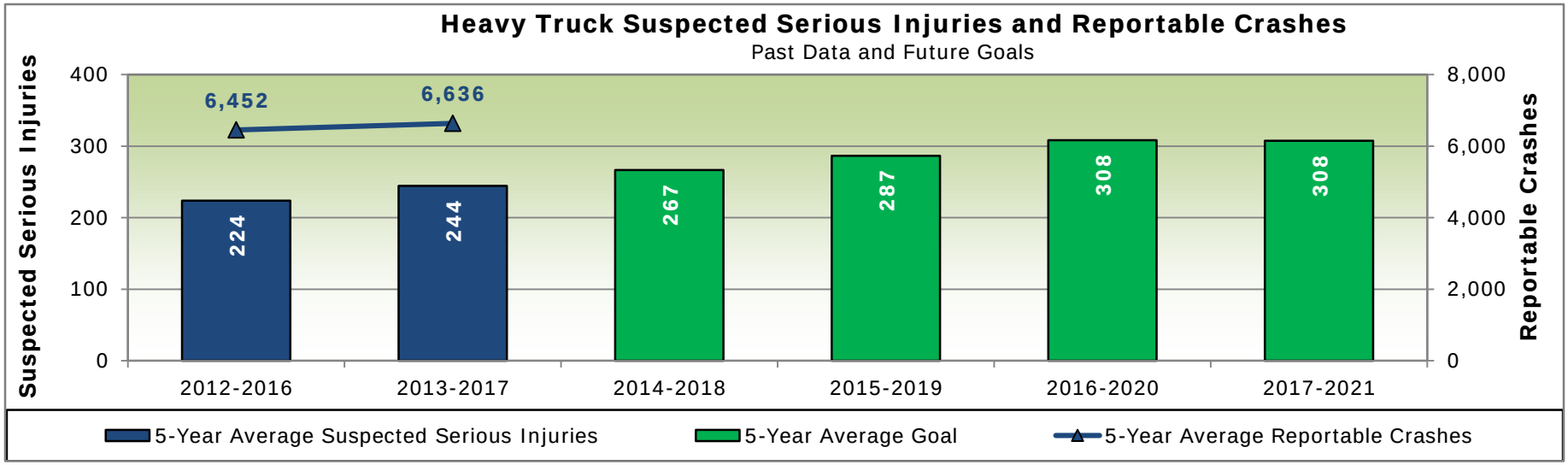
Heavy Truck Trends and Goals

Indicates that any vehicle involved in the crash was a heavy truck any single vehicle with a weighting of 10,000 pounds or more.





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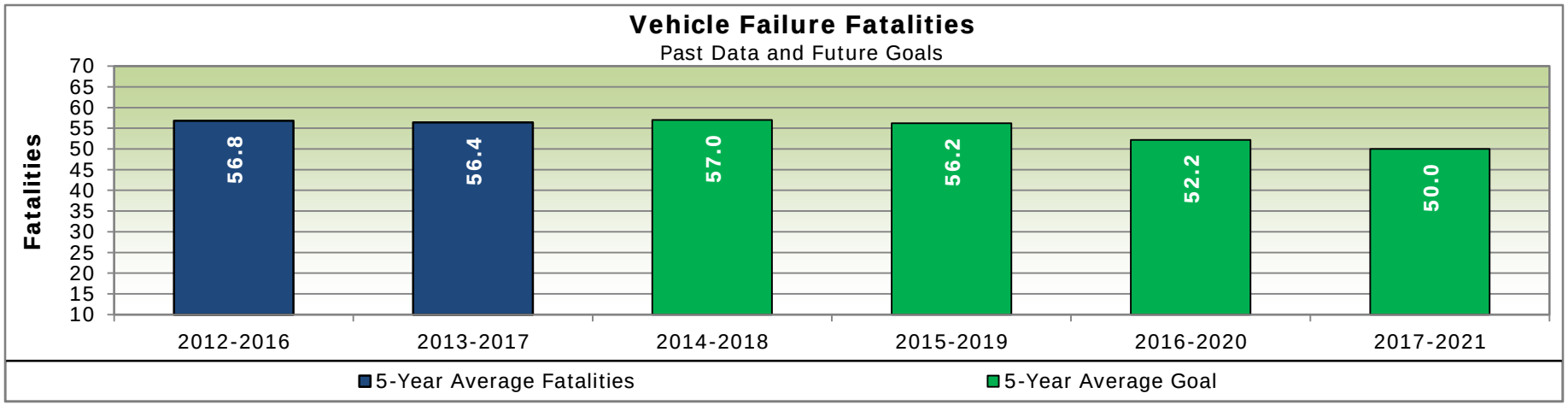
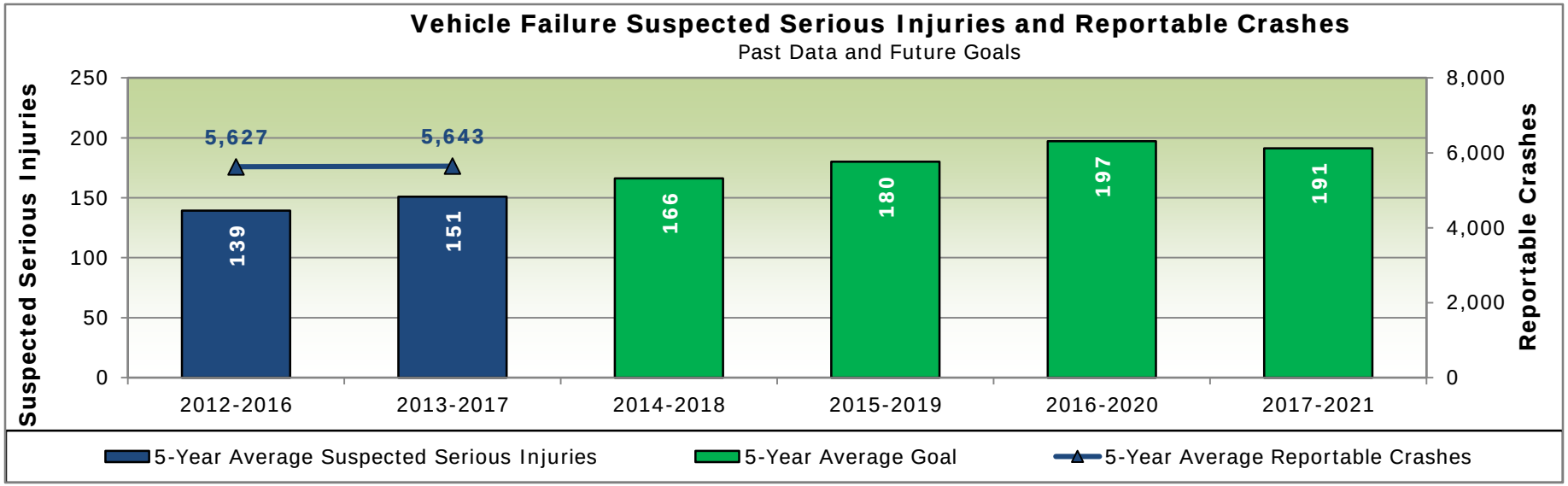
Vehicle Failure Trends and Goals

Indicates that there was a vehicle defect or failure contributing to the crash.





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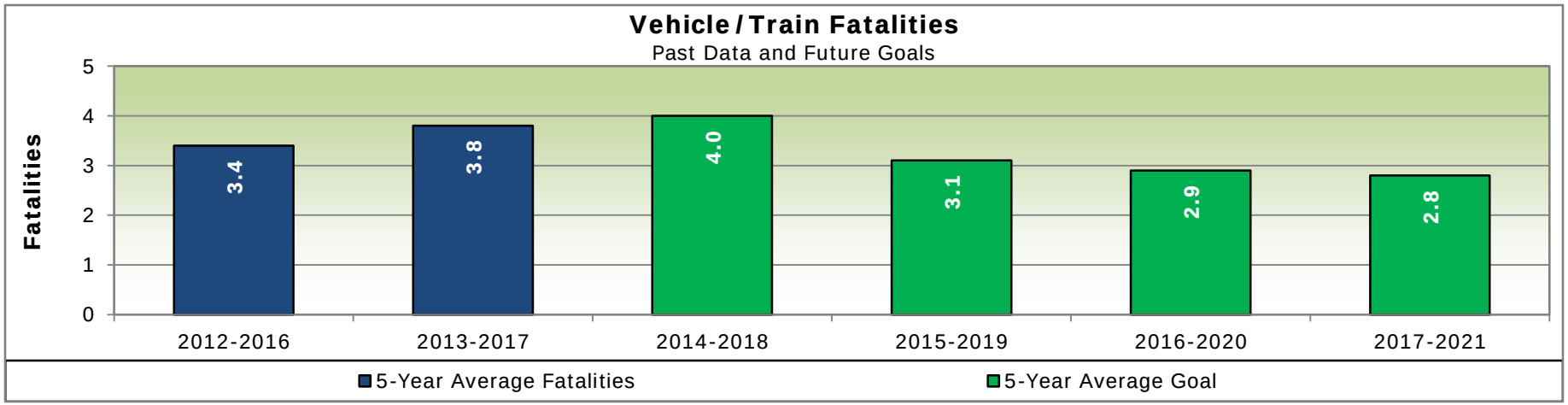
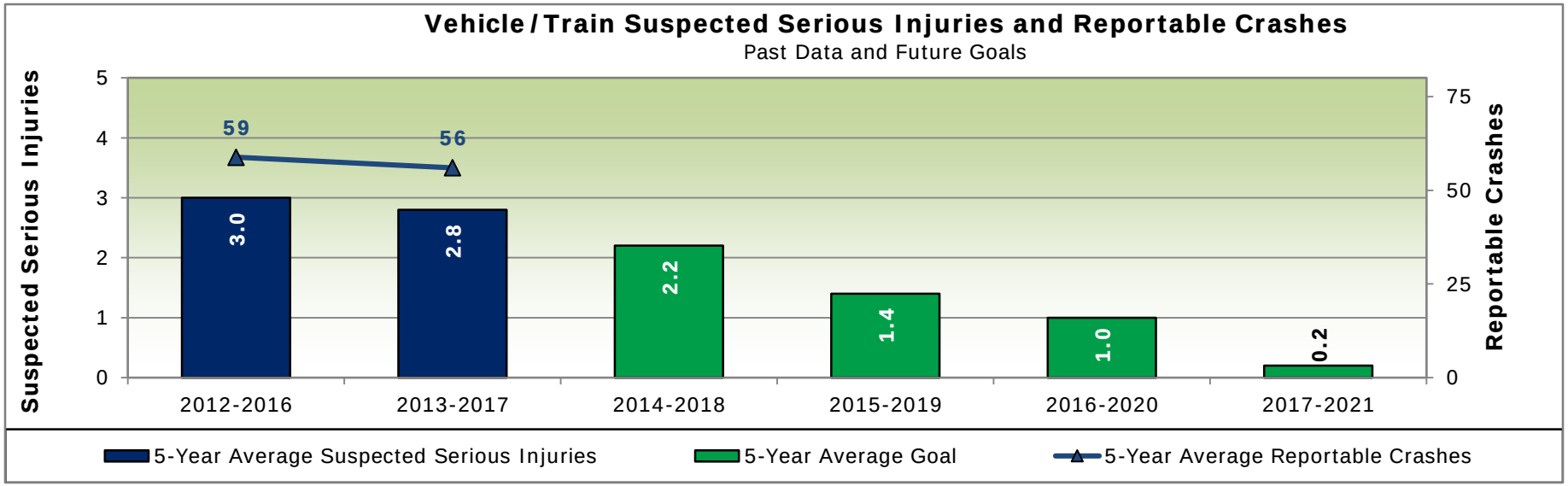
Vehicle/Train Trends and Goals

Indicates that any vehicle involved in the crash was a train or trolley.





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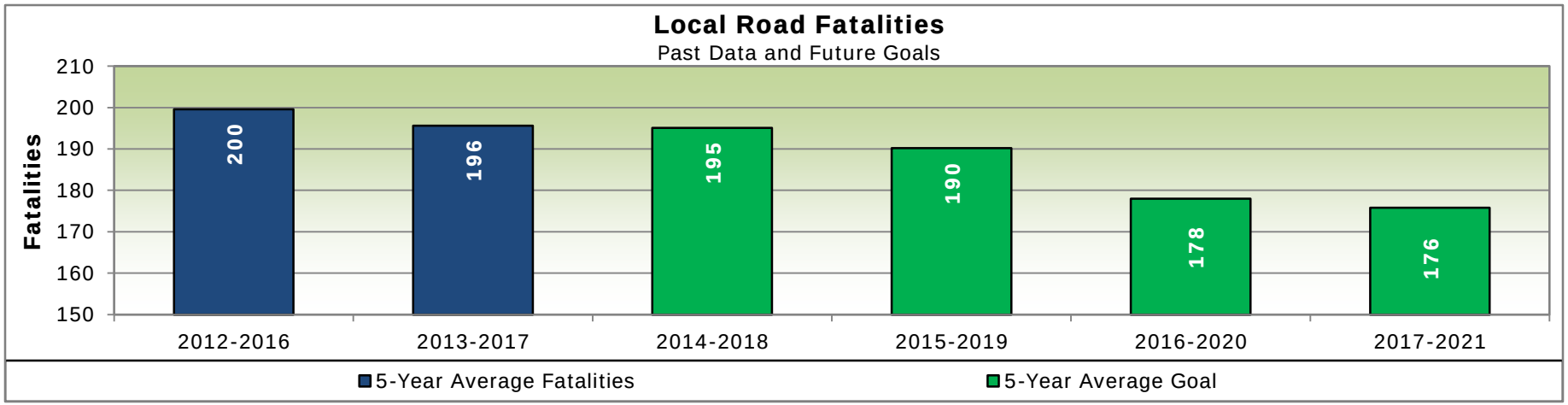
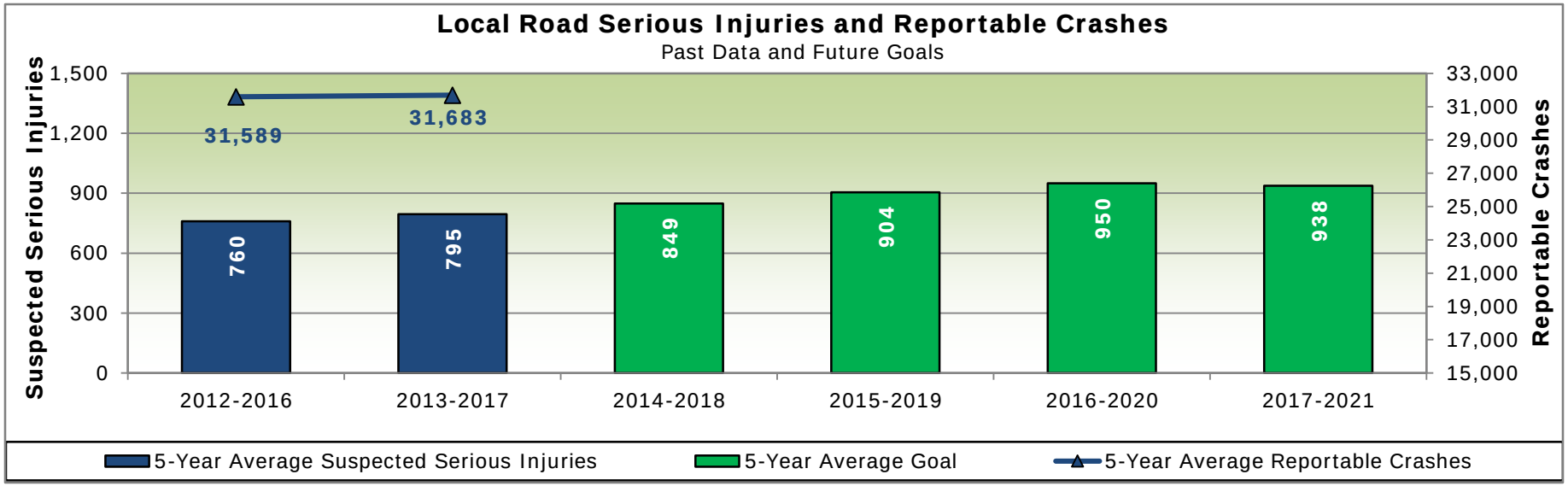
Local Road Trends and Goals

Indicates that every road was a county or municipal roadway.





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NHTSA Core Performance Measures

In their 2008 publication *Traffic Safety Performance Measures for States and Federal Agencies*, the National Highway Traffic Safety Administration (NHTSA) outlined ten core outcome measures, one core behavioral measure, and three activity measures. It was their recommendation that states annually set goals and report progress on the eleven core outcome and behavioral measures, as well as report progress on the activity measures.

Core Outcome Measures

- Traffic Fatalities *(Refer to Page 5)*
- Fatalities per VMT *(Refer to Page 6)*
- Serious Injuries in Traffic Crashes *(Refer to Page 8)*
- Unrestrained Passenger Vehicle Occupant Fatalities
- Fatalities in Crashes Involving a Driver or Motorcycle Operator with a BAC of 0.08 and Above
- Pedestrian Fatalities *(Refer to Page 21)*
- Bicycle Fatalities *(Refer to Page 22)*
- Motorcyclist Fatalities *(Refer to Page 23)*
- Speeding-Related Fatalities *(Refer to Page 34)*
- Unhelmeted Motorcyclist Fatalities
- Drivers Age 20 or Younger Involved In Fatal Crashes

Core Behavior Measure

- Observed Seat Belt Use for Passenger Vehicles

Activity Measures

- Seat Belt Citations Issued During Grant-Funded Enforcement Activities
- Impaired Driving Arrests Made During Grant-Funded Enforcement Activities
- Speeding Citations Issued During Grant-Funded Enforcement Activities

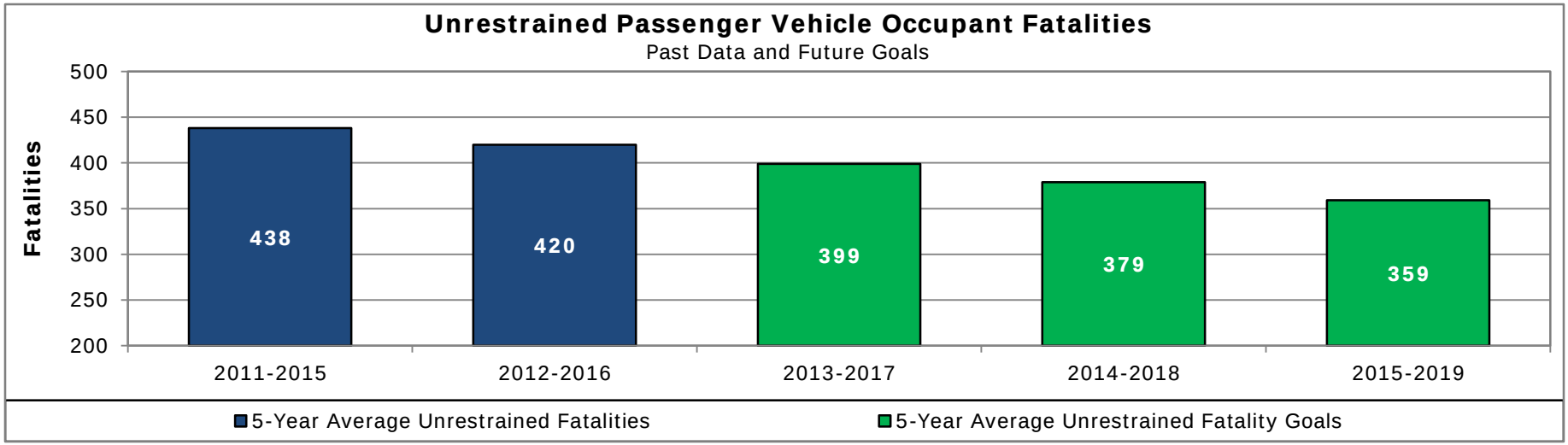
These performance measures, with one exception, utilize data from the NHTSA Fatality Analysis Reporting System (FARS). FARS is a nationwide census providing Congress and the American public systematic, yearly data regarding fatal injuries suffered in motor vehicle crashes. The exception is the Serious Injuries in Traffic Crashes, which come from state data.

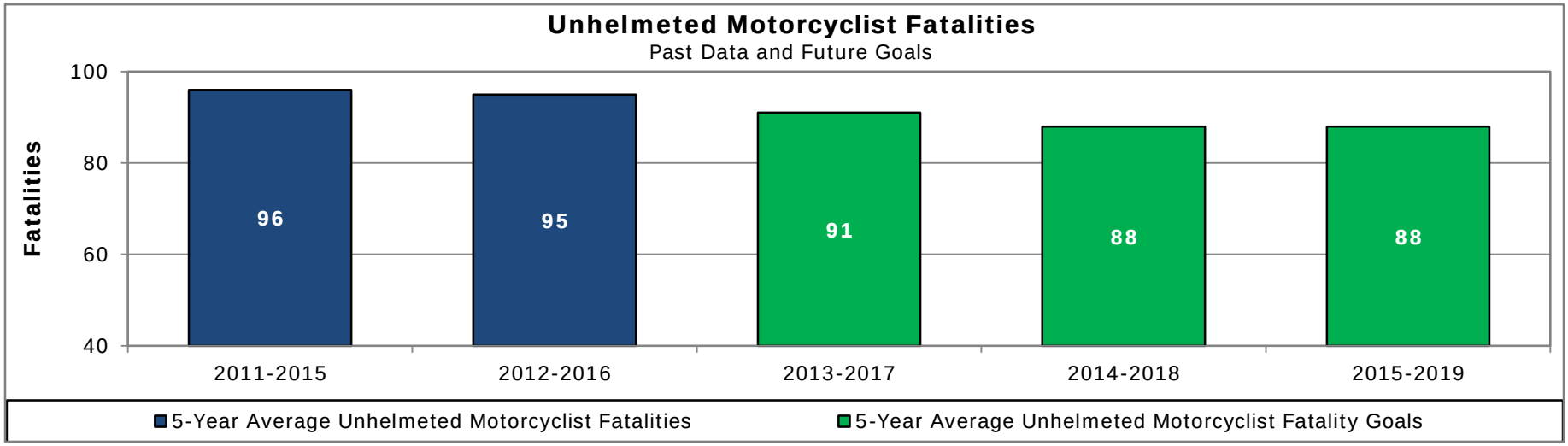
Note: Due to the availability of 2017 State data, various Core Outcome Measures mentioned above make reference to pages illustrating charts with relevant data. This is being done to minimize redundancy within this report.

Please note the following:

- ***2016 is the latest year for which FARS data is available.***
- ***2017 data is State provided***

NHTSA Performance Measures





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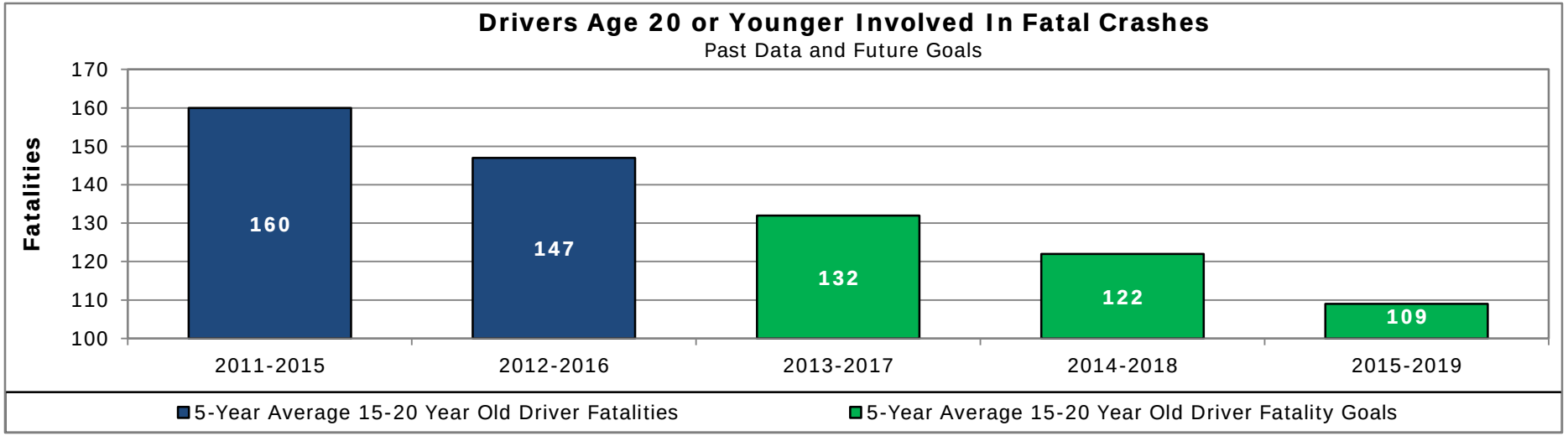
DEPARTMENT OF TRANSPORTATION

NHTSA Performance Measures



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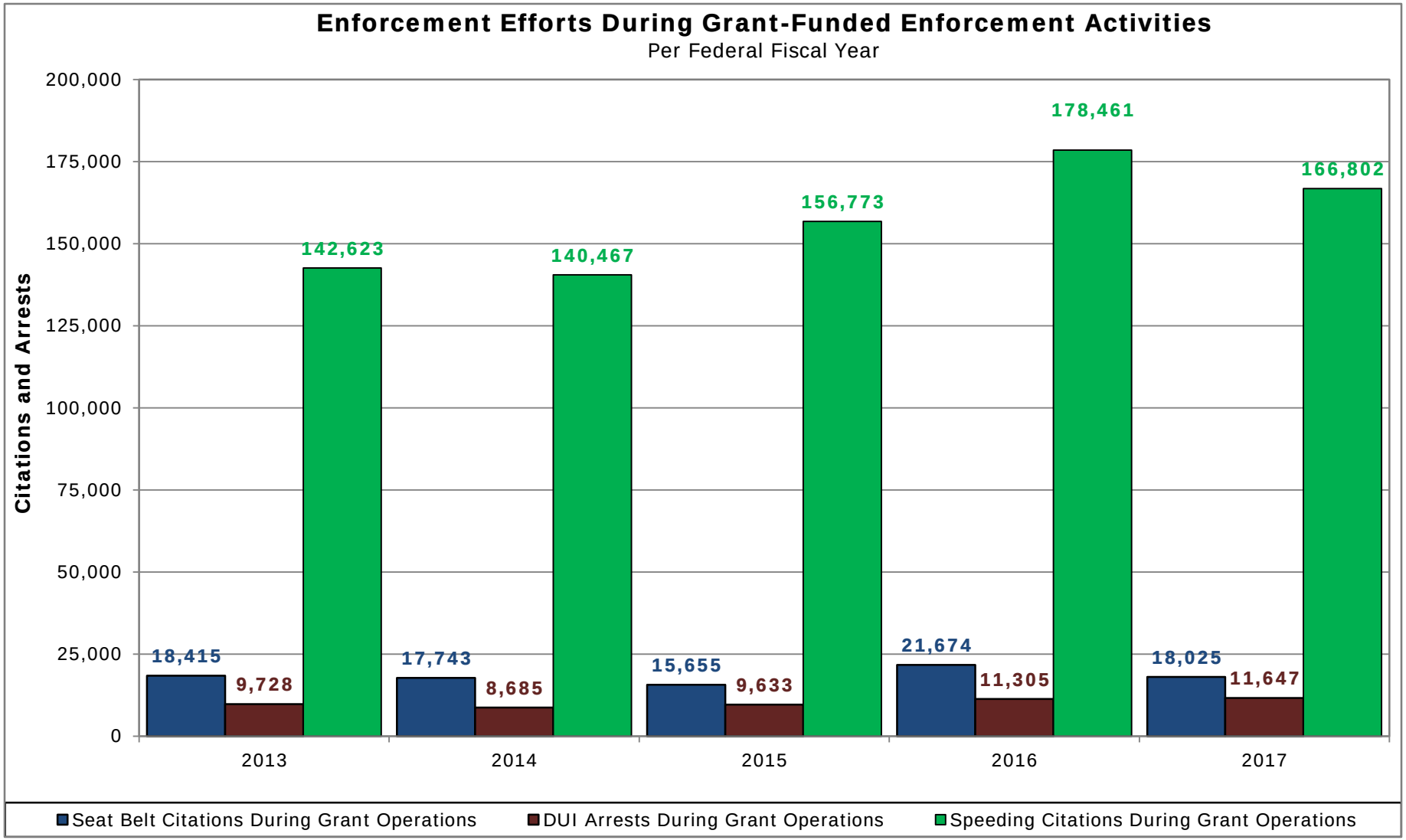
NHTSA Performance Measures



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DEPARTMENT OF TRANSPORTATION

Aggressive Driving and Speeding

According to 2017 fatality statistics, almost 11% of all fatalities in Pennsylvania involved aggressive driving, while 40% of all fatalities were related to speeding.

