Insurance Institute for Highway Safety
Highway Loss Data Institute

Crashing, Crash Avoidance and the Future of Driving

CAS Annual Meeting
November 13, 2018

Matt Moore, Senior Vice President HLDI

iihs.org

IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from crashes on the nation's roads.

HLDI shares this mission by analyzing insurance data representing human and economic losses from crashes and other events related to vehicle ownership.

Both organizations are wholly supported by auto insurers.

IIHS – HLDI supporting groups

AAA Carolinas
Acceptance Insurance
Alfa Alliance Insurance Corporation
Alfa Insurance
Allstate Insurance Group
American Agricultural Insurance Company
American Family Mutual Insurance Company
American National
Ameriprise Auto & Home
Amica Mutual Insurance Company
Auto Club Enterprises
Auto Club Group
Auto-Owners Insurance
Bitco Insurance Companies
California Casualty Group
Celina Insurance Group
Censtat Casualty Company
CHUBB
Colorado Farm Bureau Mutual Insurance Company
Concord Group Insurance Companies
COUNTRY Financial
CSAA Insurance Group
Desjardins Insurance
ECM Insurance Company
Elephant Insurance Company
EMC Insurance Companies
Erie Insurance Group
Esurance
Farm Bureau Financial Services
Farm Bureau Insurance of Michigan
Farm Bureau Mutual Insurance Company of Idaho
Farmers Insurance Group
Farmers Mutual of Nebraska
Florida Farm Bureau Insurance Companies
Frankenmuth Insurance
Gainsco Insurance
GEICO Corporation
The General Insurance
Georgia Farm Bureau Mutual Insurance Company
Goodville Mutual Casualty Company
Grange Insurance
Grinnell Mutual
Hallmark Financial Services
Hanover Insurance Group
The Hartford
Haulers Insurance Company, Inc.
Horace Mann Insurance Companies
Imperial Fire & Casualty Insurance Company
Indiana Farm Bureau Insurance
Indiana Farmers Insurance
Infinity Property & Casualty
Kemper Corporation
Kentucky Farm Bureau Mutual Insurance Companies
Liberty Mutual Insurance Company
Louisiana Farm Bureau Mutual Insurance Company
The Main Street America Group
Mercury Insurance Group
MetLife Auto & Home
Mississippi Farm Bureau Casualty Insurance Company
MMG Insurance
Munich Reinsurance America, Inc.
Mutual Benefit Group
Mutual of Enumclaw Insurance Company
Nationwide
New Jersey Manufacturers Insurance Group
Nodak Mutual Insurance Company
Norfolk & Dedham Group
North Carolina Farm Bureau Mutual Insurance Company
Northern Neck Insurance Company
Ohio Mutual Insurance Group
Old American Indemnity Company
Oregon Mutual Insurance Company
Paramount Insurance Company
Pekin Insurance
PEMCO Insurance
Plymouth Rock Assurance
Progressive Insurance
PURE Insurance
Qualitas Insurance Company
Redpoint County Mutual Insurance Company
The Responsive Auto Insurance Company
Rider Insurance
Rockingham Group
RSA Canada
Safe Auto Insurance Company
Safeco Insurance
Samsung Fire & Marine Insurance Company
SECURA Insurance
Selective Insurance Company of America
Sentry Insurance
Shelter Insurance