While the trend over the past several years has been one of decline, there is still much work to be done to combat aggressive driving and meet our safety goals. We expect 250 municipal police agencies and all state police troops to participate in the current year.

Note that an Aggressive Driving Related Crash is defined by NHTSA as a crash containing two or more aggressive driving crash causation factors, listed on the next page.

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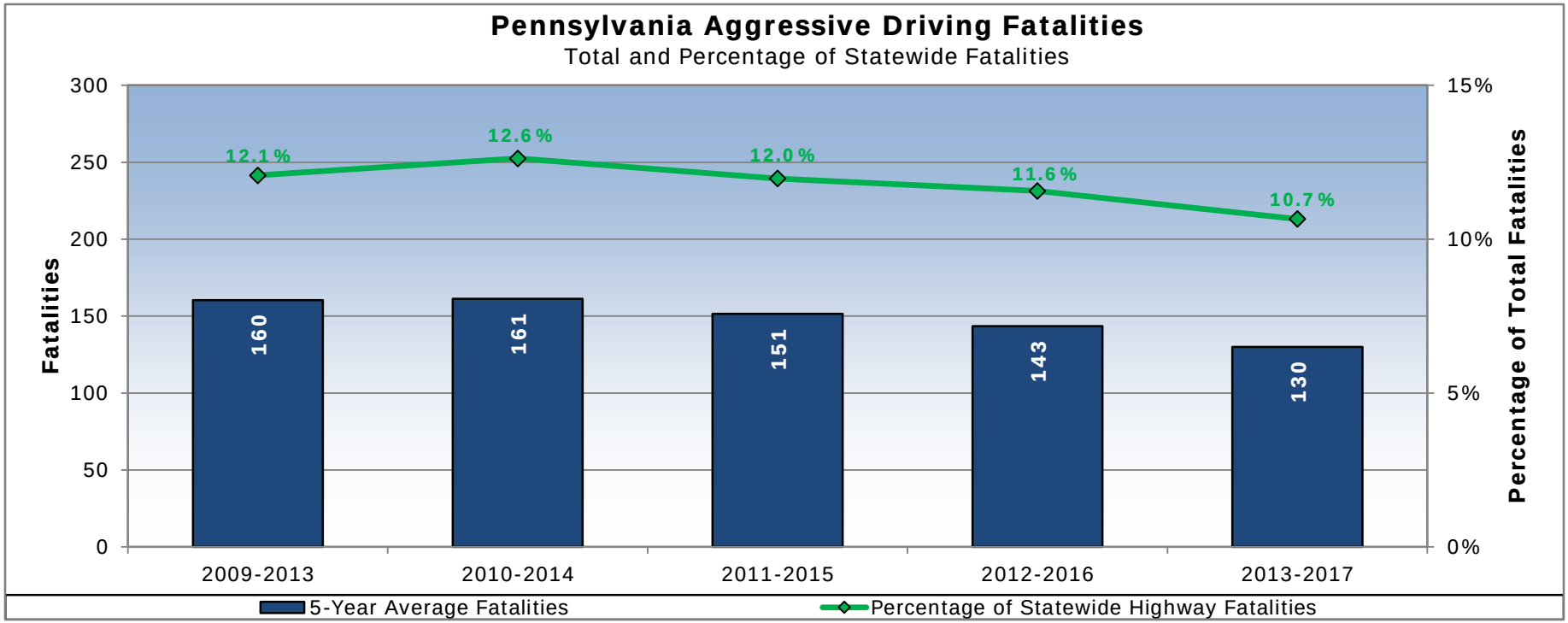
Aggressive Driving and Speeding



Aggressive Driving Crashes are determined based on a crash having any two of the following driving characteristics:

- Making an illegal U-Turn
- Turning from the wrong lane
- Passing in no passing zone
- Failure to respond to TCD
- Speeding
- Driver fleeing police (police chase)
- Sudden slowing or stopping
- Careless passing or lane change
- Running a stop sign
- Tailgating
- Driving too fast for conditions
- Making improper or careless turns
- Proceeding without clearance after stop
- Running a red light
- Making improper entrance to highway
- Making improper exit from highway

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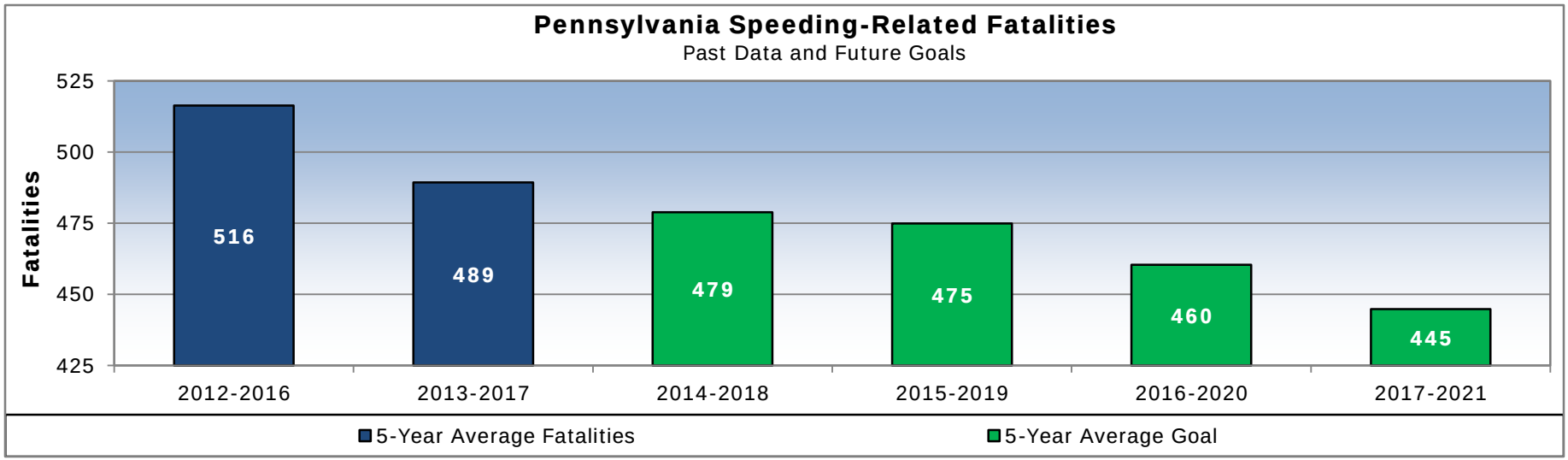
Aggressive Driving and Speeding

Indicates that any vehicle was speeding, driving too fast for conditions, or involved in a police chase.



Pennsylvania (PA) Speeding convictions:

- Historically, the PA Courts have convicted as high as 365,309 speeding cases for the year 2008, to as low as 225,638 cases (2013).
- For 2015, the PA Courts have convicted 296,583 cases.
- Currently, the PA Courts (2009-2015) are averaging over 250,000 speeding-case, convictions per year.

Information provided by the Administrative Office of Pennsylvania Courts

pennsylvania DEPARTMENT OF TRANSPORTATION

Impaired Driving

A significant goal of the Department is the reduction of crashes and fatalities due to impaired driving within the Commonwealth. Almost one-third of all traffic fatalities in Pennsylvania were attributable to driving under the influence during 2017.

Progress has been made in this area – the 293 alcohol-related fatalities in 2017 were the second lowest since records for this statistic were started in the 1980s, and were more than a half less than the recent peak in 2002. However, there is much more work to be done:

- Approximately 57% of DUI convictions were for a second or subsequent offense in 2016.
- Driving while impaired by drugs is increasing; nearly 65% of all DUI cases now include at least one charge for driving under the influence of a drug other than alcohol.

The Pennsylvania Ignition Interlock Law (Act 33 of 2016) retains the requirements for second or subsequent DUI offenders, but now also requires a one-year period of ignition interlock for first-time DUI offenders who had a BAC of 0.10 or higher at the time of arrest. Individuals guilty of chemical breath/blood test refusals are subject to a one-year period of ignition interlock under Act 33 as well.

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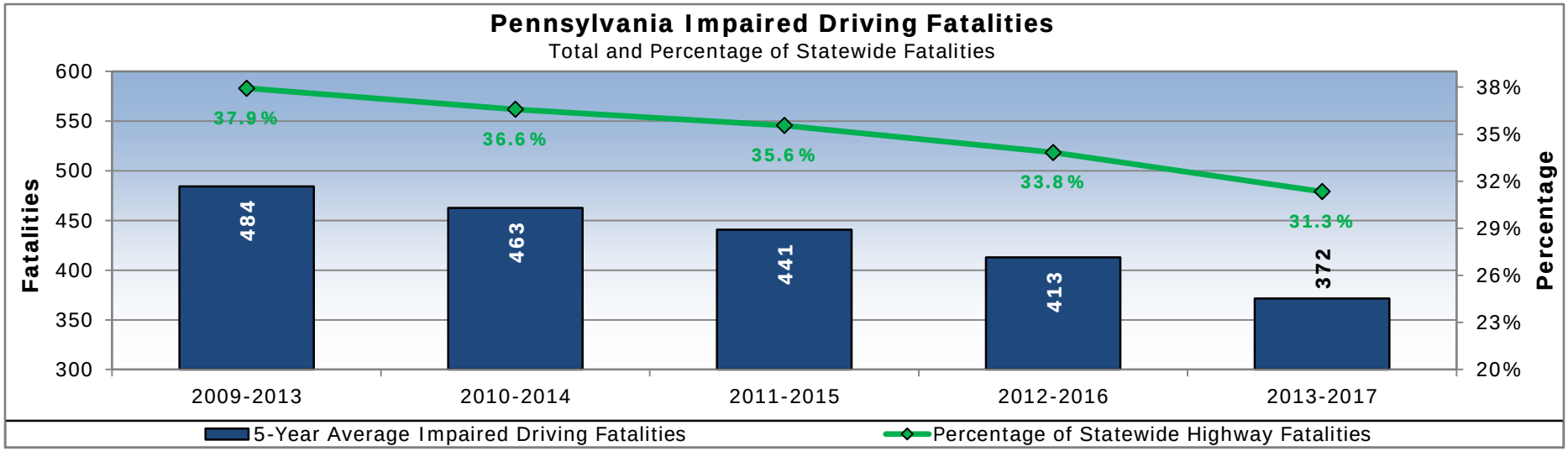
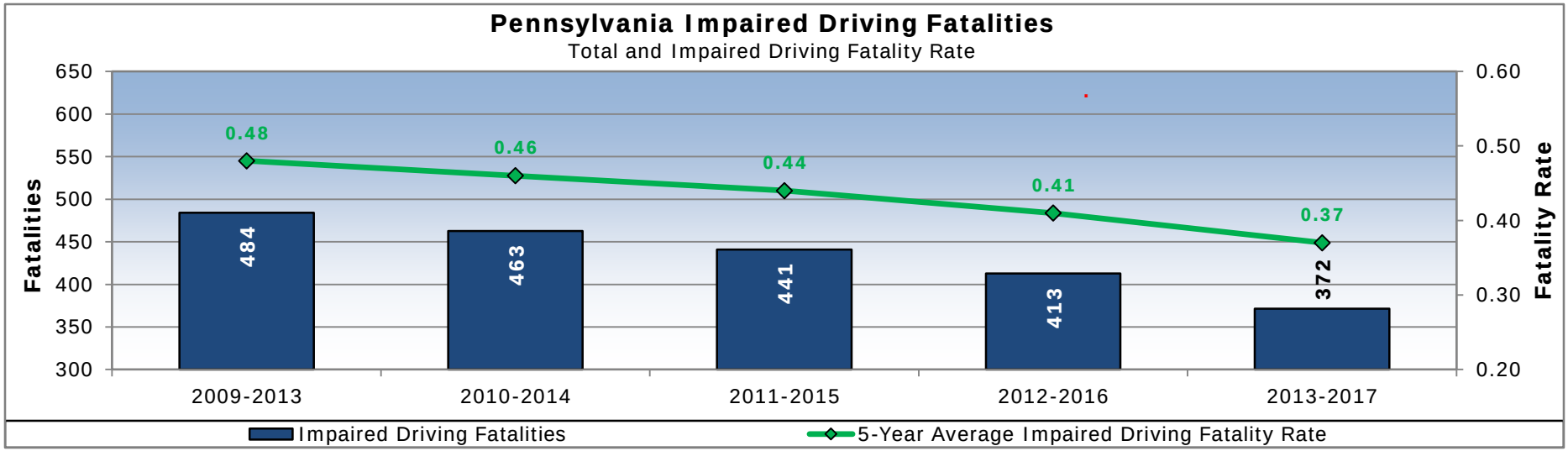
Impaired Driving





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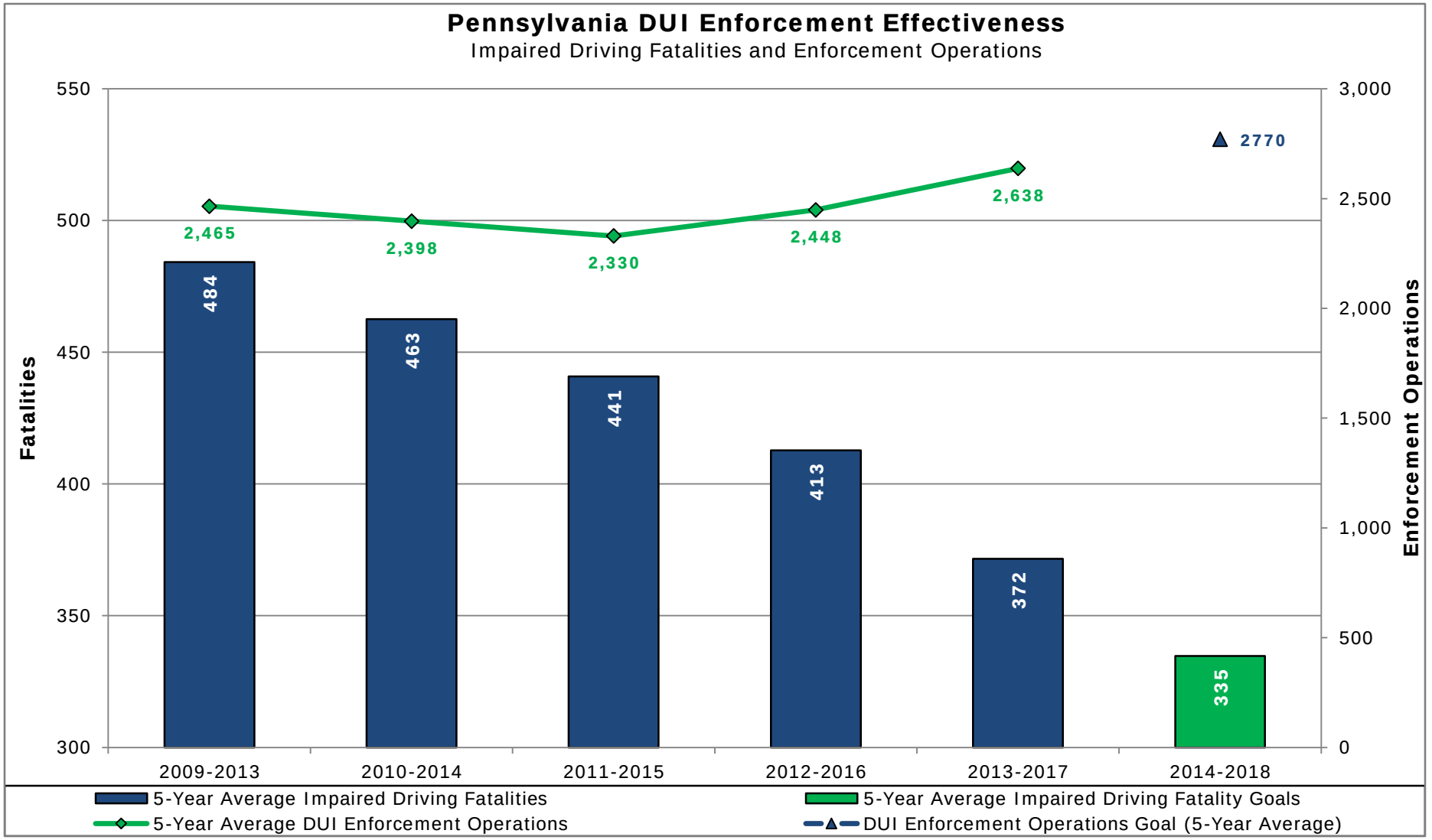
DEPARTMENT OF TRANSPORTATION

Impaired Driving



DUI Enforcement Operations include checkpoints and roving patrols.

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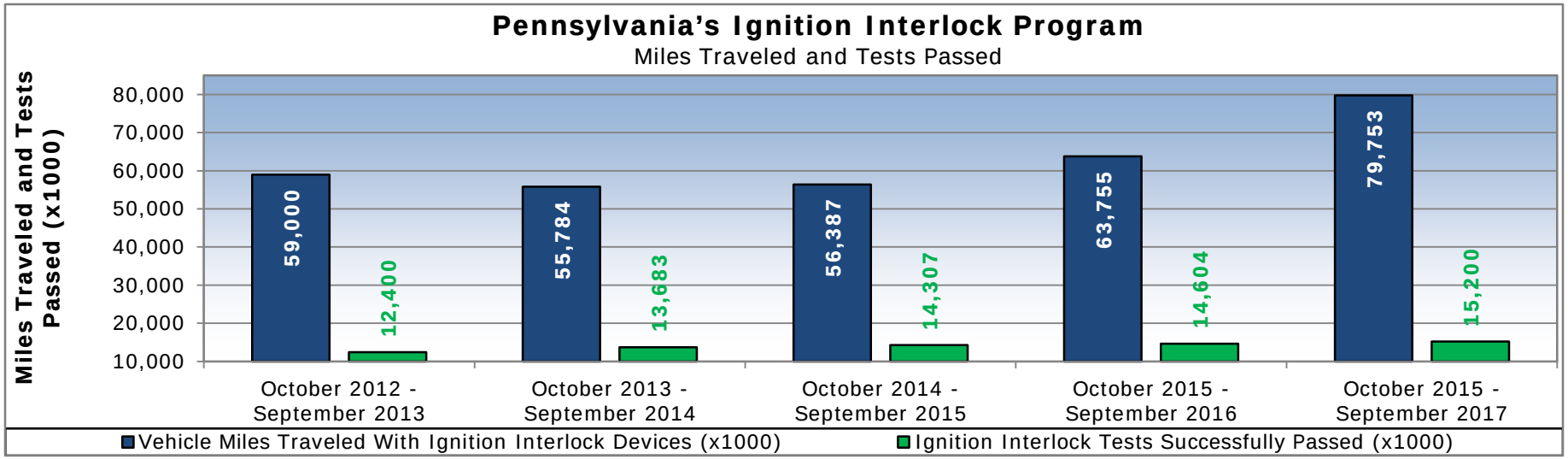
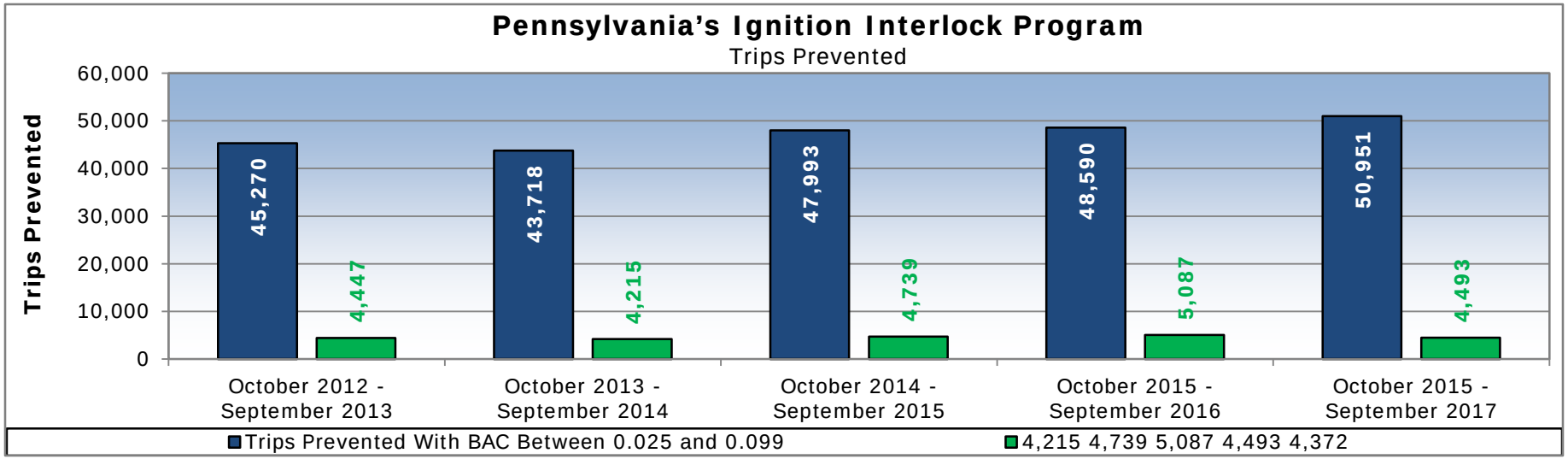
Impaired Driving





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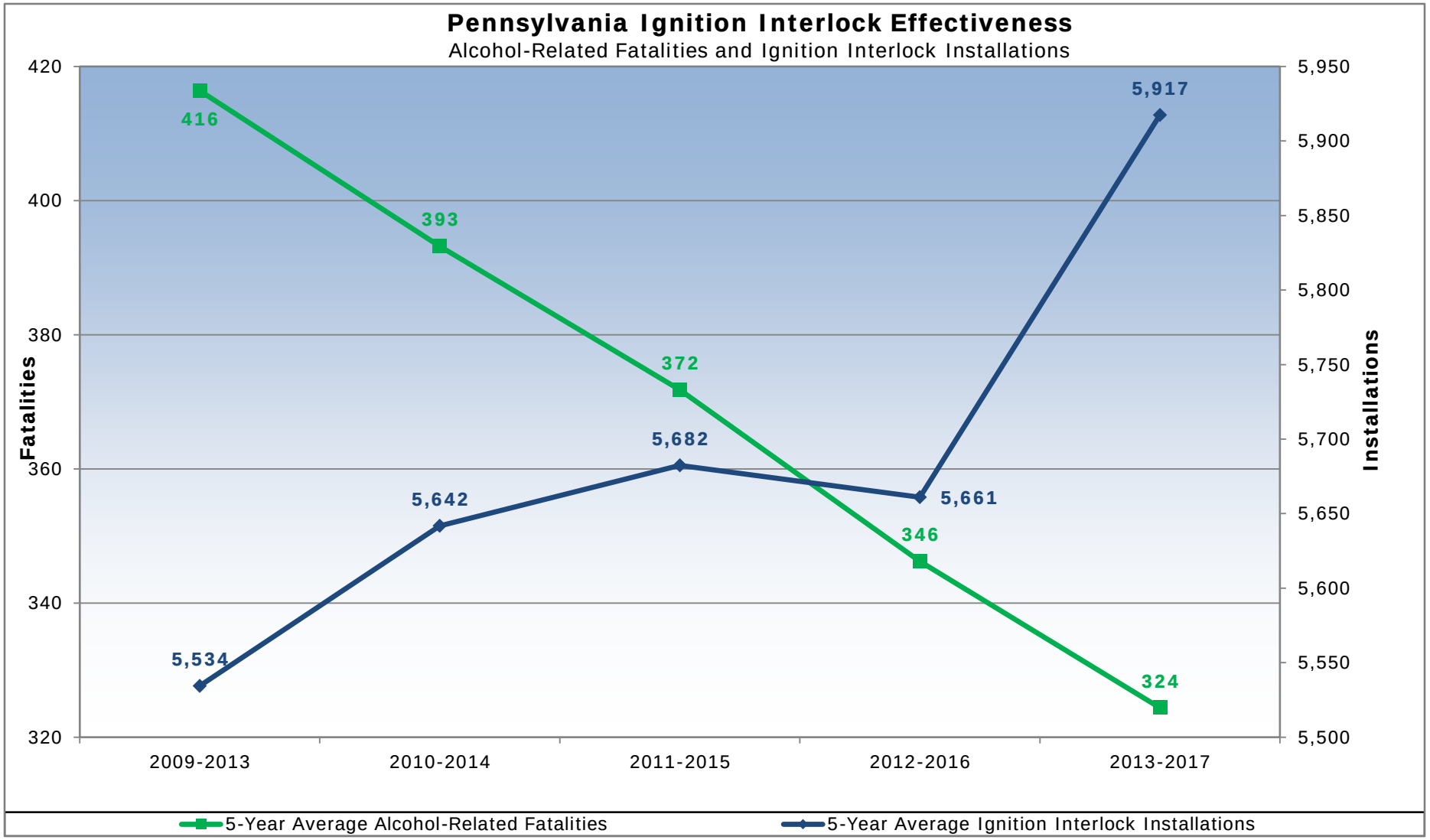
Impaired Driving



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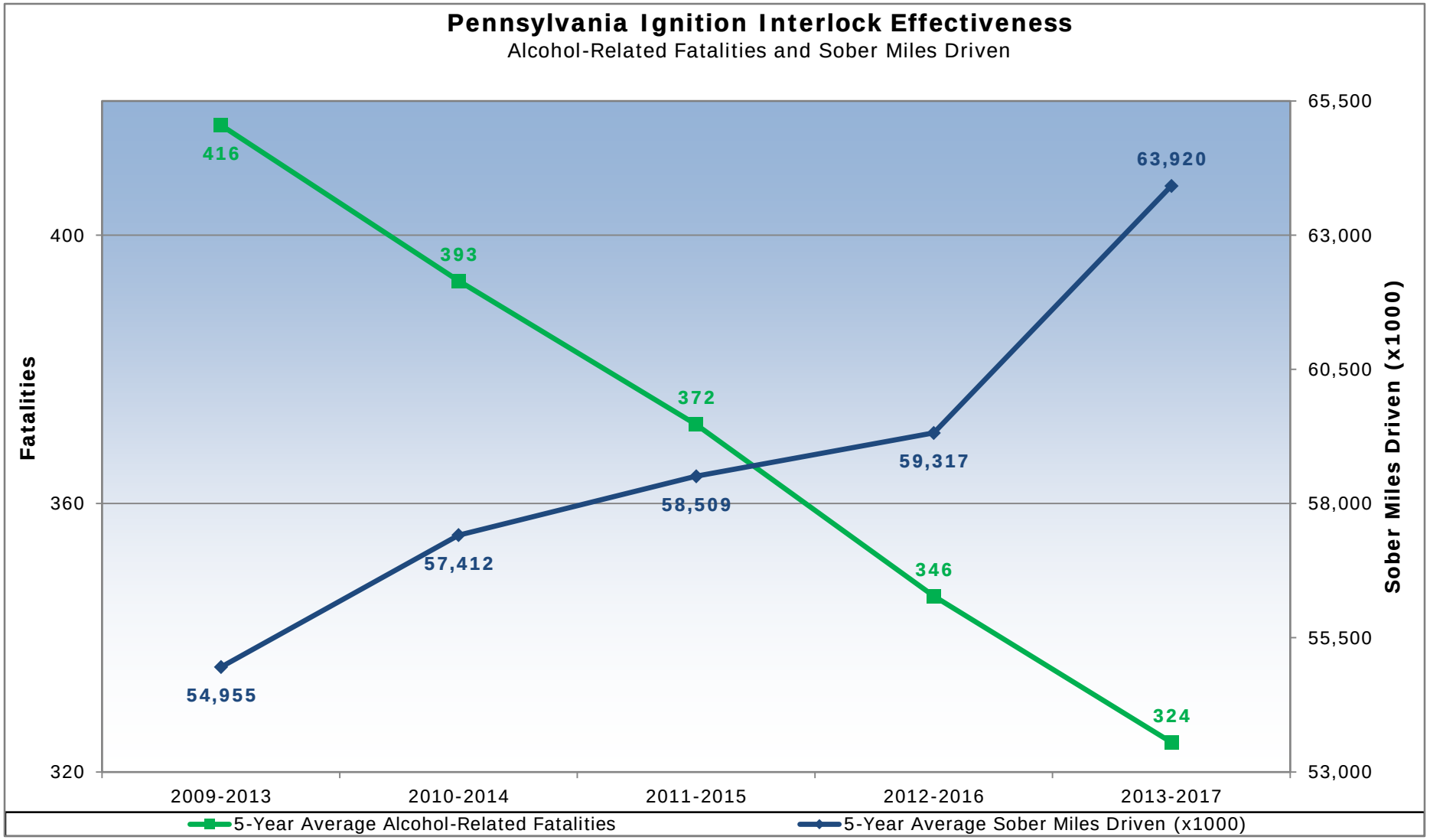
Impaired Driving



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DEPARTMENT OF TRANSPORTATION

Occupant Protection

- One of Pennsylvania's top safety priorities is increasing the rate of properly restrained drivers and passengers. The statewide use rate in 2017 was 85.6%. That year only 11% of crashes involved at least one unbelted person but 31% of people suffering a major injury in a crash and 40% of people killed in a crash were unbelted. According to NHTSA, proper occupant restraint can increase the chance of surviving a crash by up to 60%.

- Pennsylvania law currently allows for primary enforcement of restraint use for drivers and passengers under the age of 18. For those 18 and over, the law allows for secondary enforcement of seat belt use in the front seat of a vehicle only. Pennsylvania is one of only 15 states that does not have a primary seat belt enforcement law covering all ages. Primary seat belt law states average over 90% seat belt use. NHTSA estimates that a 90% seat belt use in PA would save an additional 52 lives, 766 serious injuries, and $227 million in costs each year.

- Pennsylvania's occupant protection program targets all ages with education and outreach along with high visibility enforcement. The child passenger safety program reaches caregivers, schools and daycares, the medical community, and law enforcement to educate on the proper use of child passenger restraints. A network of certified child passenger safety technicians within communities assist caregivers in proper restraint use, and a network of car seat and booster loan programs receive seats through state funds to loan to families in need.

- The high visibility enforcement program includes funded overtime seat belt enforcement from state and local law enforcement agencies (LEAs) during the two national Click it or Ticket mobilizations. There is also a yearly teen-focused education and enforcement campaign conducted by select local LEAs, and in-kind enforcement from local LEAs during non-mobilization months of the year. Each of these enforcement campaigns are accompanied by national and/or state paid media campaigns, and earned media generated by the PennDOT press office, participating LEAs, and local safety partners.

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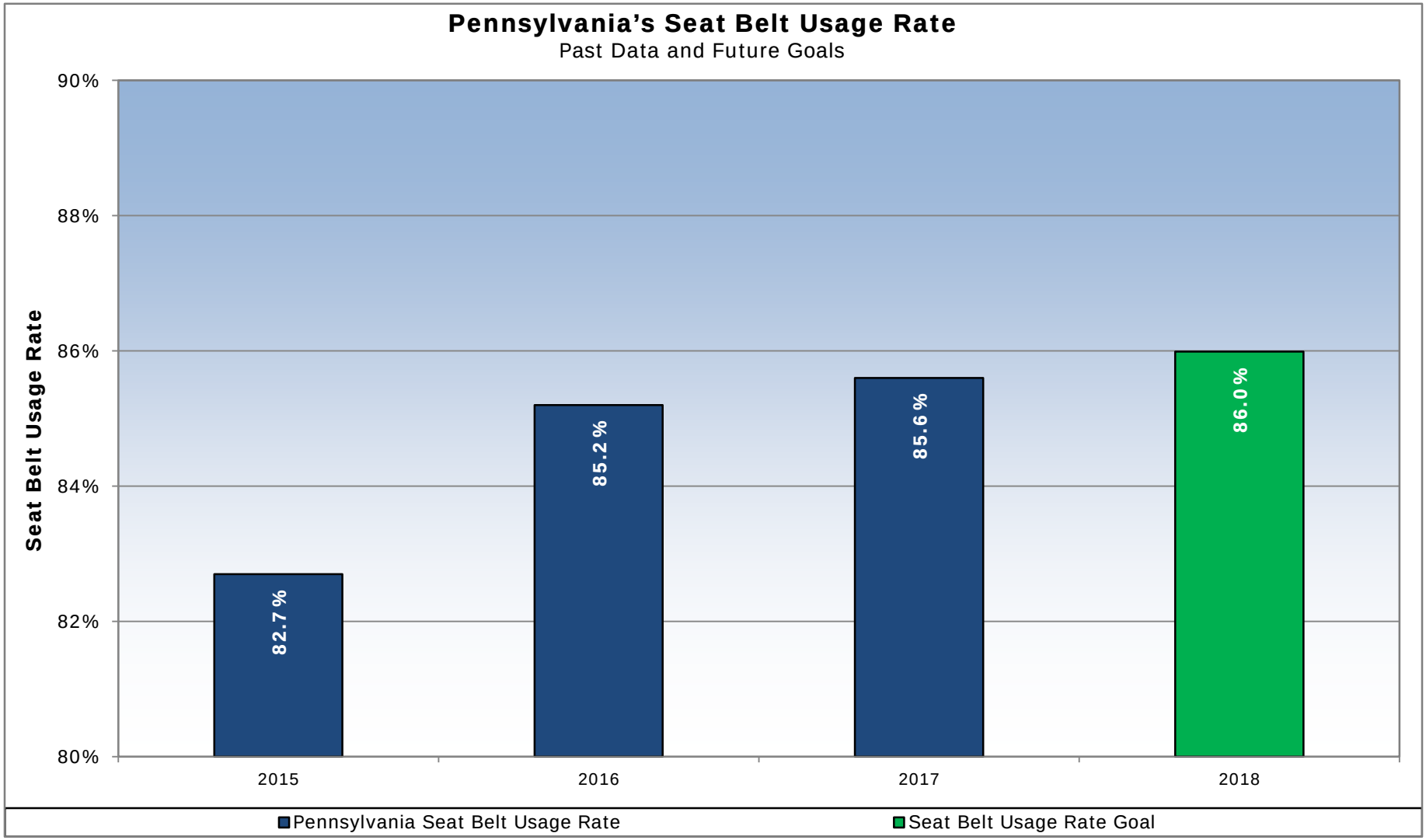
DEPARTMENT OF TRANSPORTATION

Occupant Protection



The current goal for seat belt rate usage in Pennsylvania is an increase to 90% over the next 20 years (from 83.8% in 2011 to 90.0% in 2031).

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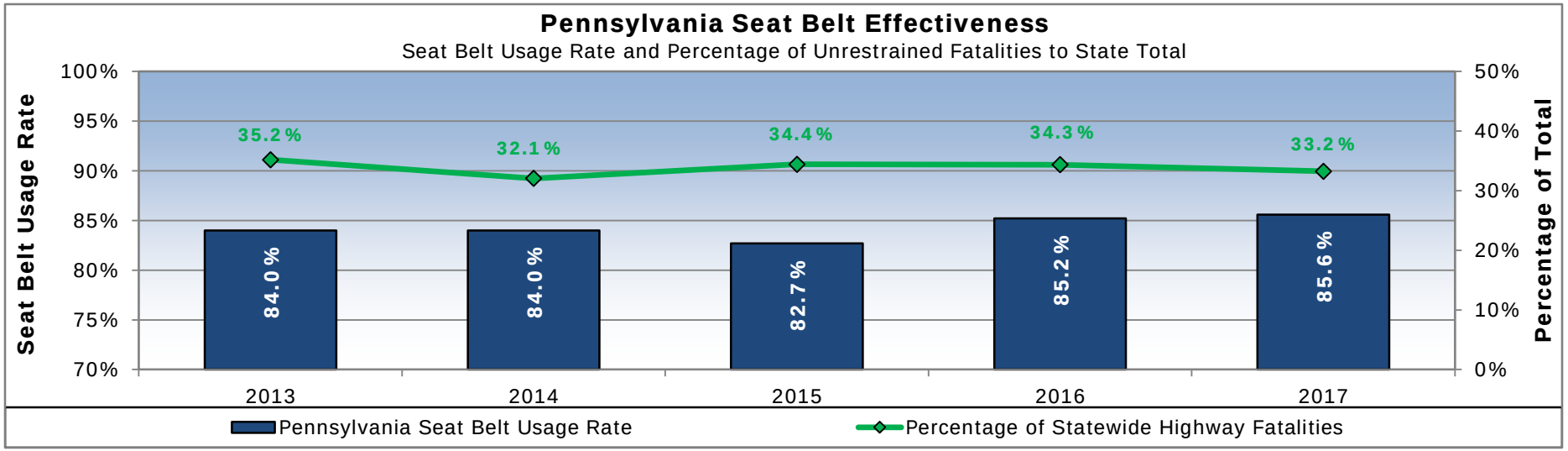
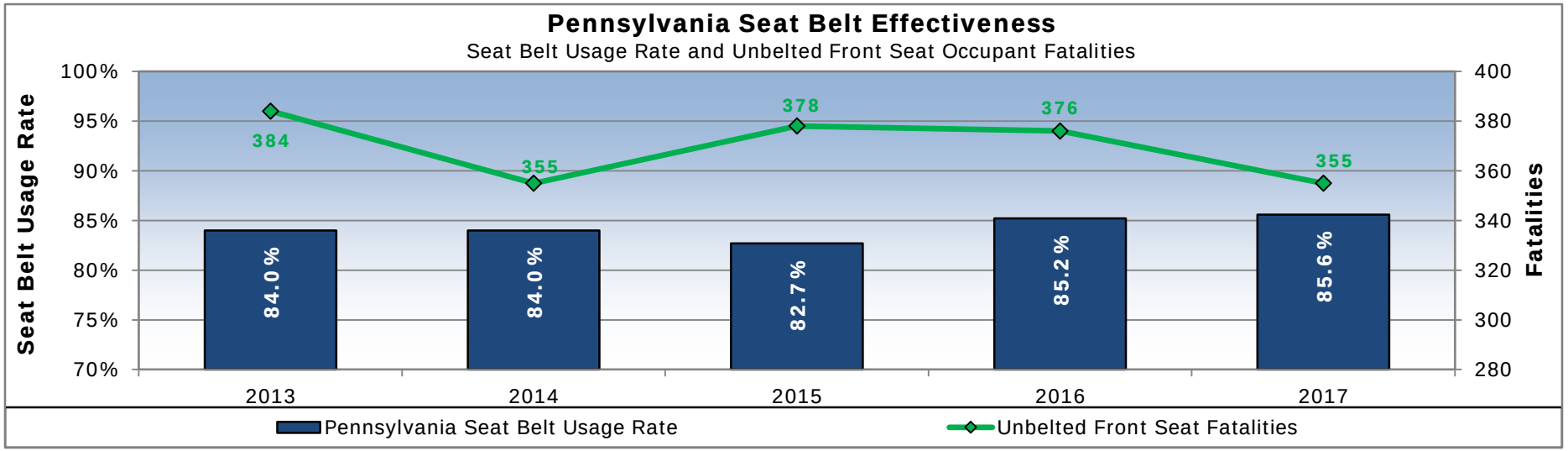
DEPARTMENT OF TRANSPORTATION

Occupant Protection





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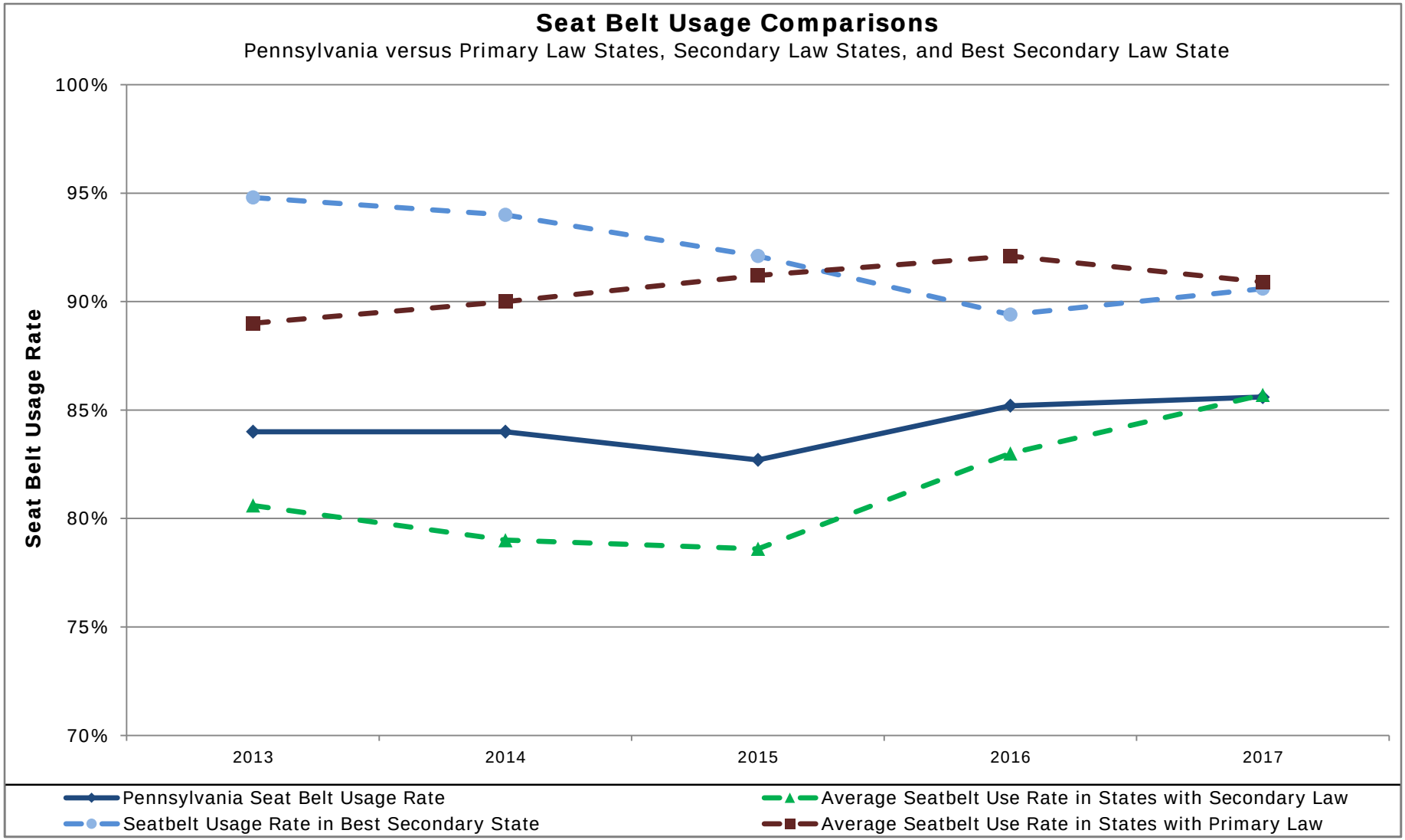
DEPARTMENT OF TRANSPORTATION

Occupant Protection



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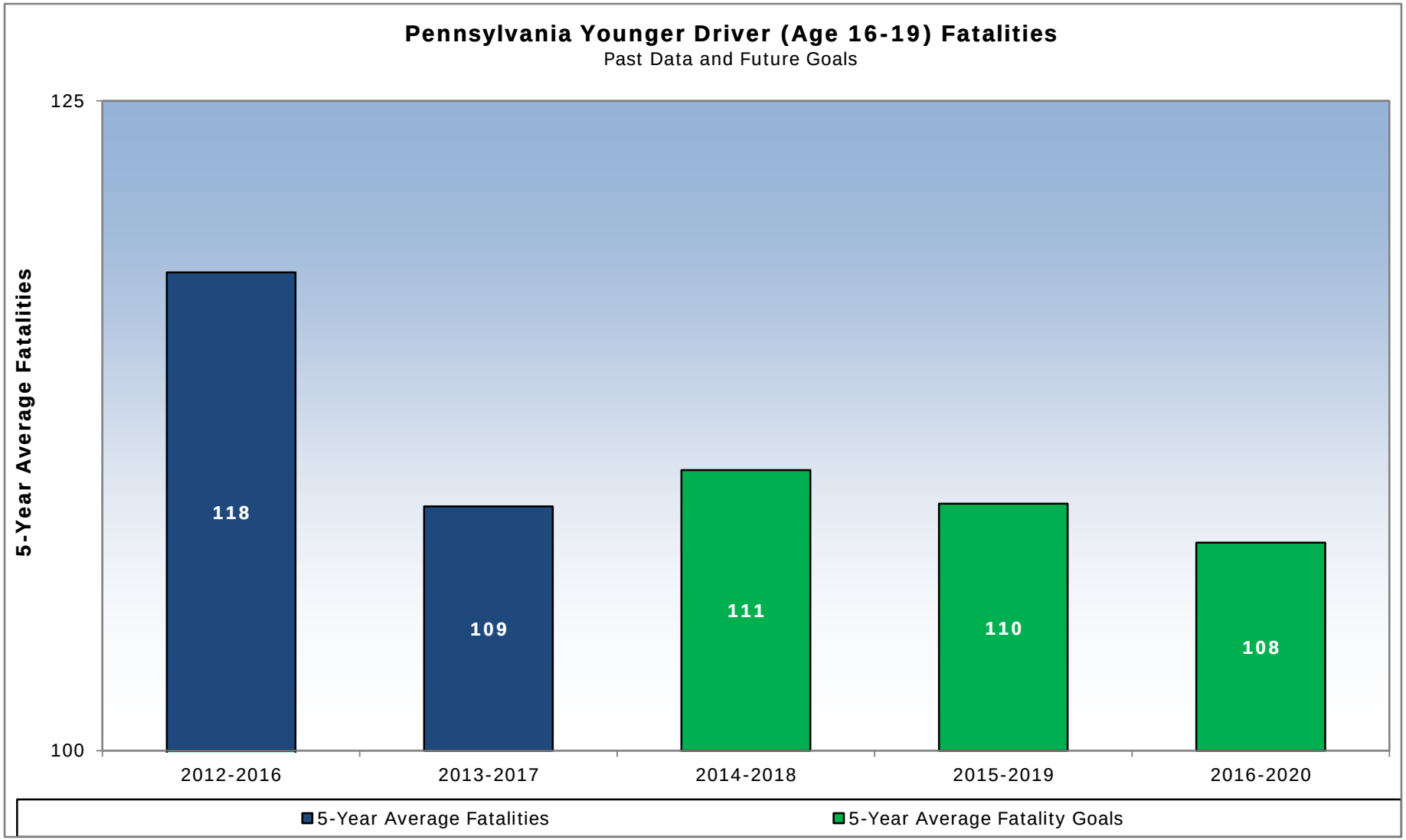
Younger Drivers



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DEPARTMENT OF TRANSPORTATION

Commercial Vehicle Safety

Stretching from the shores of Lake Erie to the Delaware River, Pennsylvania serves as the gateway to the population centers of the northeastern United States.

According to the 2016 Pennsylvania Highway Statistics report, the percent of daily vehicle-miles travelled (DVMT), compared to the total of all vehicle miles travelled in Pennsylvania, has increased annually since 2010. The number of miles DVMT for trucks has increased annually for the last five years resulting in a 6.6% increase in total vehicle miles travelled by trucks since 2012.

For the purposes of analysis, PennDOT defines a “heavy truck” as any single vehicle with a weighting of 10,000 pounds or more.

A heavy truck crash or fatality indicates that any vehicle involved was a heavy truck, and does not reflect crash causation.

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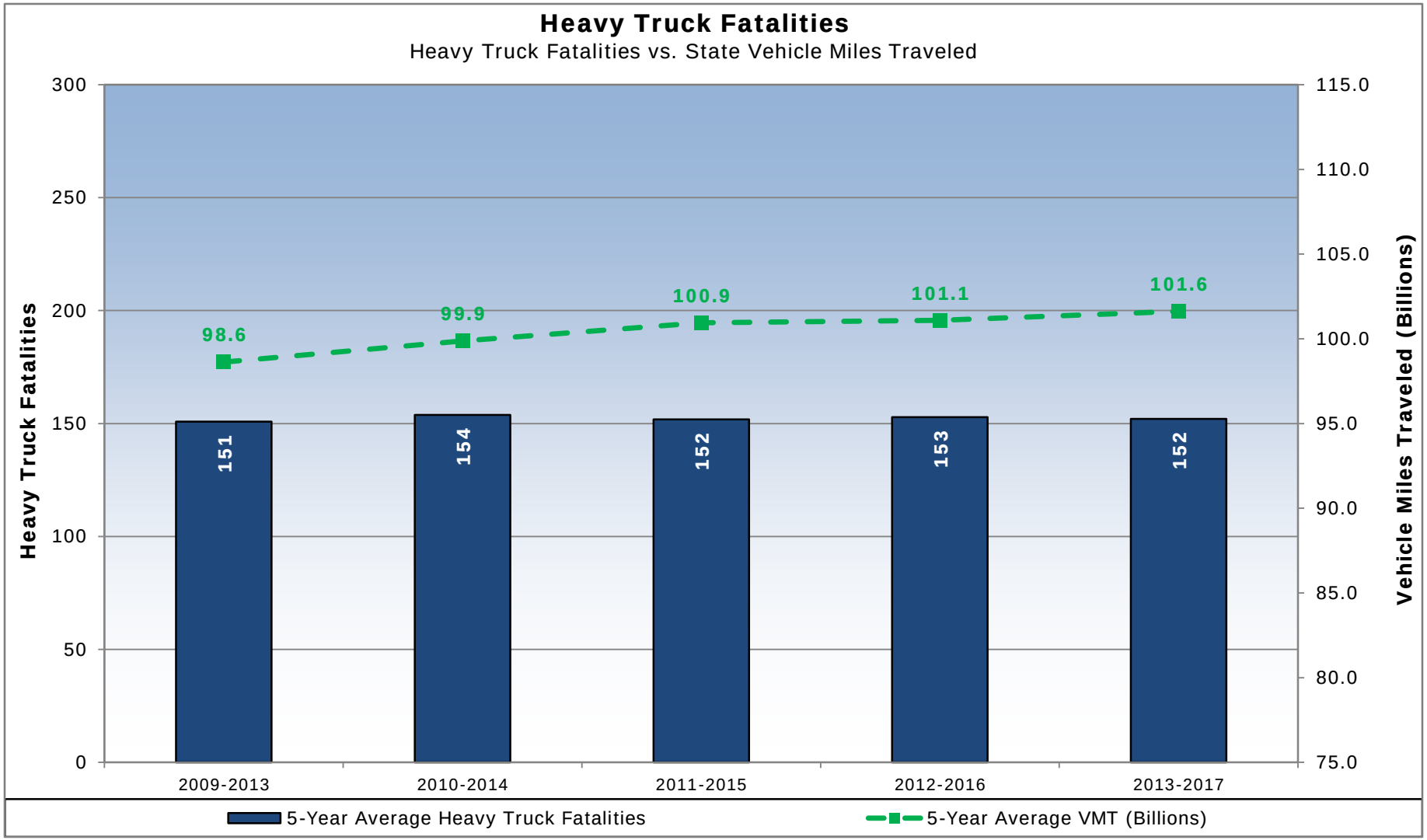
Commercial Vehicle Safety



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DEPARTMENT OF TRANSPORTATION

Motorcycles

Pennsylvania is home to a growing population of motorcycle riders. From 2008 to 2017, Pennsylvania saw a 3.6 percent increase in motorcyclists. Because of their size, motorcycles can be easily hidden in blind spots and are easily overlooked by other drivers. The majority of multivehicle crashes involving a motorcycle over the past four years have had a vehicle other than the motorcycle cited as the prime contributing factor in the crash. Therefore it is important that drivers be aware of motorcycles sharing the road. Additionally, roughly 20 percent of all motorcycle operators killed in a crash in Pennsylvania were reported as suspected of drug and or alcohol impairment by law enforcement in 2015. Motorcycle fatalities totaled 186 in 2017, accounting for approximately 16 percent of all traffic fatalities in Pennsylvania. Pennsylvania has several programs and efforts in place to stem the rise in motorcycle incidents:

- Pennsylvania's Share the Road with Motorcycles Campaign encourages motorists to "Watch for Motorcycles" through mediums such as billboards, stickers, yard signs, and electronic message board messages.
- Live Free Ride Alive is a state-operated safety initiative, including its website, www.LiveFreeRideAlive.com, which is dedicated to informing the public about motorcycle facts and figures as well as information on training programs and motorcycle permit and license tests.
- Pennsylvania's Motorcycle Safety Program (www.pamsp.com) has been teaching safe operating practices to riders since 1985. In 2017, over 13,000 students were trained at 76 sites across the Commonwealth.
- Total Control training, Inc. provides training services for PAMSP. Courses are continually updated to help better prepare riders. Current courses include: Introduction to riding, Beginner Riding Clinic, 3 Wheel riding clinic and intermediate riding clinic .

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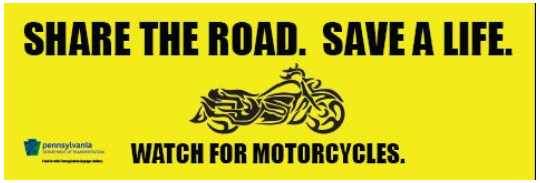
MOTORCYCLE SAFETY PROGRAM

livefreerideralive.com



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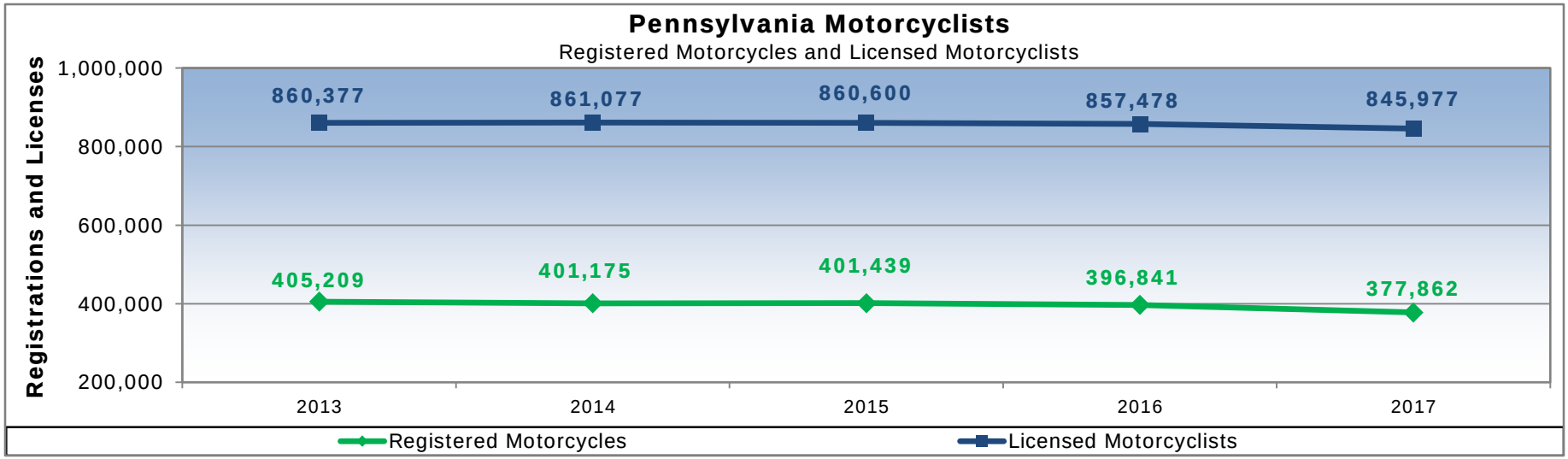
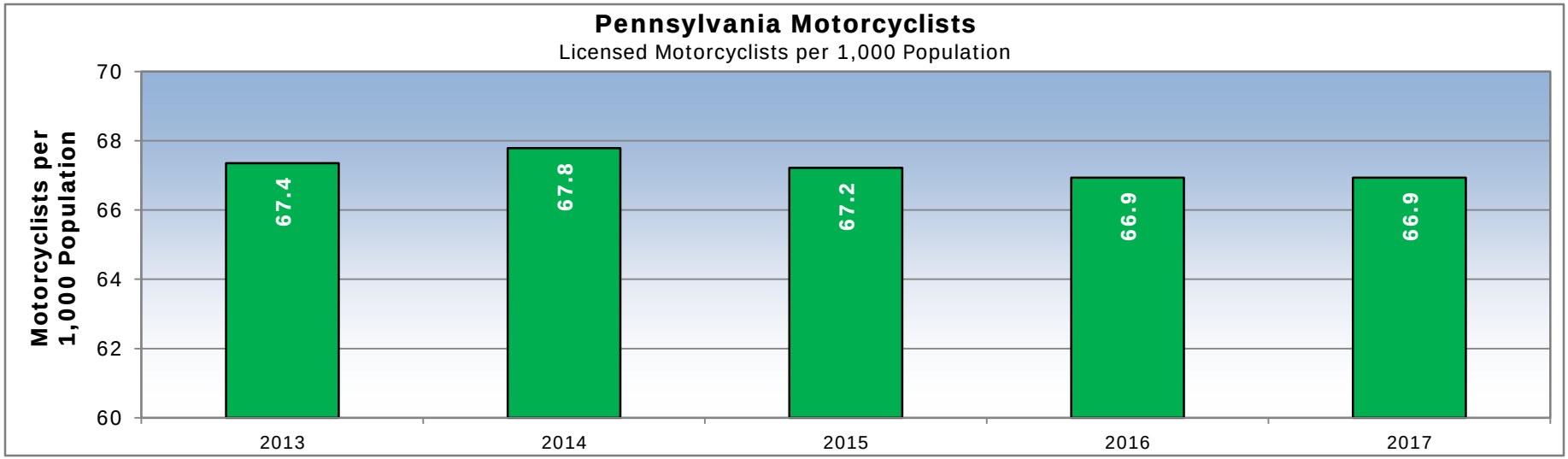
DEPARTMENT OF TRANSPORTATION

Motorcycles





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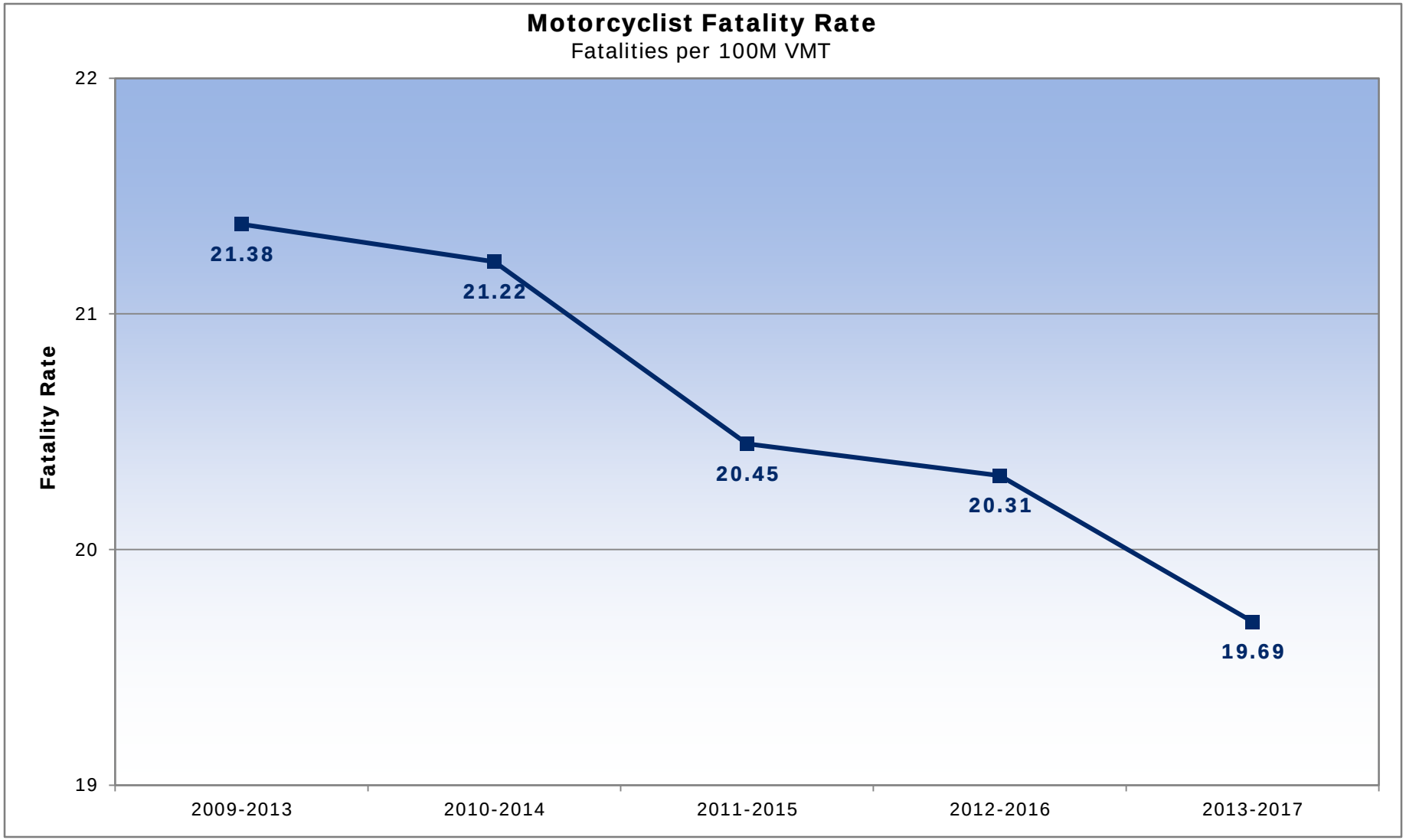
DEPARTMENT OF TRANSPORTATION

Motorcycles



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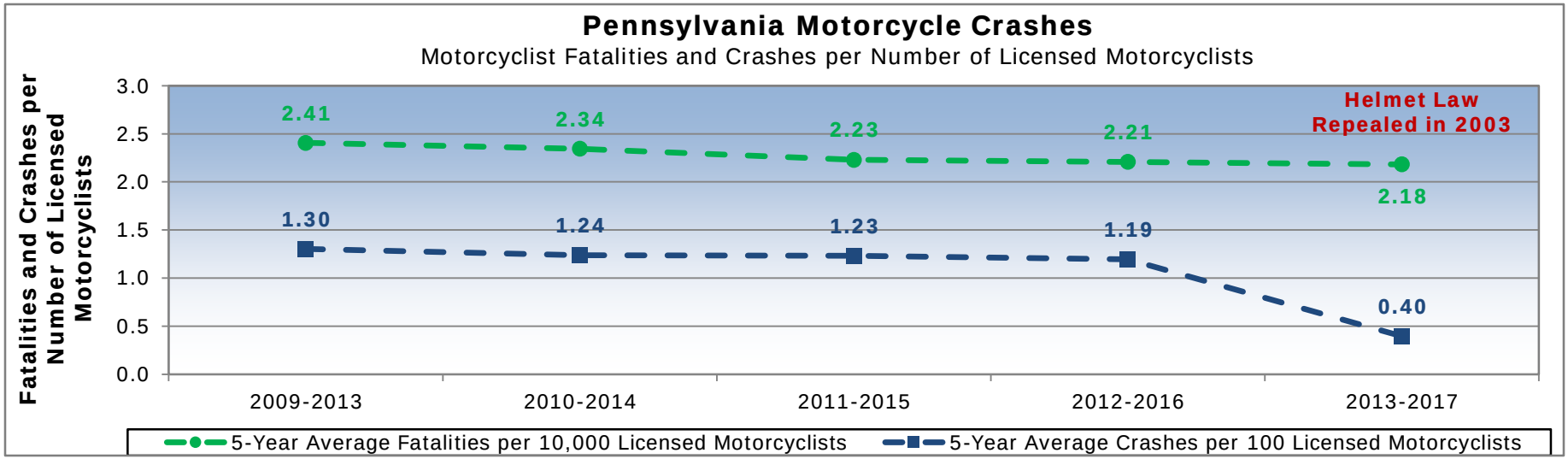
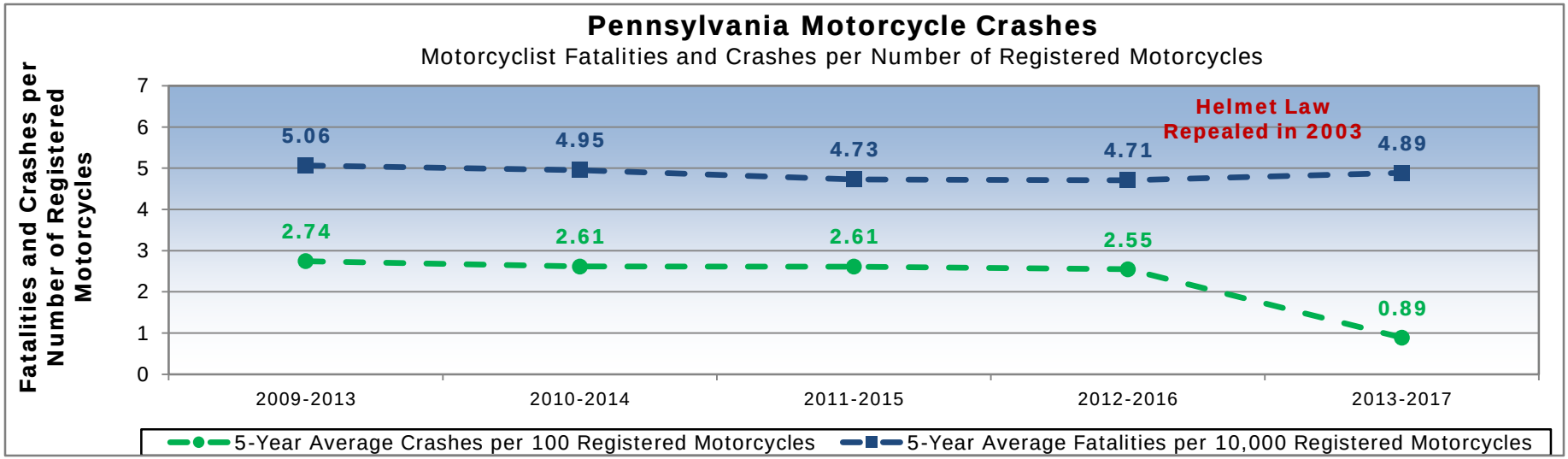
DEPARTMENT OF TRANSPORTATION

Motorcycles





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DEPARTMENT OF TRANSPORTATION

Local Roads

Pennsylvania is home to a vast network of roadways owned by local municipalities. These local roads total at approximately 78,000 miles in length and represent almost two-thirds of the road mileage in the state.

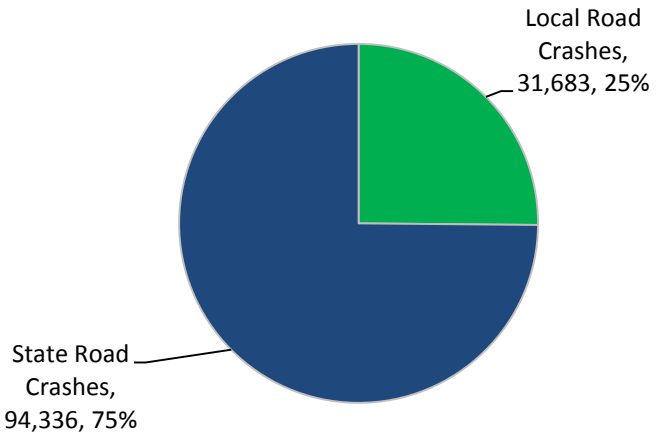
In 2017, 15% of fatalities and 25% of reportable crashes occurred on local roads in Pennsylvania.

With the goal of improving safety on local roads, PennDOT has two programs in place within its Local Technical Assistance Program (LTAP): the Local Safe Roads Communities Program and PennDOT Directed Technical Assistance Program. Both of these programs are focused on local road safety and offer a process of identification and recommendation for low-cost remediation of high safety risk areas to municipal leaders at no cost for the service.

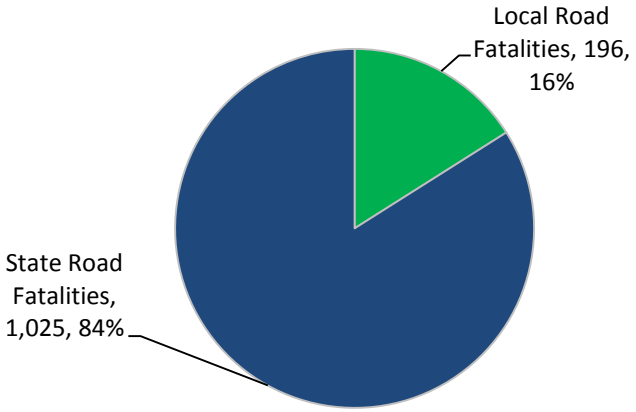
As of July 2016, 114 Local Safe Road Communities Programs and 25 PennDOT Technical Assistance Programs(construction-ready, line item quantities included) have been completed, providing assistance to examine the municipalities local road system to develop their own local road safety improvement plan. This program continues to grow and expand, as more communities are researched. LTAP, District Safety Engineers, District Bicycle/Pedestrian Coordinators and District Municipal Service Engineers continue to identify locations to make very low cost safety improvements.

Local Roads

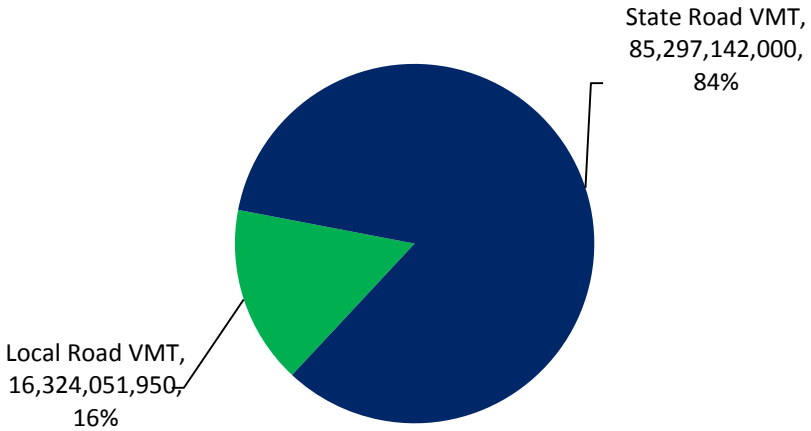
2013-2017 Reportable Crash Distribution



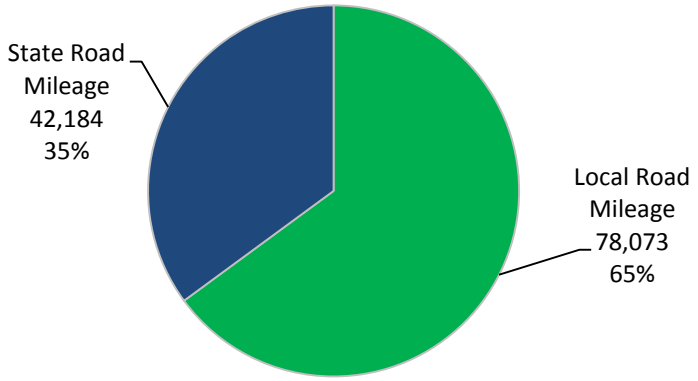
2013-2017 Traffic Fatality Distribution



Vehicle Miles Traveled Distribution



Roadway Mileage Distribution



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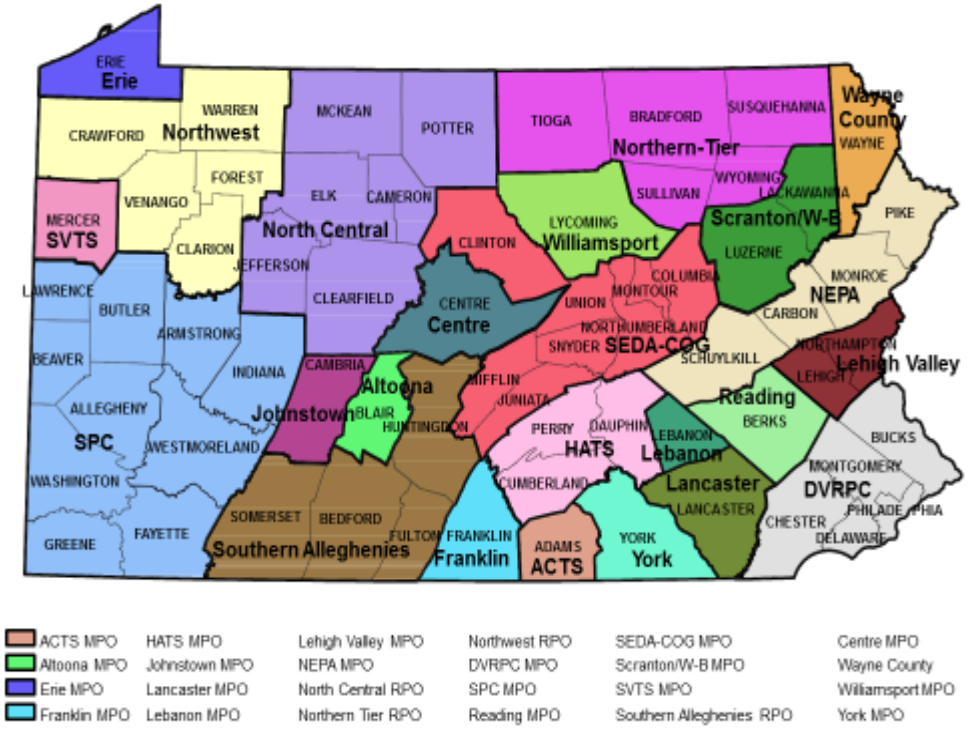
Safety Improvement Programs

Transportation planning is a collaborative effort involving many stakeholders. Some of the most prominent participants in the process are the eleven PennDOT Engineering Districts, the 23 Metropolitan and Regional Planning Organizations (MPO/RPOs), and one independent county.

PENNSYLVANIA'S TRANSPORTATION PLANNING ORGANIZATIONS



Note: Highway Safety Summary Reports are developed on an annual basis for all PennDOT Engineering Districts and may be obtained through the contact information on the last page of this report.

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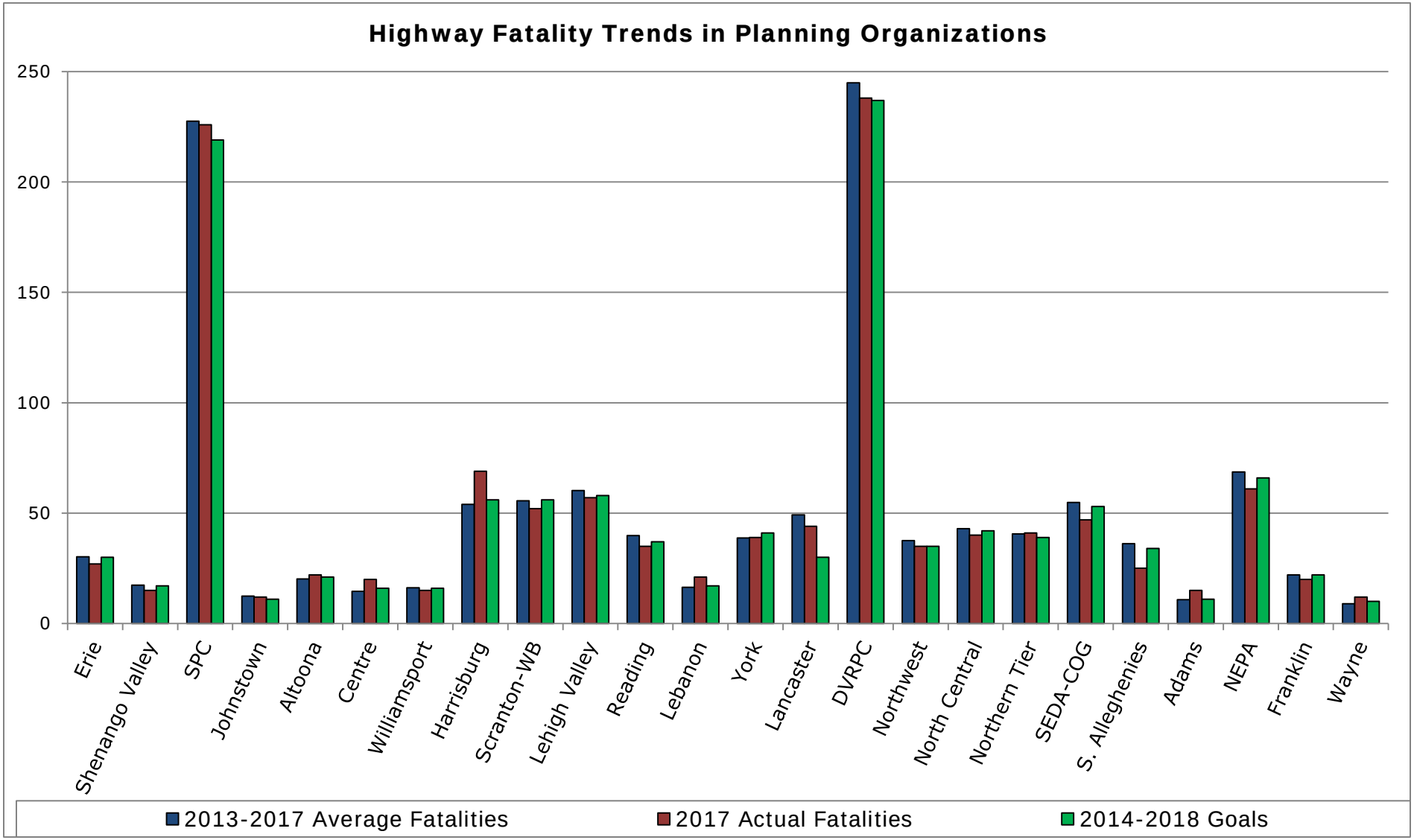
Safety Improvement Programs



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DEPARTMENT OF TRANSPORTATION

Safety Improvement Programs

Long-term safety improvement projects will be selected by each MPO and RPO based on needs identified through an examination of the crash data and through cooperation with PennDOT Engineering Districts and MPO/RPO planning partners.

The primary funding mechanism for highway safety improvements are federal Highway Safety Improvement Program (HSIP) funds. These funds are allocated within Pennsylvania based on a formula that utilizes safety data specific to each region, such as crashes and fatalities, in addition to the traditional formula allocation components of vehicle miles traveled and lane miles.

In alignment with the intent of the FAST Act legislation, the HSIP process is geared towards addressing locations across the state that are identified as High Crash Locations. These locations are identified by analyzing crash data using regionalized Safety Performance Functions.

HSIP projects program locations in the following four step selection process:

- Address a location on the network screenings with positive excess values
- Employ a systematic, proven countermeasure, including implementation of Intersection Safety Implementation Plan, Roadway Departure Safety Implementation Plan, and Speed Management Action Plan.
- Address a unique location, with executive approval

Additional funding for safety improvements may come through the Low Cost Safety Improvement Program, which is aimed at lower-cost, systematic countermeasures.

Safety Improvement Programs

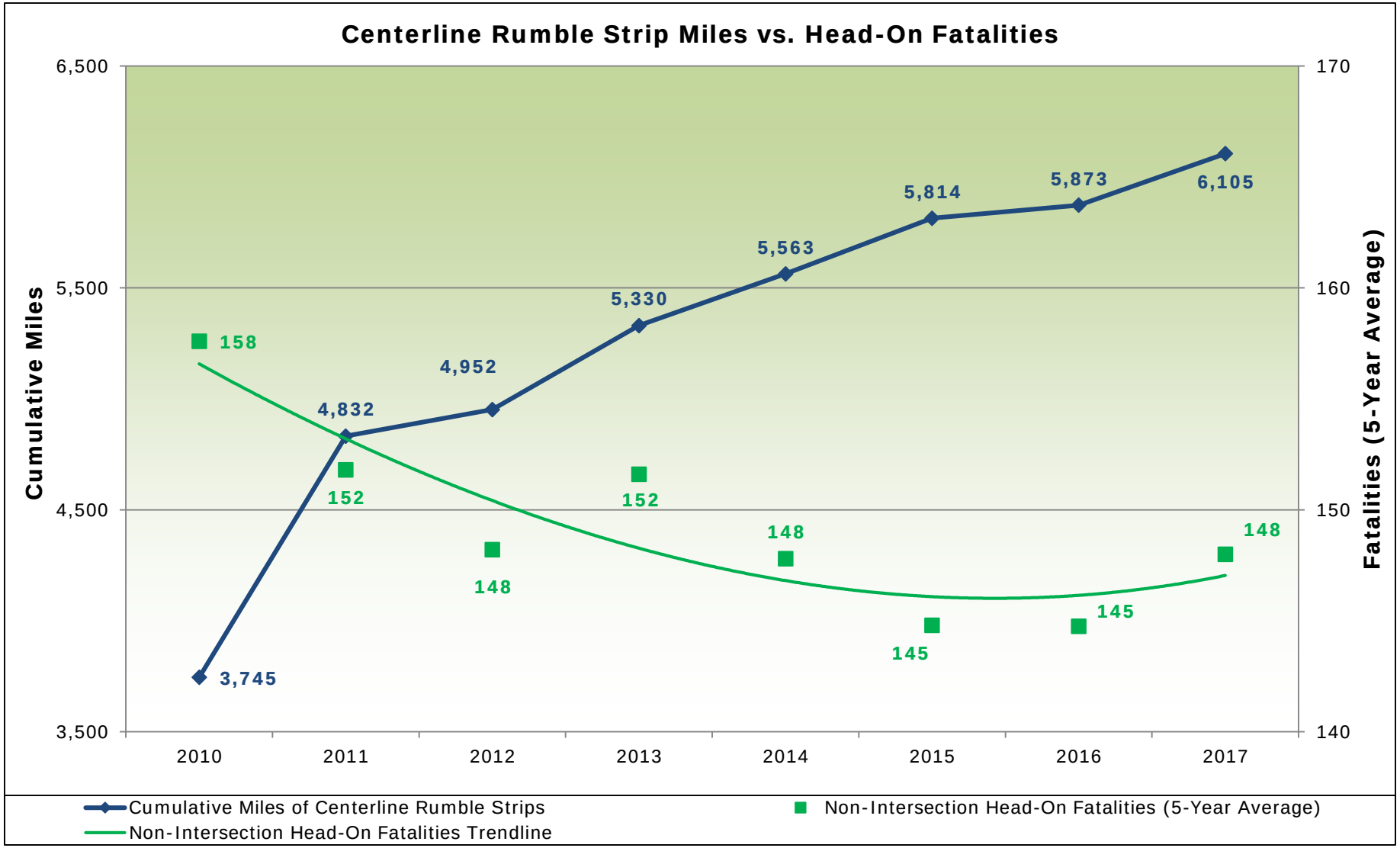
Highway Safety Improvement Program (HSIP)

- HSIP Program funds can be used for medium to high cost roadway safety improvements/ countermeasures to address areas and locations that have high instances of fatalities and serious injuries. HSIP funds can also be used to supplement LCSIP projects.
- HSIP projects can also utilize the following systematic proven countermeasures, based on problem identification, in the following priority:
  - Centerline Rumble Strips
  - Edgeline/Shoulder Rumble Strips
  - Intersection Safety Implementation Plan
  - Roadway Departure Safety Implementation Plan
  - Speed Management Action Plan

Low Cost Safety Improvement Program (LCSIP)

- Provides low cost roadway safety improvements/countermeasures to address areas and locations that have high instances of crashes.
- Includes, but is not limited to, the following countermeasures:
  - Centerline/Edgeline Rumble Strips
  - Intersection Improvements
  - Curve Safety Improvements
  - Removal of Frequently Hit Trees
  - Utility Pole Relocation
  - Pedestrian Safety Improvements
    - Pedestrian Countdown Signals
    - Yield To Pedestrian Channelizing Devices

Safety Improvement Programs



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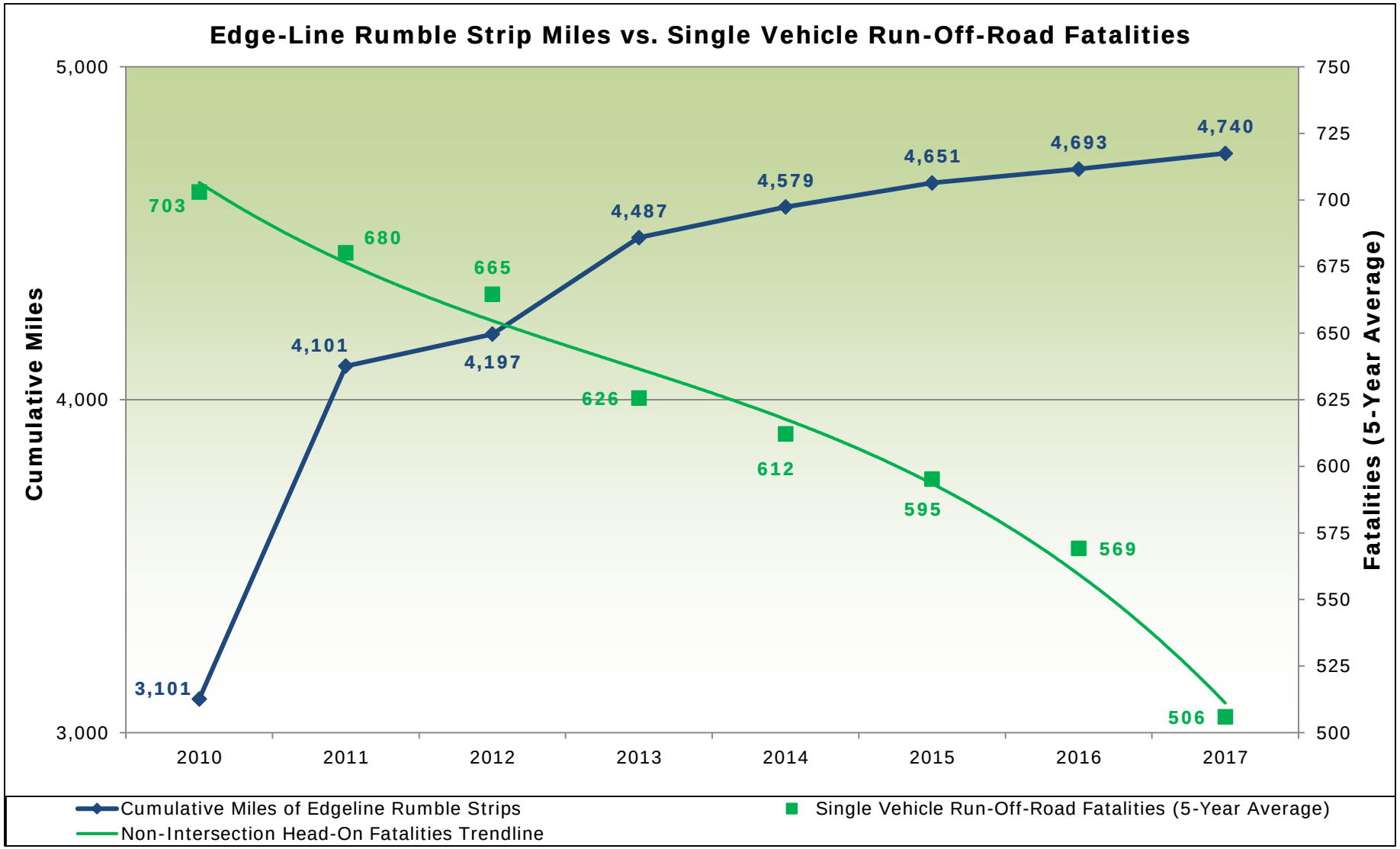
Safety Improvement Programs



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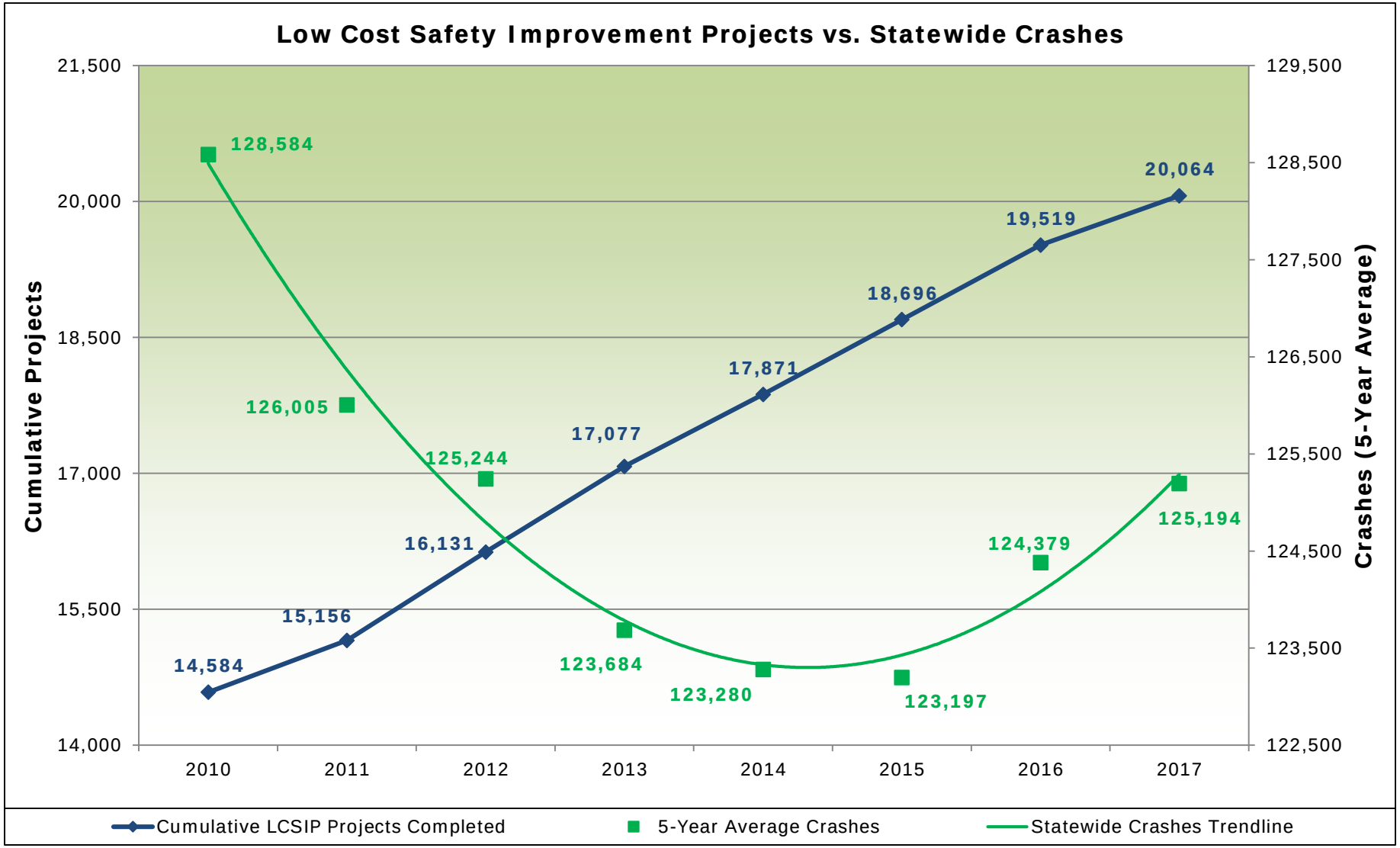
Safety Improvement Programs



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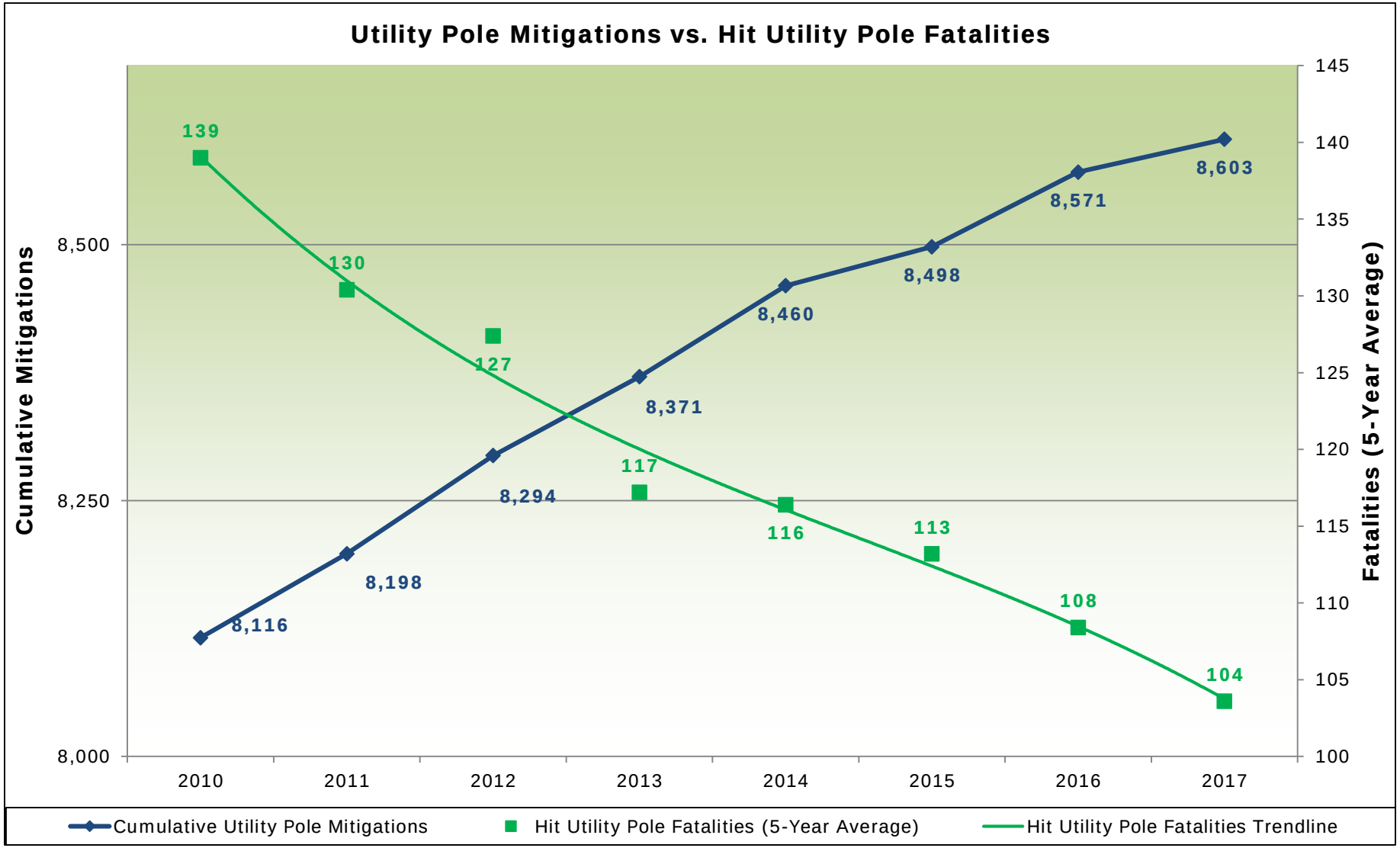
Safety Improvement Programs



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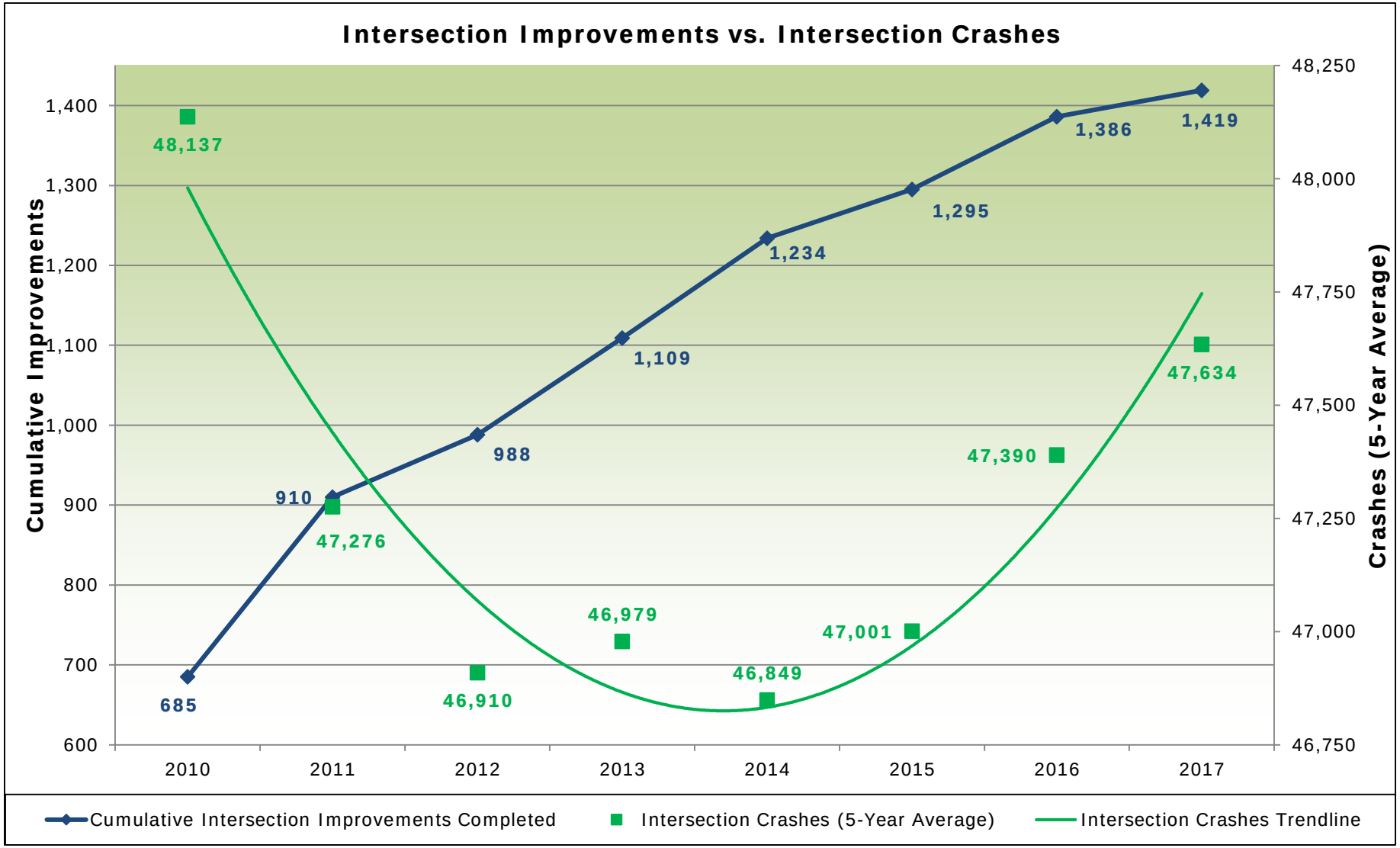
Safety Improvement Programs



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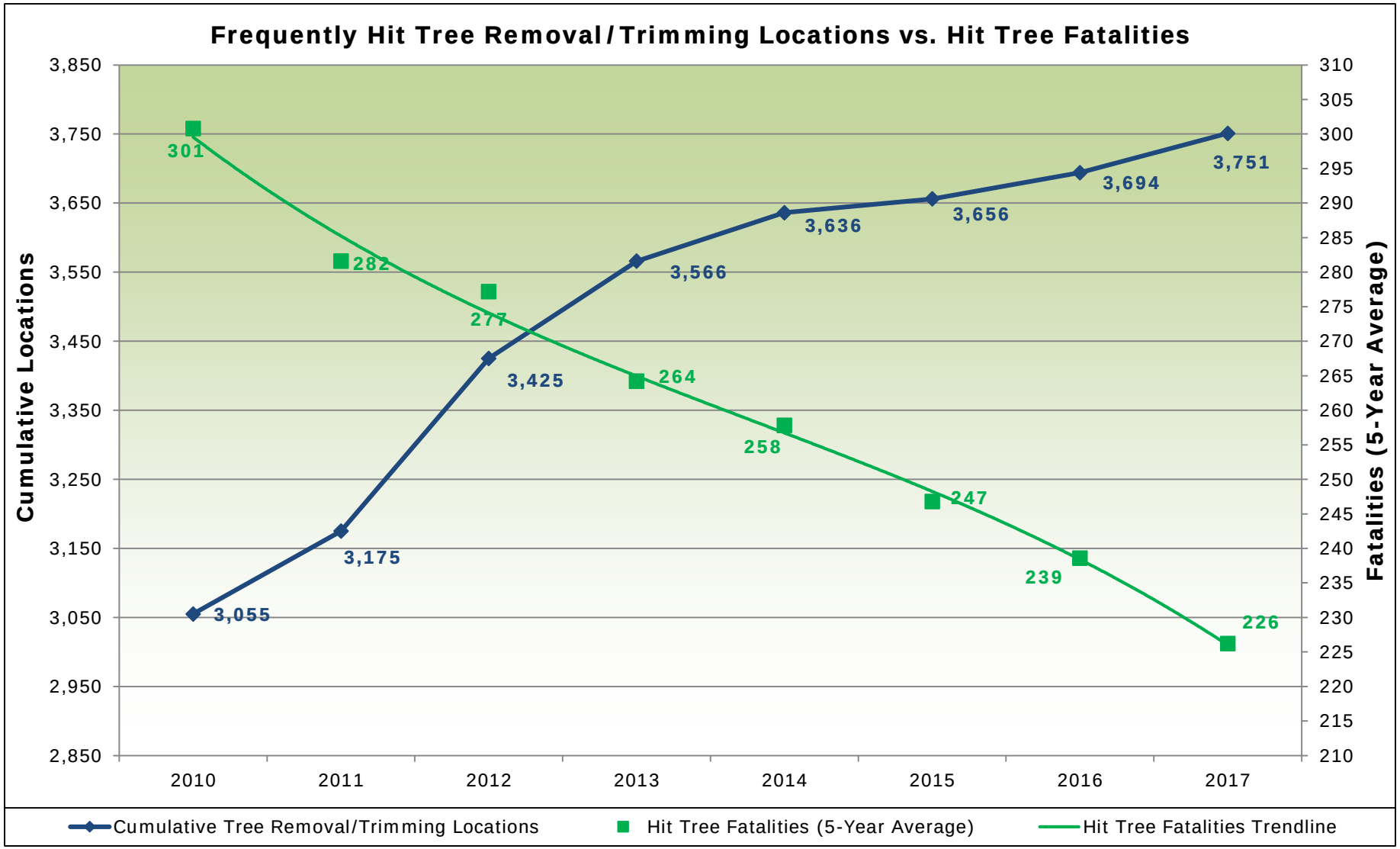
Safety Improvement Programs



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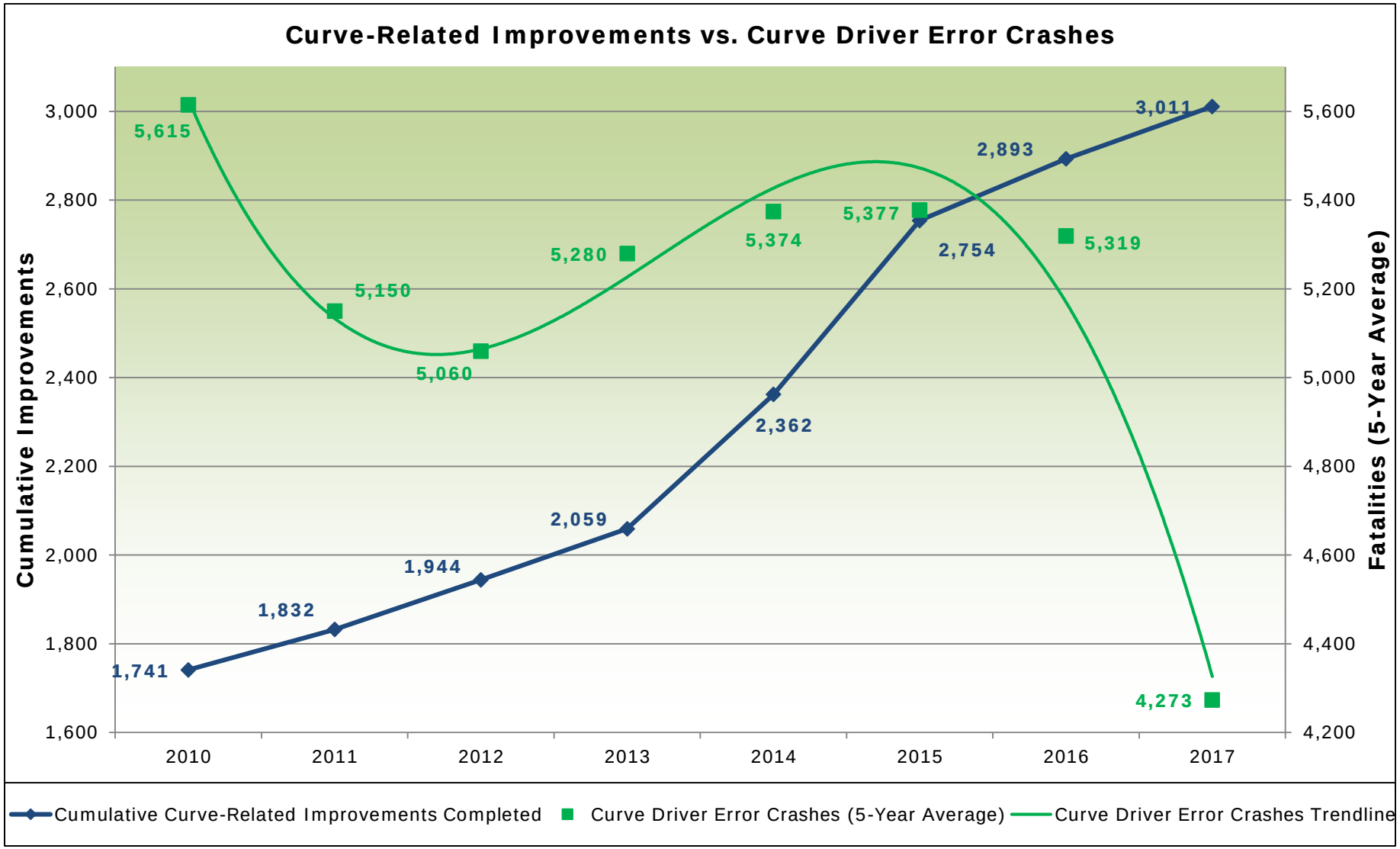
Safety Improvement Programs



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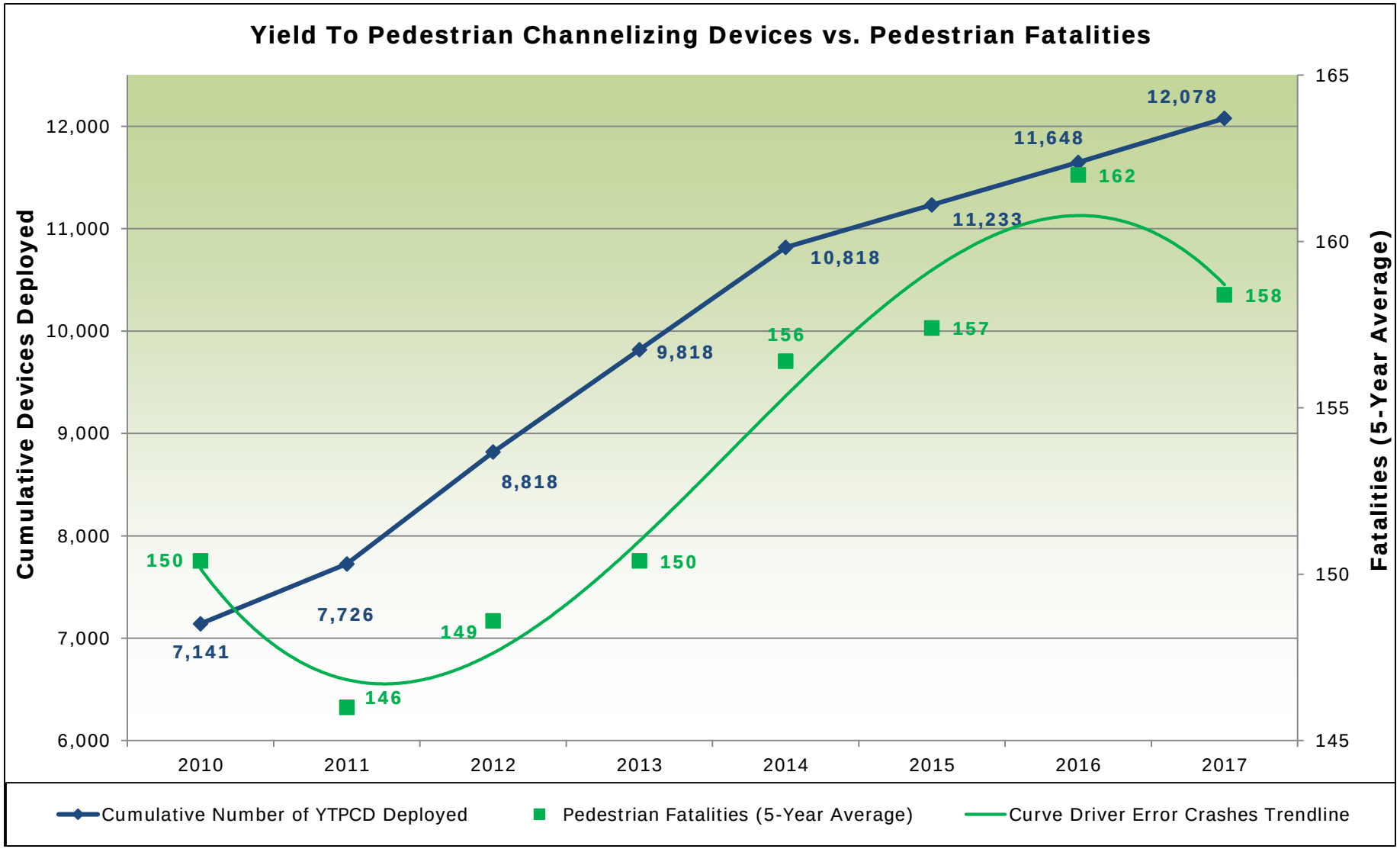
Safety Improvement Programs



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Benchmarking

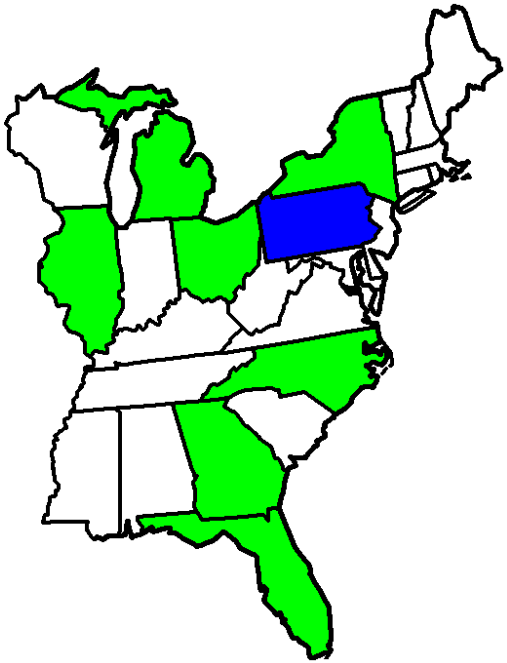
In order to develop context for the progress Pennsylvania is making in its highway safety improvement efforts, NHTSA FARS data from seven similar states was collected and compared.

Similar states for benchmarking were determined based on the following factors:

- Population
- Land Area
- Urban/Rural Proportions (Land Area, Population, and VMT)
- Federal Highway Safety Grant Money Received

The seven similar states for benchmarking are:

- Florida
- Georgia
- Illinois
- Michigan
- New York
- North Carolina
- Ohio



For comparison purposes, the following safety parameters were compared:

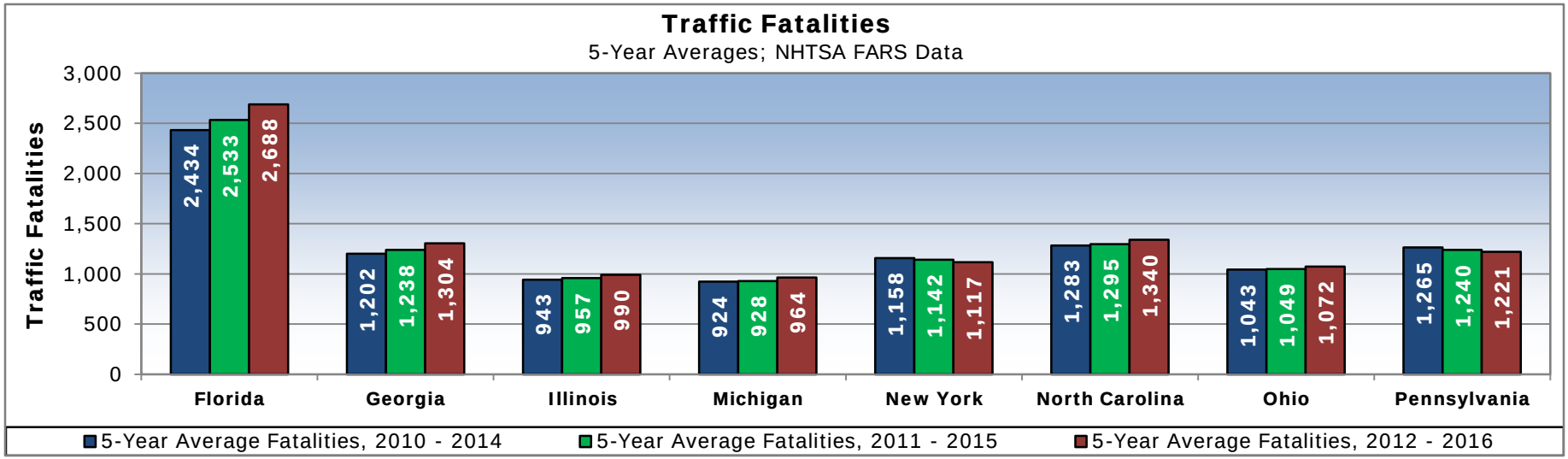
- Driving Laws
- 5-Year Average Traffic Fatalities
- Percent Reduction in 5-Year Average Traffic Fatalities
- 5-Year Average Traffic Fatalities per 100,000 Population
- Rural and Urban Fatality Rates
- 5-Year Average Unbelted Fatalities
- Seat Belt Usage Rates

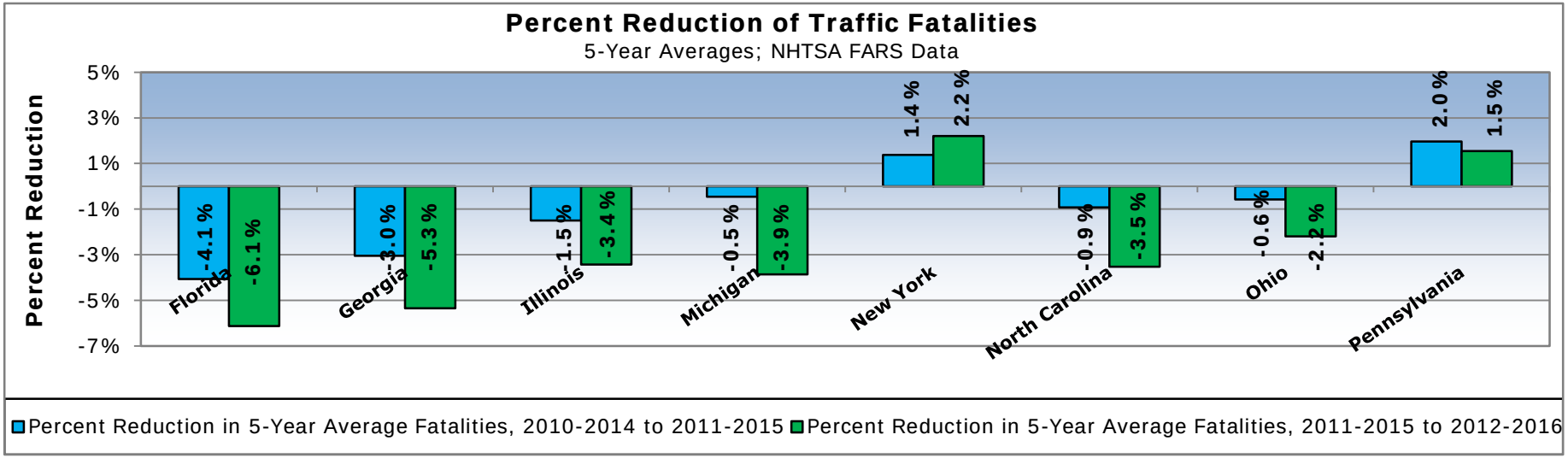
Benchmarking

State Driving Law Comparison										
State	Automated Enforcement	Aggressive Driving Laws	BAC 0.08	MCH (Motorcycle Helmet)	PSB (Primary Seat Belt Law)	GDL (Graduated Drivers License)	ALR (Administrative License Revocation)	Sober CheckPoint Allowed	Cellphone Hand-held Ban	Cellphone Texting Ban
Florida	Statewide**	Yes	1994	Repealed 2000	2009	Yes	1990	Yes	No	No
Georgia	Statewide**	Yes	2001	1969	1996	Yes	1994	Yes	No	Yes
Illinois	Yes	No	1997	Repealed 1970	2003	Yes	1986	Yes	Yes	Yes
Michigan	No	No	2003	Repealed 2012	2000	Yes	None	No	No	Yes
New York	Cities Pop.>1 million.; 150 intersections/city**	No	2003	1967	1984	Yes	None	Yes	Yes	Yes
North Carolina	Some cities**	Yes	1993	1968	1985	Yes	1984	Yes	No	Yes
Ohio	Municipalities*	No	2003	Repealed 1978	None	Yes	1993	Yes	No	No
Pennsylvania	Philadelphia**	Yes	2003	Repealed 2003	None	Yes	None	Yes	No	Yes

* No official law
** Red light cameras only

Benchmarking





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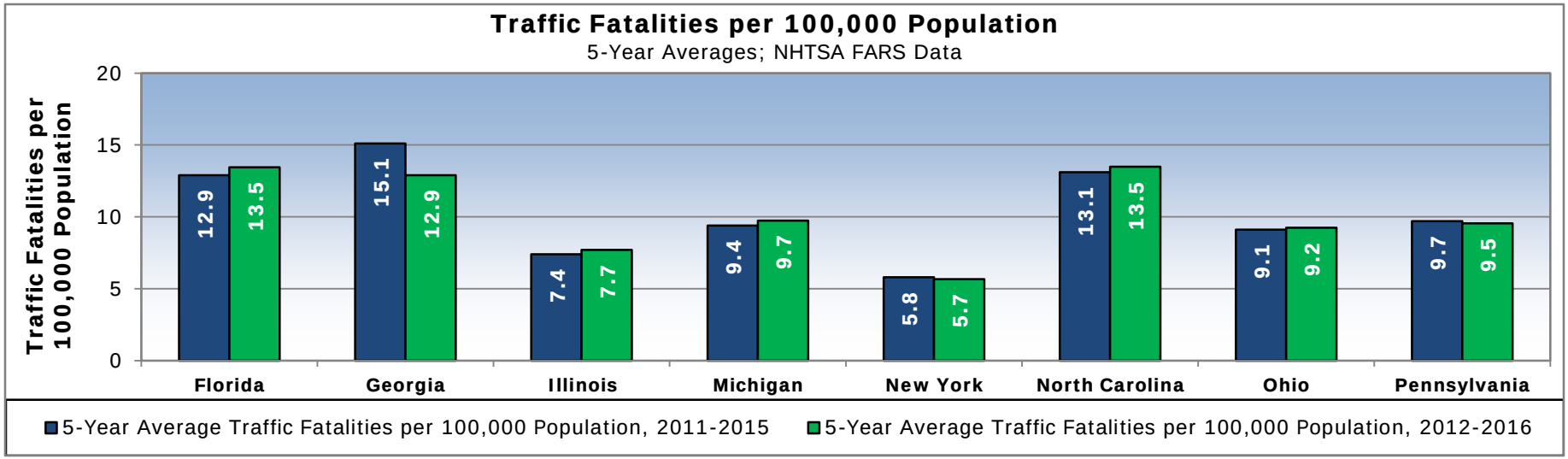
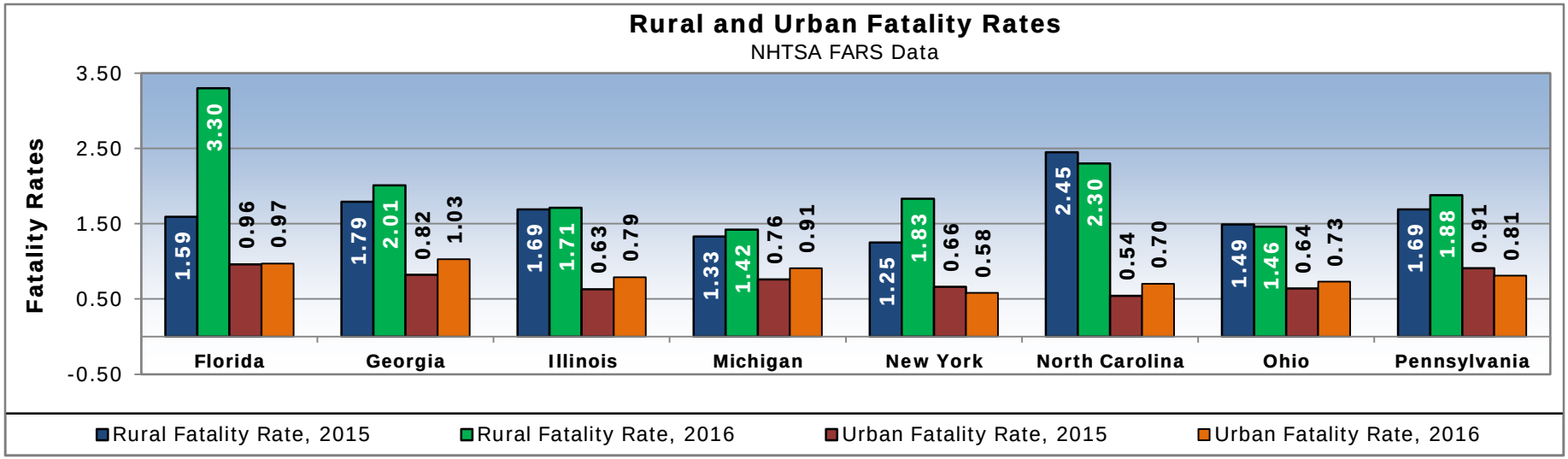
Benchmarking





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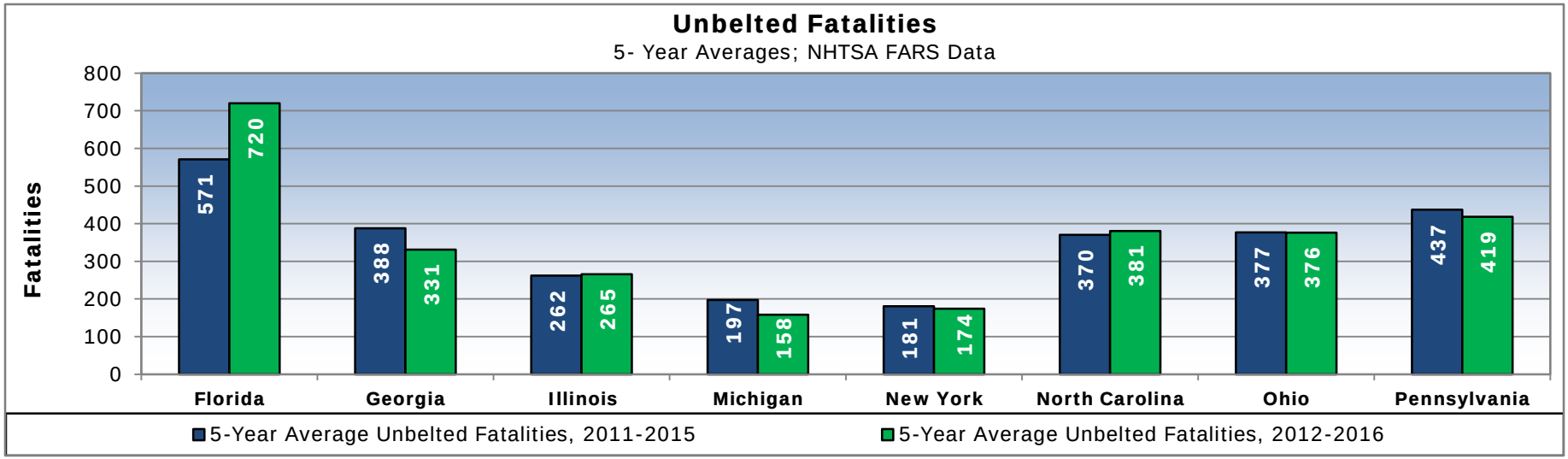
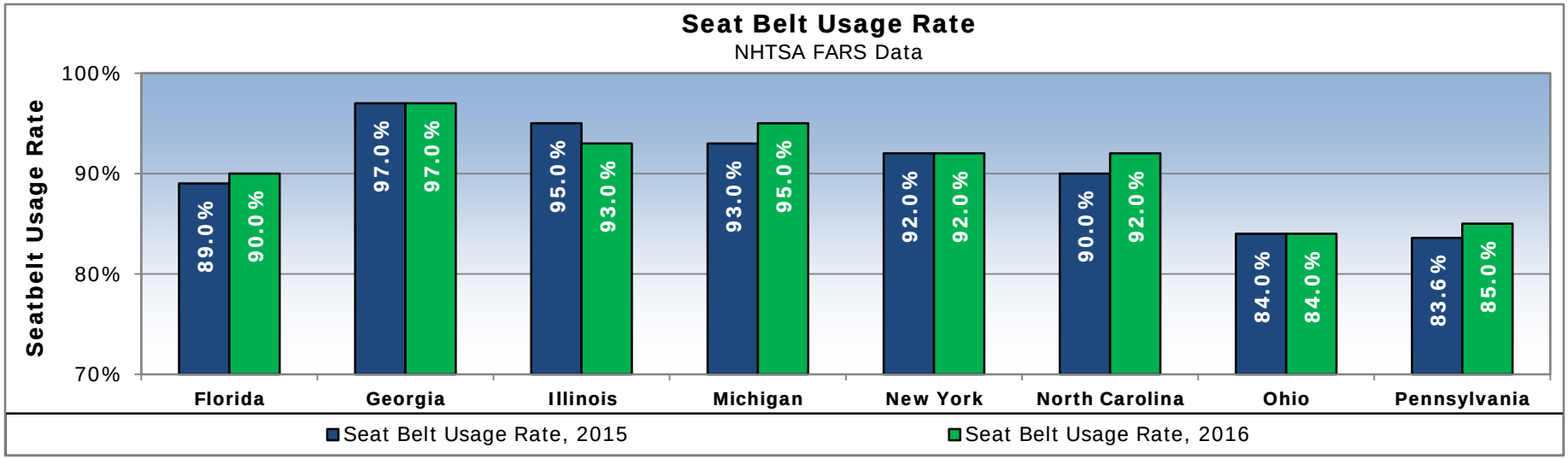
Benchmarking





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Statistical Analysis

The **correlation coefficient**, **r**, measures the strength of the relationship between two variables and results in a determination of strong or weak.

If r = 1.0 there is perfect correlation.
If r = -1.0 there is perfect negative or inverse correlation.
If 0 < r < 1, both variables tend to increase or decrease together.
If -1 < r < 0, one variable increases as the other decreases.

$$r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

The following is a general interpretation of r values (positive and negative):

0.0-0.2: Very Weak
0.2-0.4: Weak
0.4-0.7: Moderate
0.9-1.0: Very Strong

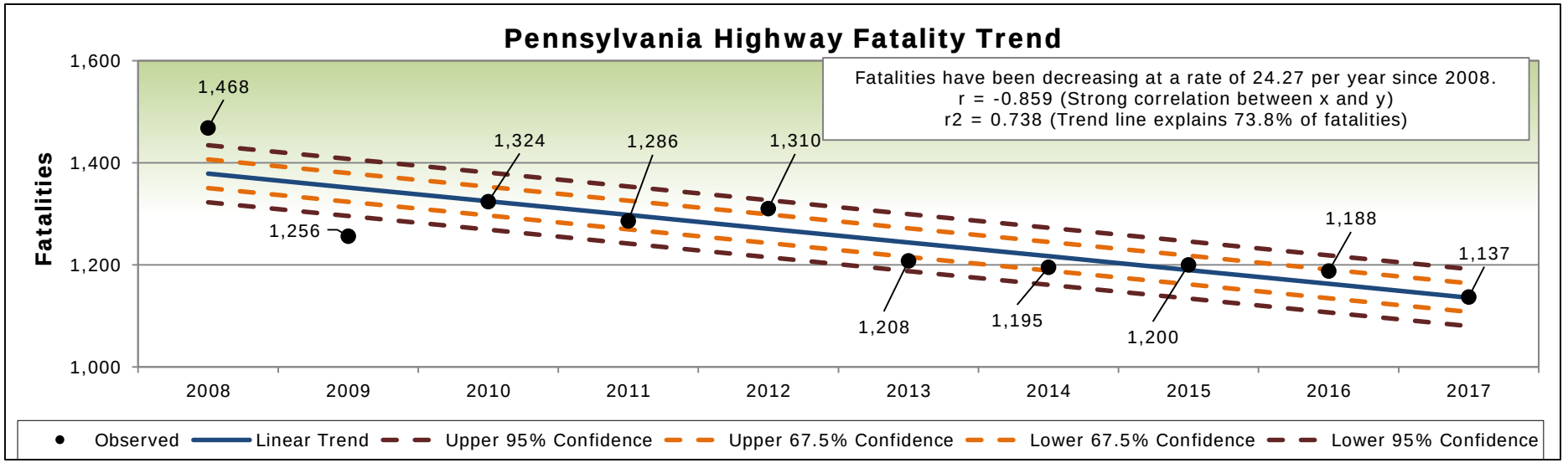
The **coefficient of determination**, **r^2**,is used to give the proportion of the variance (fluctuation) of one variable that is predictable from the other. This coefficient helps to explain how well the regression (trend) line represents the data. *For example, if the $r^2 = 0.85$, we can say that approximately 85% of the data can be explained, while 15% cannot.*

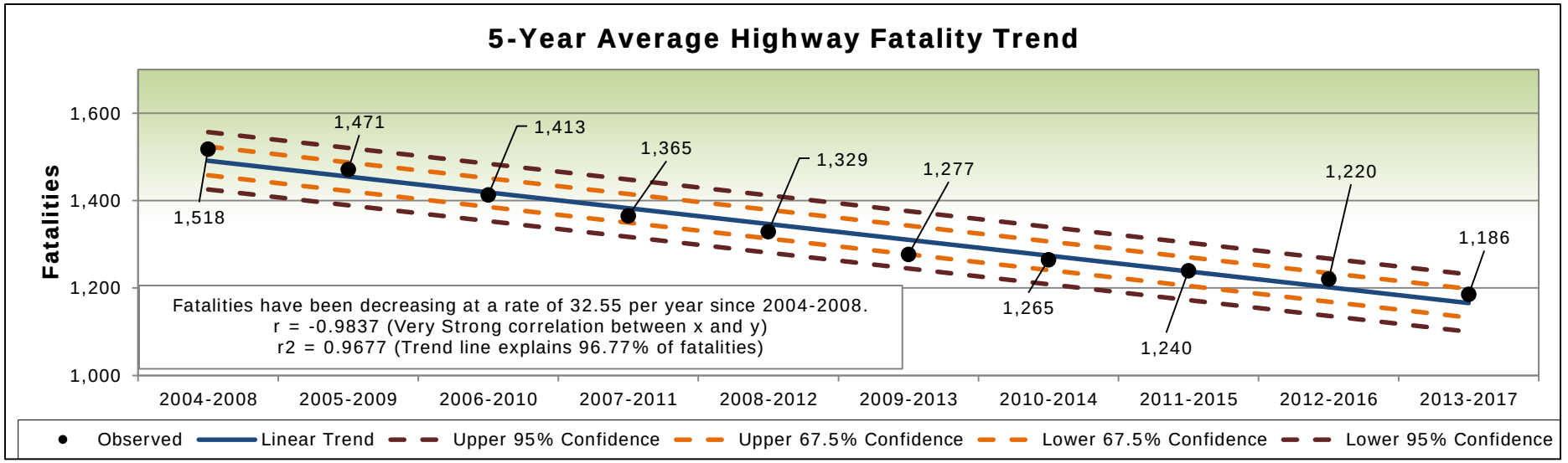
Confidence Interval is the range on either side of the sample mean (trend line) and are used to indicate the reliability of an estimate. The confidence interval lines are limits on either side of the trend line to help predict the next value.

The upper and lower confidence levels at 67.5 and 95 percent parallel the trend line. If both the trend and confidence interval lines are extended you can predict the next value will fall within its respective interval line.

*Please note that in the following chart titles “x” and “y” represent the x axis and the y axis.

Statistical Analysis





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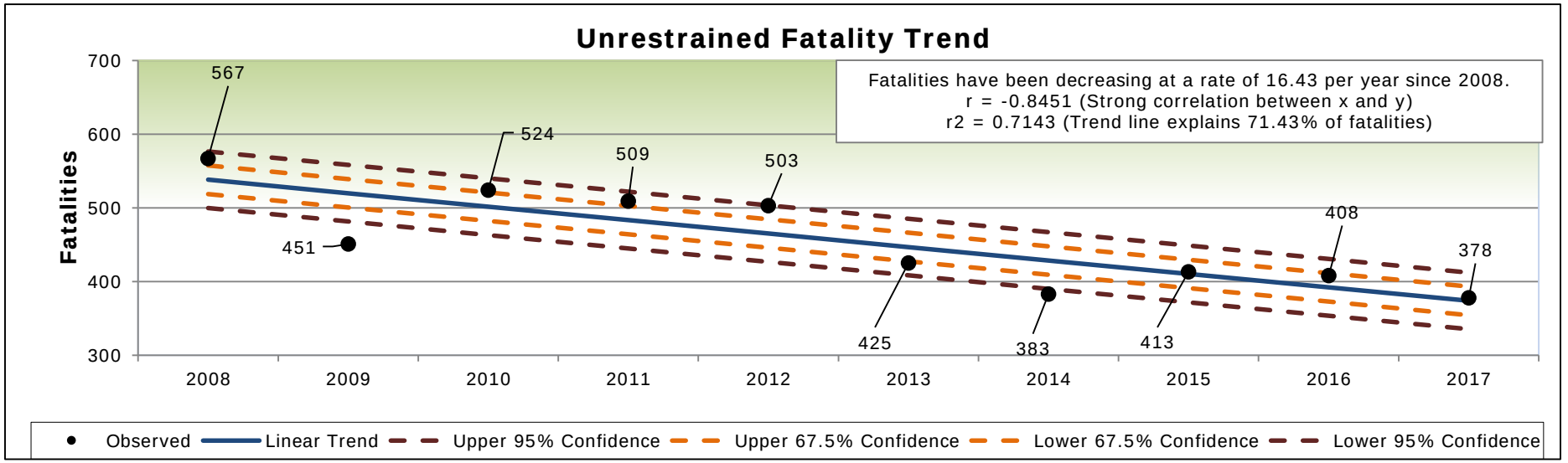
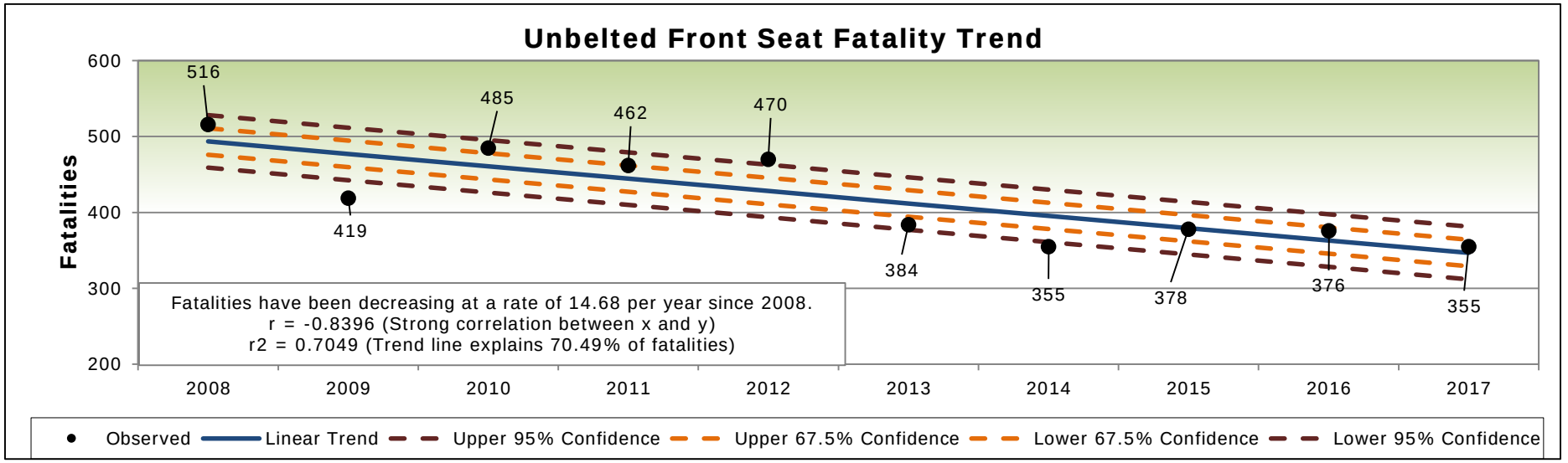
Statistical Analysis





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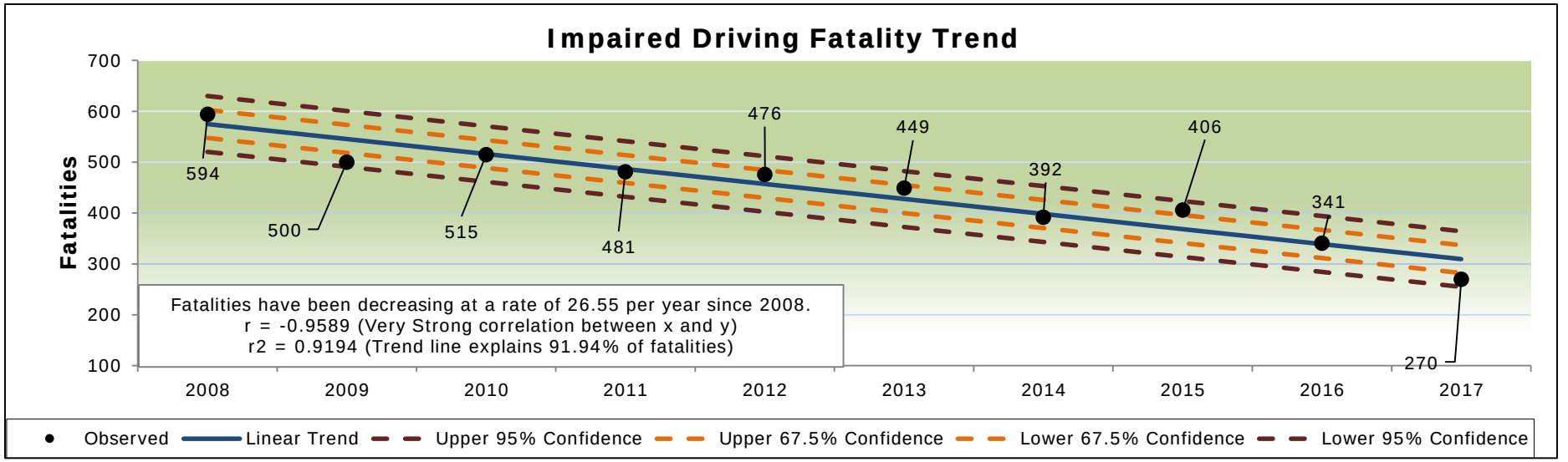
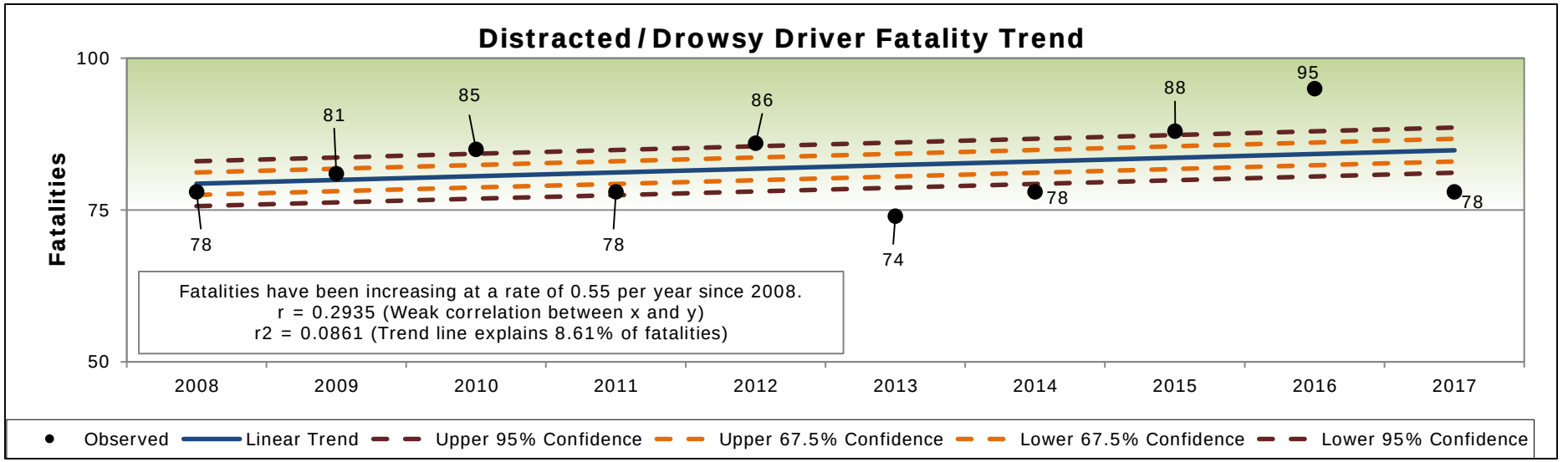
Statistical Analysis





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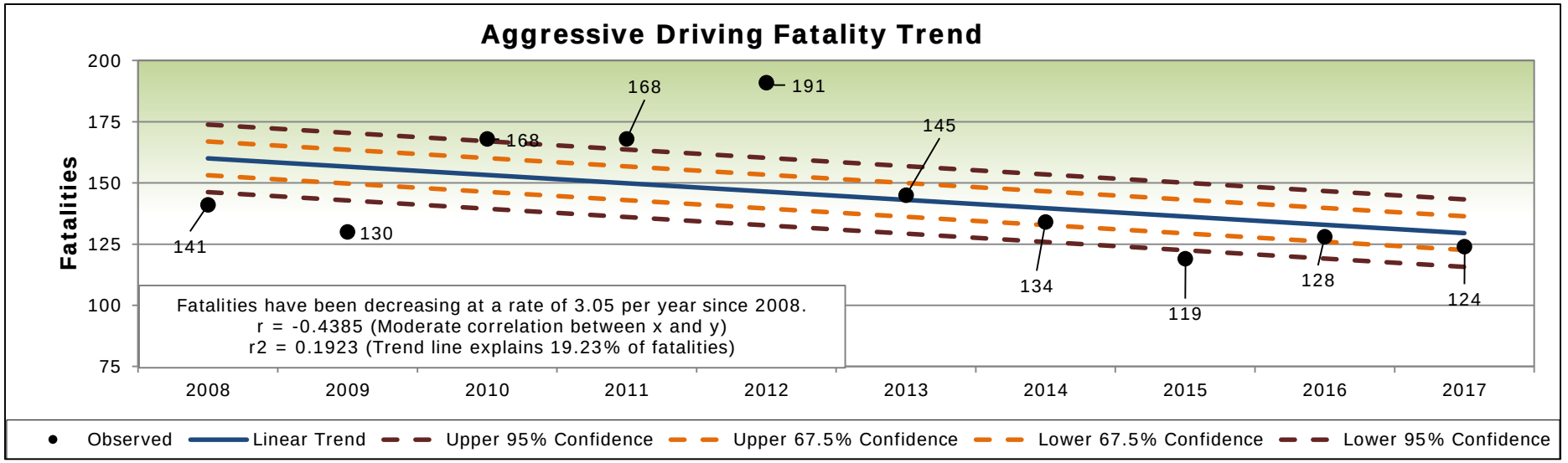
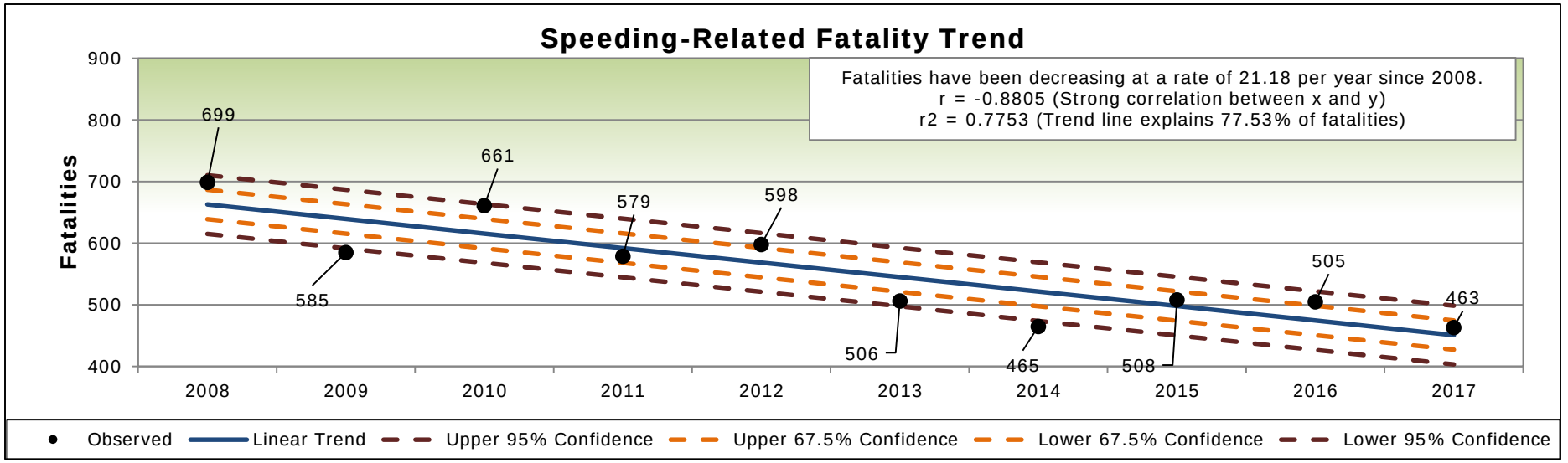
Statistical Analysis





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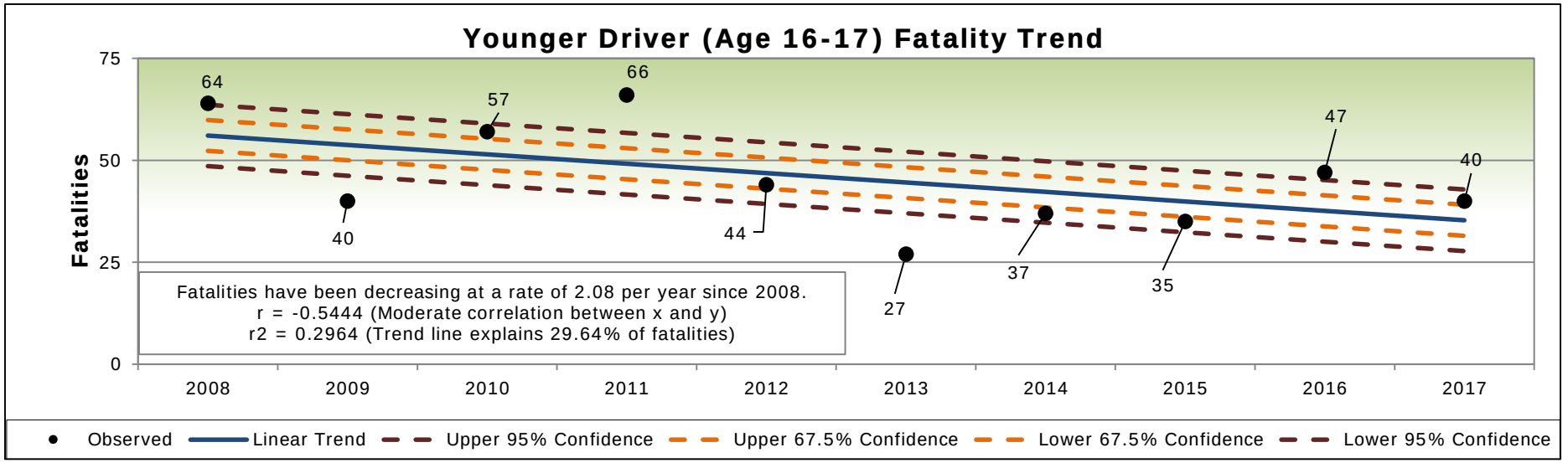
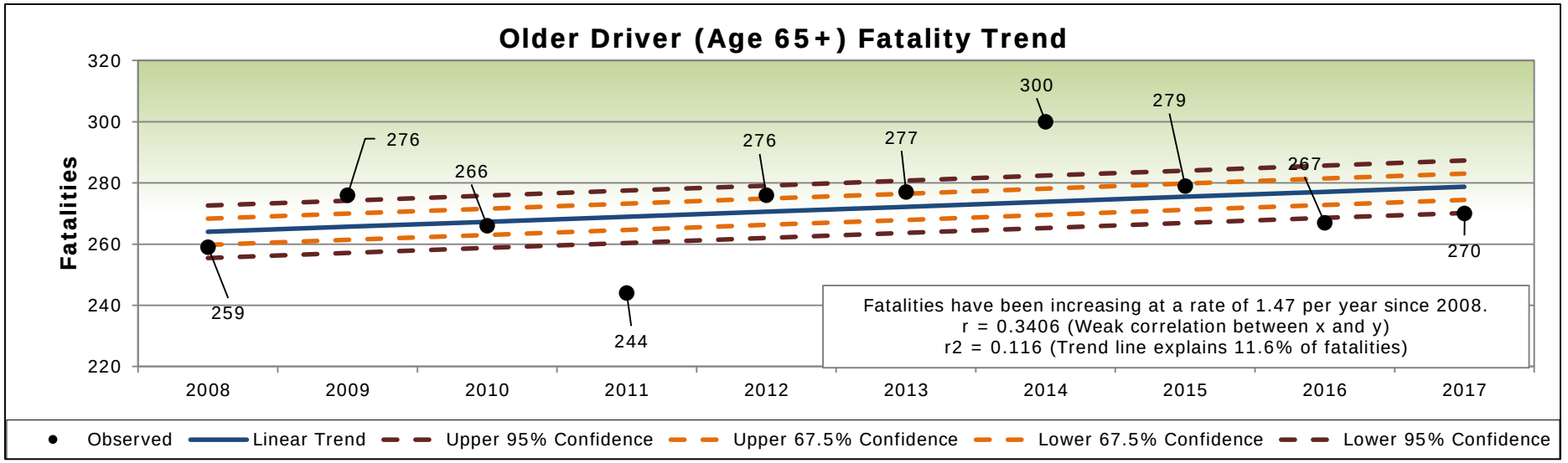
Statistical Analysis





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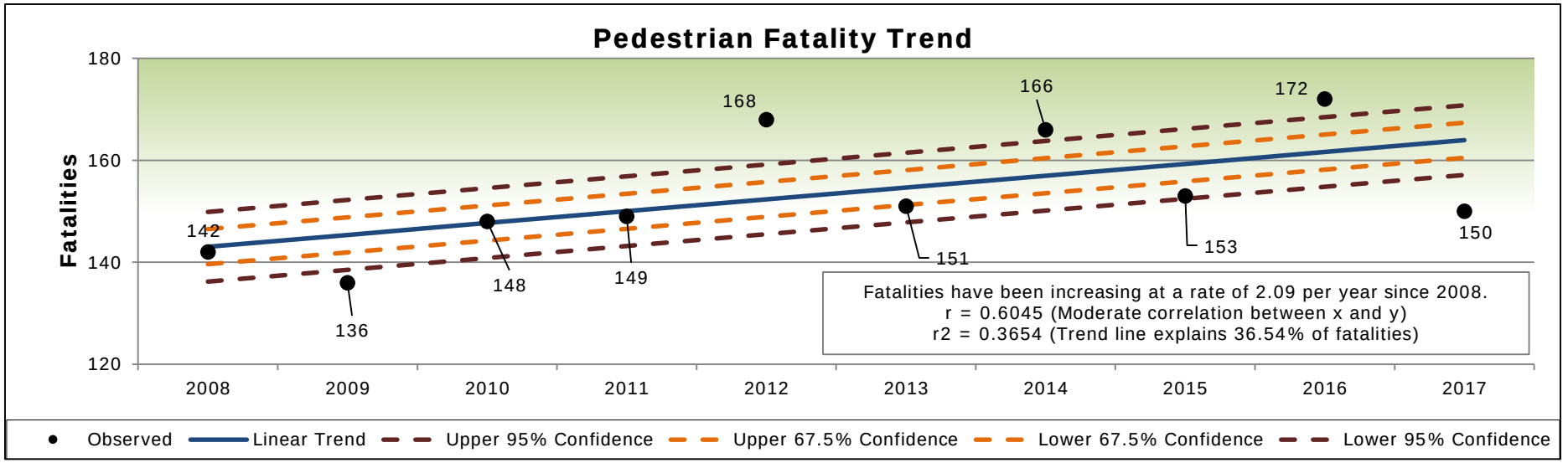

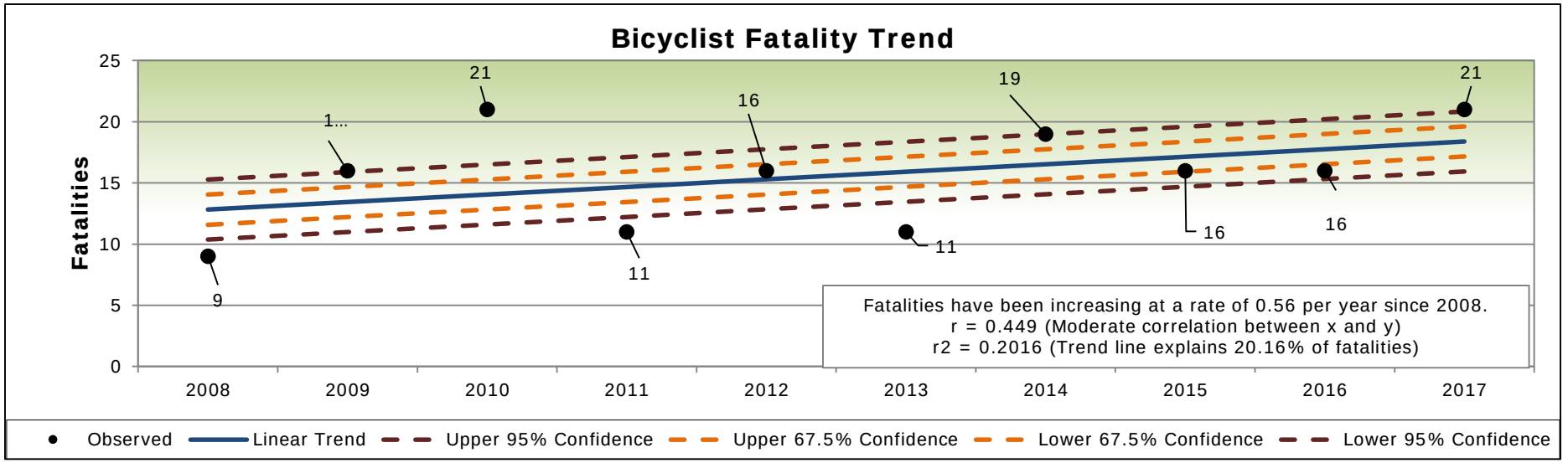

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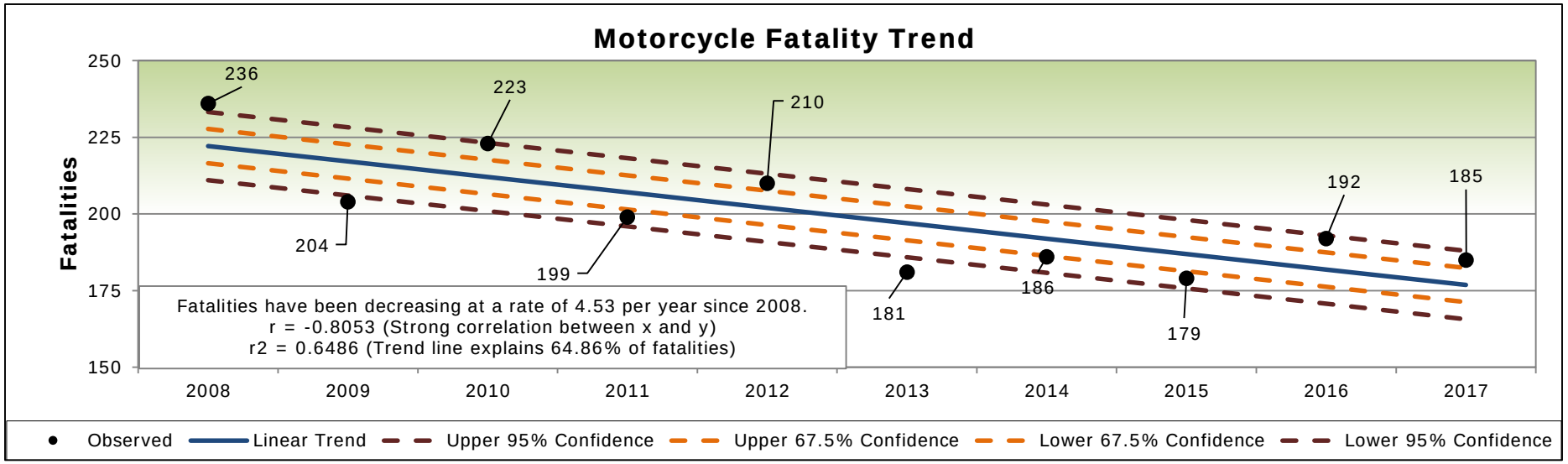

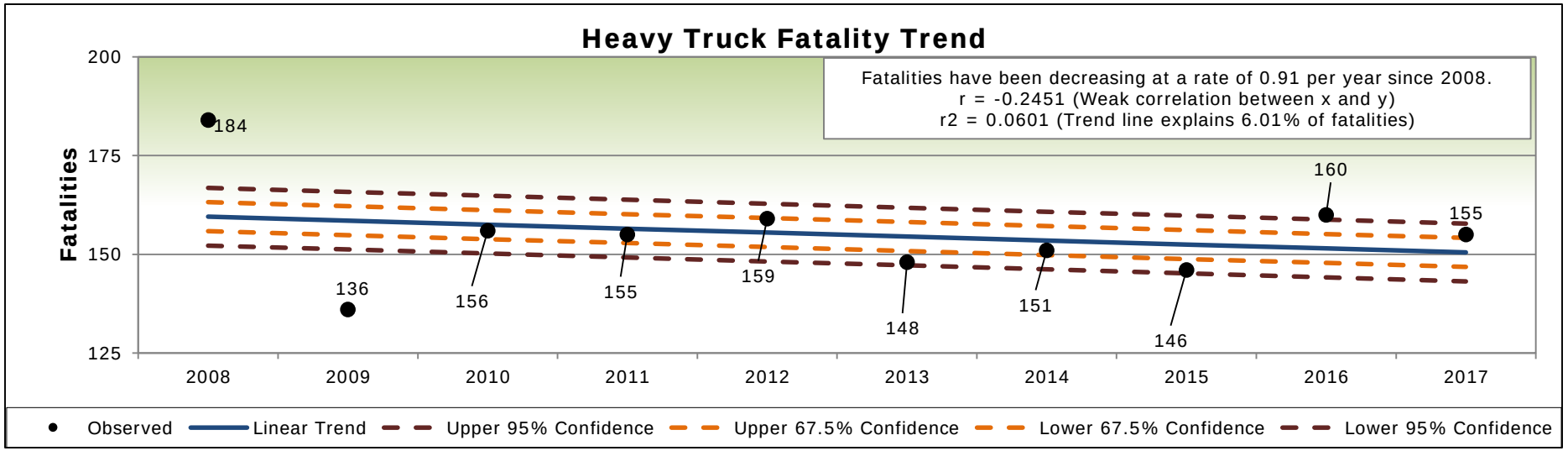

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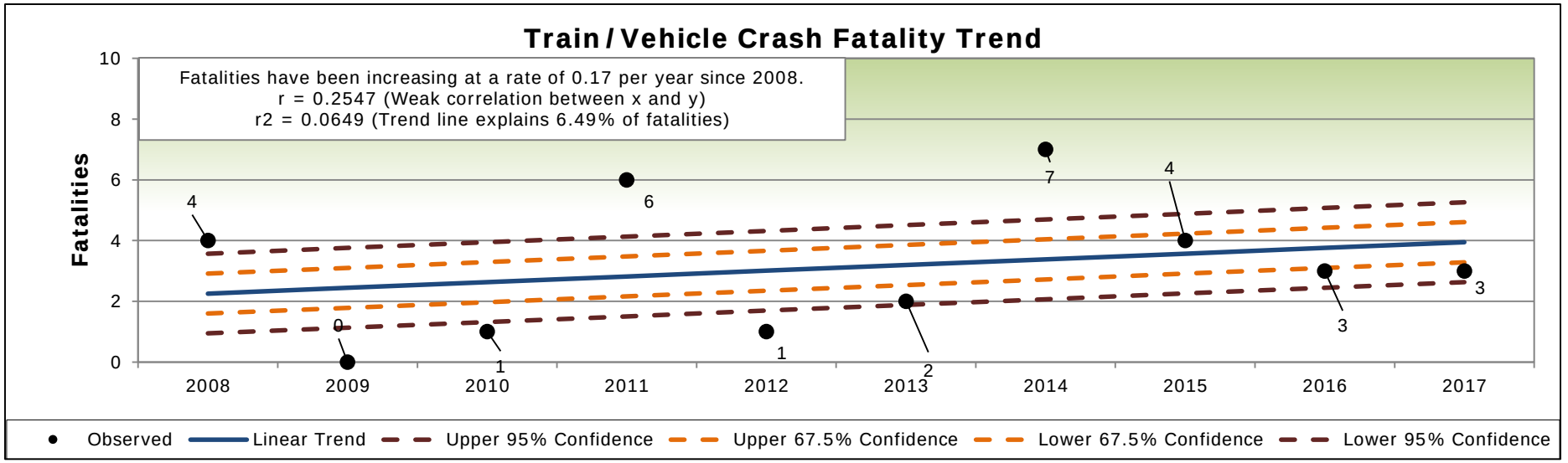

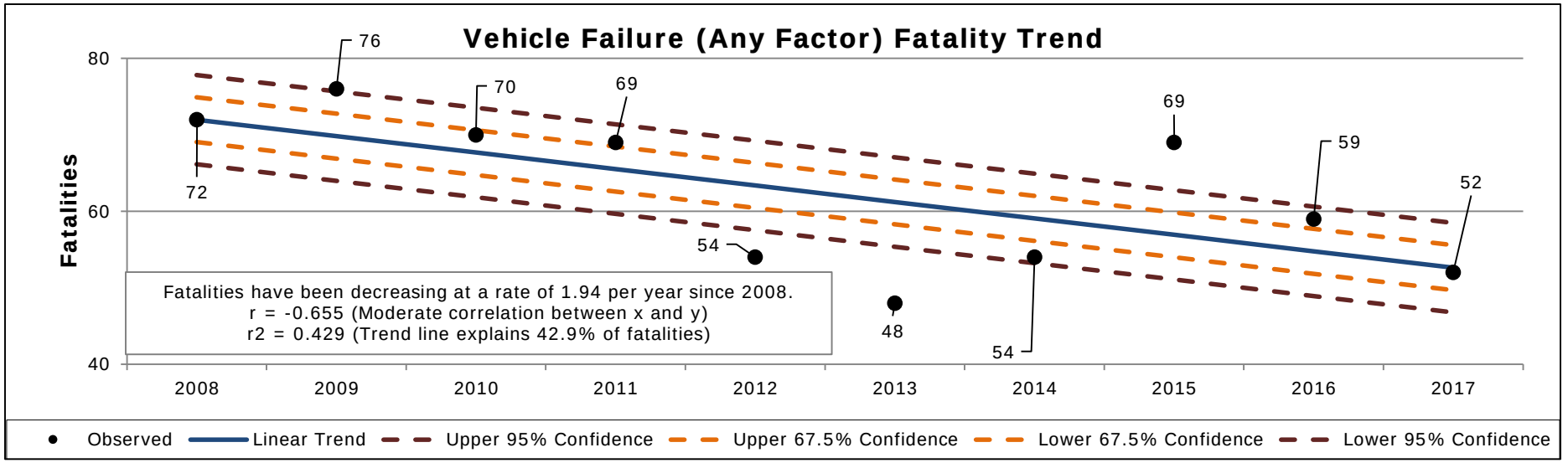

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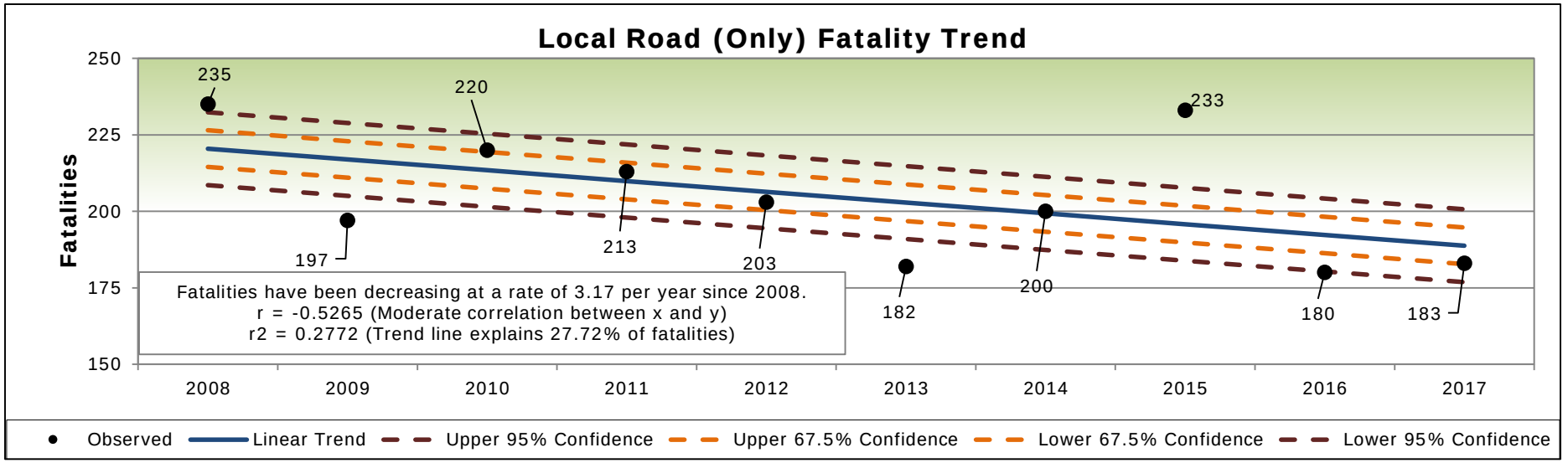

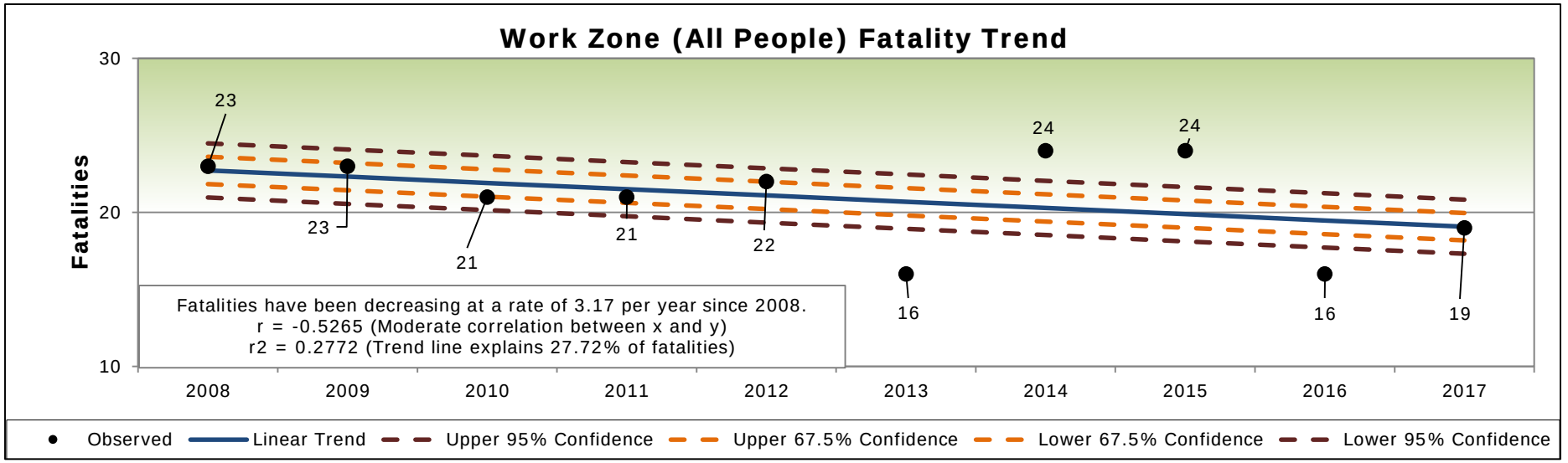

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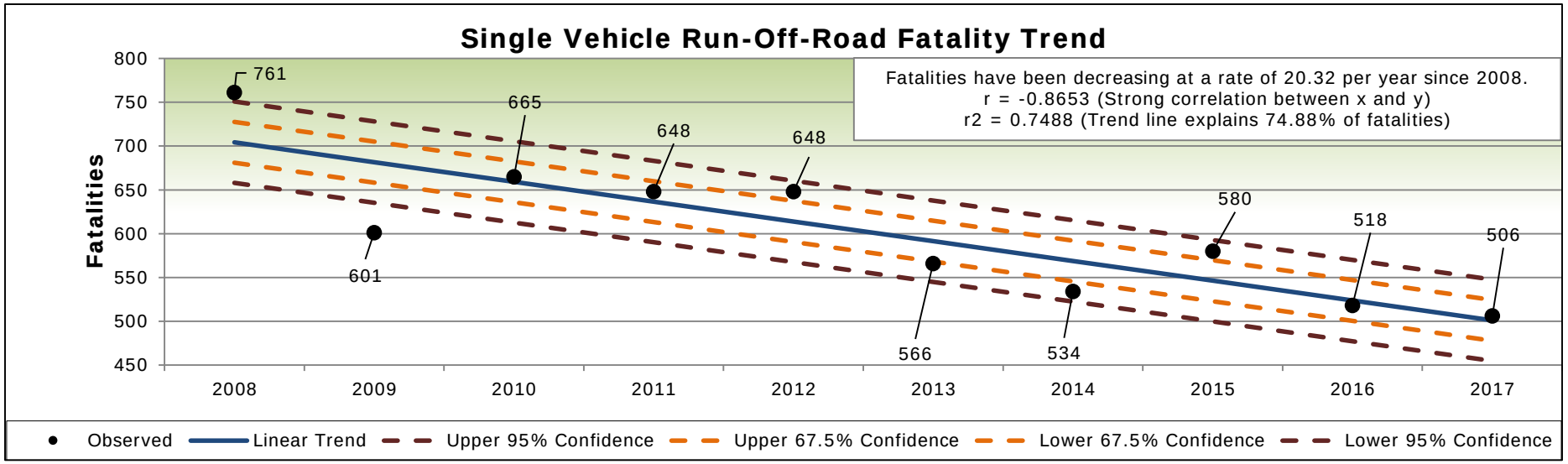
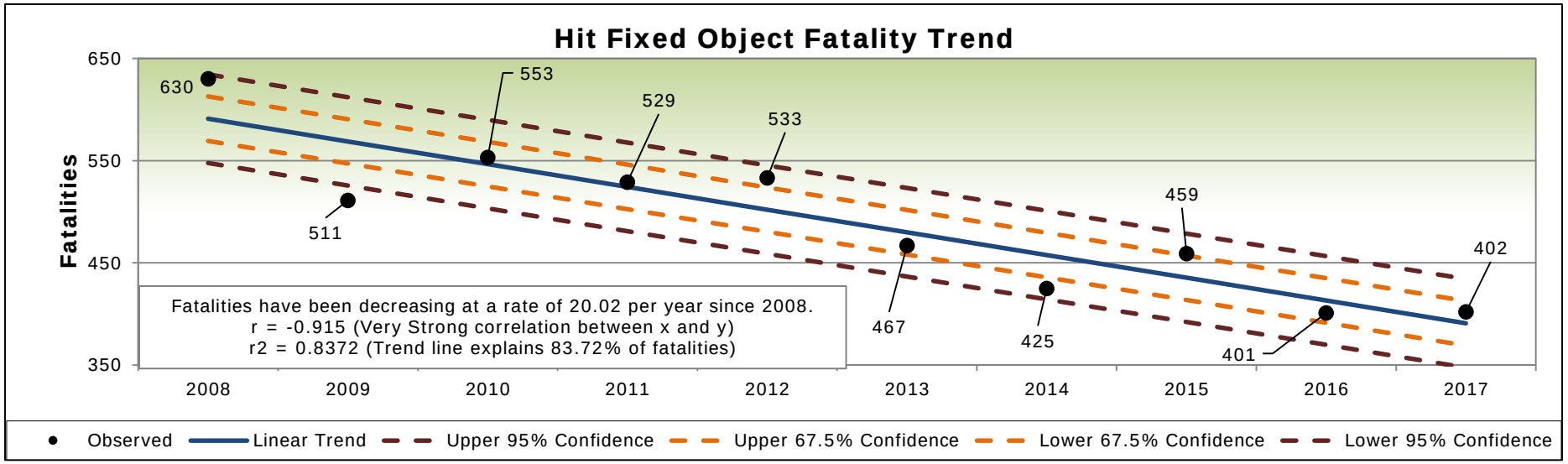
Statistical Analysis





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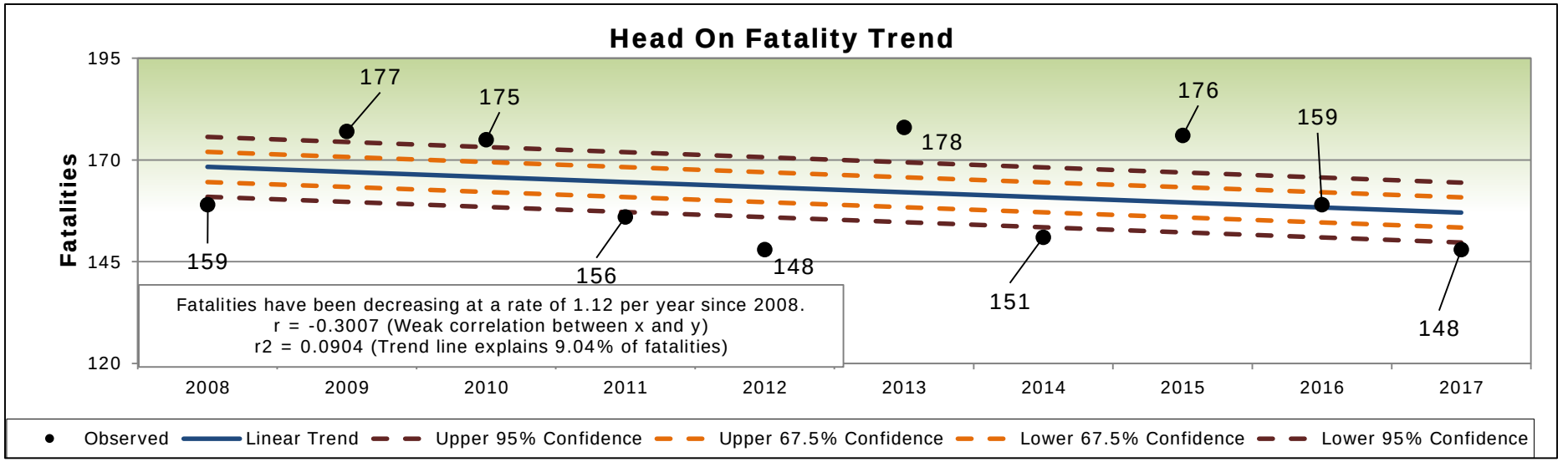
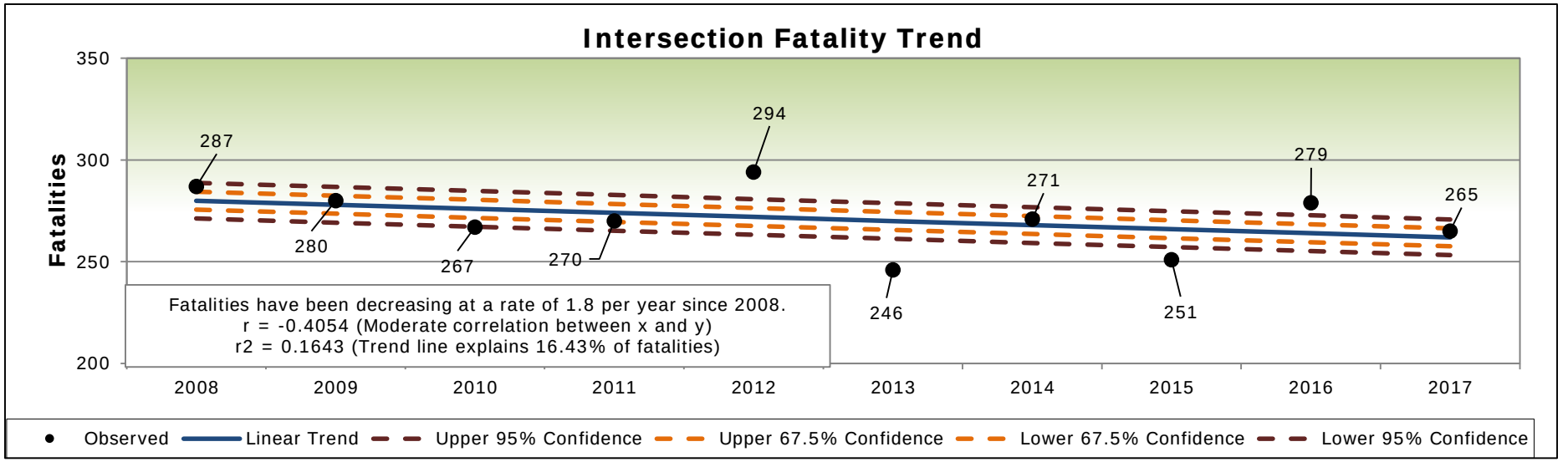
Statistical Analysis





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Statistical Analysis

Strategic Focus Areas			2010	2011	2012	2013	2014	2015	2016	2017	5-Year Average 2013-2017	Percent Change 2016 to 2017	Percent Change 2017 vs. 5-Year Avg	Percent Change 2010 to 2017
Impaired Driving	Alcohol-Related	Fatalities	444	425	402	369	326	337	297	293	346	-12%	-14%	-34%
		Serious Injuries	882	812	872	780	674	682	878	817	777	29%	13%	-7%
		Total Injuries	9,155	9,069	9,121	8,434	7,806	7,525	6,183	7,170	7,814	-18%	-21%	-22%
		Reportable Crashes	12,387	11,778	11,924	11,023	10,537	10,549	10,255	10,332	10,858	-3%	-6%	-17%
Occupant Protection	Unre-strained	Fatalities	524	509	503	425	383	413	408	378	426	-1%	-4%	-28%
		Serious Injuries	893	926	870	871	763	734	1,007	911	849	37%	19%	2%
		Total Injuries	17,229	18,355	17,183	15,630	14,306	14,533	14,756	15,379	15,282	2%	-3%	-11%
		Reportable Crashes	15,442	16,298	15,528	14,436	13,627	13,534	14,992	14,309	14,423	11%	4%	-7%
Distracted/ Drowsy Driving	Distracted/Drowsy Driver	Fatalities	85	78	86	74	78	88	95	73	84	8%	13%	-14%
		Serious Injuries	347	305	336	271	260	291	491	492	330	69%	49%	42%
		Total Injuries	12,280	12,091	12,686	11,801	11,518	11,957	10,445	11,555	11,681	-13%	-11%	-6%
		Reportable Crashes	16,195	16,712	17,316	16,832	16,543	17,426	18,685	18,226	17,360	7%	8%	13%
Aggressive Driving	Aggressive Driving	Fatalities	168	168	191	145	134	119	128	124	143	8%	-10%	-26%
		Serious Injuries	276	296	288	281	269	276	425	393	308	54%	38%	42%
		Total Injuries	5,341	5,788	6,183	5,793	5,730	5,536	5,408	5,585	5,730	-2%	-6%	5%
		Reportable Crashes	5,755	6,318	6,744	7,036	6,877	6,761	6,996	6,828	6,883	3%	2%	19%
	Speeding-Related	Fatalities	661	579	598	506	465	508	505	463	516	-1%	-2%	-30%
		Serious Injuries	1,096	1,101	1,131	1,028	928	763	1,399	1,261	1,050	83%	33%	15%
		Total Injuries	21,131	22,035	21,605	21,456	19,921	20,289	17,757	20,683	20,206	-12%	-12%	-2%
		Reportable Crashes	28,627	31,023	30,053	31,569	29,974	31,326	30,946	31,000	30,774	-1%	1%	8%
Younger Drivers	Age 16-17 Driver	Fatalities	57	66	44	27	37	35	47	40	38	34%	24%	-30%
		Serious Injuries	217	183	153	138	108	119	172	192	138	45%	25%	-12%
		Total Injuries	5,488	5,152	4,931	4,416	3,783	4,231	4,150	4,394	4,302	-2%	-4%	-20%
		Reportable Crashes	7,105	6,935	6,723	6,419	5,763	6,273	6,671	6,727	6,370	6%	5%	-5%
Older Drivers	Age 65+ Driver	Fatalities	266	244	276	277	300	279	267	270	280	-4%	-5%	2%
		Serious Injuries	488	432	468	495	496	472	773	780	541	64%	43%	60%
		Total Injuries	15,654	15,503	15,763	16,157	16,175	16,325	16,364	17,021	16,157	0%	1%	9%
		Reportable Crashes	17,555	17,603	18,219	18,727	18,805	19,948	21,125	21,319	19,365	6%	9%	21%
Pedestrian	Pedestrian	Fatalities	148	149	168	151	166	153	172	150	162	12%	6%	1%
		Serious Injuries	335	345	361	335	270	328	429	455	345	31%	24%	36%
		Total Injuries	5,115	5,367	5,179	4,988	4,523	4,553	4,402	4,040	4,729	-3%	-7%	-21%
		Reportable Crashes	4,450	4,506	4,537	4,374	4,000	4,001	4,201	4,086	4,223	5%	-1%	-8%
Bicycles	Bicyclist	Fatalities	21	11	16	11	19	16	16	21	16	0%	0%	0%
		Serious Injuries	67	66	57	66	46	53	99	96	64	87%	55%	43%
		Total Injuries	1,645	1,490	1,532	1,522	1,425	1,403	1,355	1,258	1,447	-3%	-6%	-24%
		Reportable Crashes	1,483	1,316	1,373	1,384	1,309	1,272	1,305	1,142	1,329	3%	-2%	-23%

Statistical Analysis

Strategic Focus Areas			2010	2011	2012	2013	2014	2015	2016	2017	5-Year Average 2013 2017	Percent Change 2016 to 2017	Percent Change 2017 vs. 5-Year Avg	Percent Change 2010 to 2017
Motorcycle	Motor-cyclist	Fatalities	223	199	210	181	186	179	192	185	190	7%	1%	-17%
		Serious Injuries	600	544	572	478	480	437	720	616	537	65%	34%	3%
		Total Injuries	4,305	3,932	4,296	3,611	3,501	3,619	2,927	3,340	3,591	-19%	-18%	-22%
		Reportable Crashes	4,016	3,637	3,985	3,427	3,284	3,413	3,454	3,194	3,513	1%	-2%	-20%
Heavy Truck	Heavy Truck	Fatalities	156	155	159	148	151	146	160	155	153	10%	5%	-1%
		Serious Injuries	222	230	216	203	207	193	299	323	224	55%	33%	45%
		Total Injuries	4,182	4,323	4,143	4,066	4,238	4,364	4,027	4,285	4,168	-8%	-3%	2%
		Reportable Crashes	5,844	6,344	5,889	6,121	6,596	6,916	6,740	6,807	6,452	-3%	4%	16%
Vehicle/ Train	Vehicle/ Train	Fatalities	1	6	1	2	7	4	3	3	3	-25%	0%	200%
		Serious Injuries	2	4	2	3	4	2	4	1	3	100%	33%	-50%
		Total Injuries	148	87	131	73	104	87	59	83	91	-32%	-35%	-44%
		Reportable Crashes	76	54	59	55	74	54	52	45	59	-4%	-12%	-41%
Work Zone	Work Zone	Fatalities	21	21	22	16	24	24	16	19	20	-33%	-20%	-10%
		Serious Injuries	57	51	44	39	35	36	59	60	43	64%	37%	5%
		Total Injuries	1,505	1,425	1,227	1,354	1,322	1,396	1,320	1,199	1,324	-5%	0%	-20%
		Reportable Crashes	1,884	1,811	1,661	1,845	1,845	1,935	2,075	1,789	1,872	7%	11%	-5%
Local Road	Local Road	Fatalities	220	213	203	182	200	233	180	183	200	-23%	-10%	-17%
		Serious Injuries	850	746	800	689	660	689	963	976	760	40%	27%	15%
		Total Injuries	23,849	23,216	24,079	22,319	21,195	21,800	21,566	22,107	22,192	-1%	-3%	-7%
		Reportable Crashes	32,970	30,766	31,922	31,567	30,138	32,011	32,309	32,390	31,589	1%	2%	-2%
Hit Fixed Object	Hit Fixed Object	Fatalities	553	529	533	467	425	459	401	402	457	-13%	-12%	-27%
		Serious Injuries	1,225	1,248	1,272	1,133	1,038	1,011	1,413	1,318	1,173	40%	20%	8%
		Total Injuries	21,595	22,485	21,936	21,516	19,824	20,178	17,823	16,692	20,255	-12%	-12%	-23%
		Reportable Crashes	37,522	40,102	39,185	40,360	38,551	39,885	38,244	37,824	39,245	-4%	-3%	1%
	Hit Tree	Fatalities	295	252	267	254	221	240	211	205	239	-12%	-12%	-31%
		Serious Injuries	586	497	517	493	411	418	566	556	481	35%	18%	-5%
		Total Injuries	6,567	6,658	6,660	6,379	5,770	5,753	5,001	5,520	5,913	-13%	-15%	-16%
		Reportable Crashes	9,070	9,543	9,633	9,753	8,937	9,092	8,818	8,699	9,247	-3%	-5%	-4%
	Hit Utility Pole	Fatalities	127	121	118	103	113	111	97	94	108	-13%	-10%	-26%
		Serious Injuries	303	294	350	285	281	270	362	323	310	34%	17%	7%
		Total Injuries	5,617	6,024	5,970	5,707	5,341	5,586	4,963	5,052	5,513	-11%	-10%	-10%
		Reportable Crashes	8,334	9,200	9,093	9,015	8,929	9,243	8,784	8,788	9,013	-5%	-3%	5%
	Hit Guide Rail	Fatalities	133	162	137	116	111	113	130	109	121	15%	7%	-18%
		Serious Injuries	219	266	265	267	205	217	298	255	250	37%	19%	16%
		Total Injuries	4,047	4,252	3,673	3,535	3,562	3,487	2,976	3,023	3,447	-15%	-14%	-25%
		Reportable Crashes	6,653	7,189	6,859	7,014	7,036	7,422	6,863	6,808	7,039	-8%	-3%	2%

Statistical Analysis

Strategic Focus Areas			2010	2011	2012	2013	2014	2015	2016	2017	5-Year Average 2013-2017	Percent Change 2016 to 2017	Percent Change 2017 vs. 5-Year Avg	Percent Change 2010 to 2017
Run-Off-Road	Single Vehicle Run-Off-Road	Fatalities	665	648	648	566	534	580	518	506	569	-11%	-9%	-24%
		Serious Injuries	1,573	1,575	1,607	1,405	1,303	1,274	1,825	1,691	1,483	43%	23%	8%
		Total Injuries	26,793	27,840	27,136	26,315	23,935	24,547	21,792	22,779	24,745	-11%	-12%	-15%
		Reportable Crashes	45,256	48,120	46,928	47,736	45,342	47,331	45,868	45,402	46,641	-3%	-2%	0%
Head On	Head On	Fatalities	175	156	148	178	151	176	159	148	162	-10%	-2%	-15%
		Serious Injuries	451	451	419	440	419	438	588	582	461	34%	28%	29%
		Total Injuries	7,587	7,496	7,195	6,649	6,495	6,905	6,605	4,915	6,770	-4%	-2%	-35%
		Reportable Crashes	6,964	7,162	6,542	6,549	6,359	6,941	7,326	7,115	6,743	6%	9%	2%
	Cross Median	Fatalities	84	48	40	21	25	40	11	11	27	-73%	-59%	-87%
		Serious Injuries	84	76	63	50	62	70	23	29	54	-67%	-57%	-65%
		Total Injuries	909	883	889	699	798	852	165	145	681	-81%	-76%	-84%
		Reportable Crashes	928	900	865	737	838	840	164	132	689	-80%	-76%	-86%
Intersection	Intersection	Fatalities	267	270	294	246	271	251	279	265	268	11%	4%	-1%
		Serious Injuries	1,021	982	1,029	1,010	947	915	1,465	1,374	1,073	60%	37%	35%
		Total Injuries	41,791	42,275	42,298	39,862	37,657	38,262	39,093	40,008	39,434	2%	-1%	-4%
		Reportable Crashes	46,273	47,618	47,957	47,334	45,064	47,033	49,562	49,177	47,390	5%	5%	6%
	Signalized Intersection	Fatalities	90	87	86	82	80	86	102	100	87	19%	17%	11%
		Serious Injuries	372	336	343	384	341	338	574	494	396	70%	45%	33%
		Total Injuries	18,395	18,863	19,005	17,757	17,150	17,490	17,680	18,164	17,816	1%	-1%	-1%
		Reportable Crashes	18,252	18,994	19,218	18,840	18,281	19,035	19,853	19,544	19,045	4%	4%	7%
	Stop Controlled Intersection	Fatalities	87	104	108	99	105	89	103	87	101	16%	2%	0%
		Serious Injuries	328	316	329	297	297	288	435	436	329	51%	32%	33%
		Total Injuries	13,117	12,785	12,443	12,122	11,626	11,331	11,831	12,174	11,871	4%	0%	-7%
		Reportable Crashes	14,778	14,545	14,397	14,721	14,329	14,398	15,200	15,213	14,609	6%	4%	3%
TOTAL	TOTAL	Fatalities	1,324	1,286	1,310	1,208	1,195	1,200	1,188	1,137	1,220	-1%	-3%	-14%
		Serious Injuries	3,556	3,402	3,455	3,248	3,040	3,030	4,397	4,227	3,434	45%	28%	19%
		Total Injuries	95,129	95,737	94,762	90,215	86,527	89,131	86,162	88,547	89,359	-3%	-4%	-7%
		Reportable Crashes	121,217	125,322	124,062	124,077	121,309	127,127	129,395	128,188	125,194	2%	3%	6%

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Methodology: Fatality Rate and Suspected Serious Injury Rate

After 2016 Vehicle Miles Traveled (VMT) count was increased by 1% (Projection for the upcoming year).

- Note: A 1% increase was determined in observation of historical trends in VMT.

Fatality Rate Projection is calculated by:

1. The most recent year, fatality count is reduced by 2% (Targeted fatality count for the upcoming year).
2. The fatality rate per 100 million VMT is calculated for each of the 5 most recent consecutive years ending in the year for which the targets are established.
3. The fatality rates (Rounded to the hundredth decimal place) are added together.
4. The sum of the fatality rates is divided by five and rounded to the thousandth decimal place.

Suspected Serious Injury Rate Projection is calculated by:

1. The most recent year, suspected serious injury count is reduced by 2% (Targeted suspected serious injury count for the upcoming year).
2. The suspected serious injury rate per 100 million VMT is calculated for each of the 5 most recent consecutive years ending in the year for which the targets are established.
3. The suspected serious injury rates (Rounded to the hundredth decimal place) are added together.
4. The sum of the suspected serious injury rates is divided by five and rounded to the thousandth decimal place.

Safety Performance Management Measures
Agency/Docket Number: FHWA-2013-0020
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Highway Safety Manual Tools and Resources

In January 2016 Penn State University completed research for Pennsylvania Regionalized Safety Performance Factors (SPFs). These regionalized SPFs allow for a more accurate way to predict crash frequencies. Pennsylvania continues to strive for more Data Driven Safety Analysis using the Highway Safety Manual (HSM). The following tools and resources are now available through the ECMS, File Cabinet.

Folder	Name	Version	File
ADV-General Requirements	PennDOT HSM Tool A	12/1/2017	Primary (Pa Specific) Crash Frequency Analysis tool
ADV-General Requirements	PennDOT HSM Tool B	08/08/2018	Alternatives and Safety Benefit Tool (Requires file export from PennDOT HSM Tool A)
ADV-General Requirements	PennDOT HSM Tool User Manual	10/04/2018	Guide: In reference to PennDOT HSM Tool A & B
ADV-General Requirements	Regionalized Safety Performance Functions Report	10/17/2017	Reference to the development of PA specific, Safety Performance Functions.

The ECMS Home page is at the following hyperlink:
https://www.dot14.state.pa.us/ECMS/

(If you do not have password access to ECMS you may log-in as a guest.)
After logging onto ECMS you will need to click on the “References” link (the last tab on the dark-blue task-bar). In the drop-down menu, click on “File Cabinet”.

HSM Tools and Resource contacts:

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Highway Safety Manual Tools and Resources

In Addition, the following resources are available on the PennDOT Safety Site:

PennDOT HSM Analysis Tools
- Tool A (Existing Condition Analysis)
- Tool B (Alternatives analysis)
- User Manual

Supplements
- Tool B Lane and Shoulder Width Supplement 1
- Tool B Lane and Shoulder Width Supplement 2

Data
- State Road Horizontal Curve Inventory (2017)
- Local Road Traffic Count(2018)

To access the resources click on the hyperlink above. Next, Click on the " Safety Infrastructure Improvement" window located mid–way down the screen. The resources are located to the right hand side under "PENNSYLVANIA HIGHWAY SAFETY MANUAL(HSM) TOOLS & DATA"

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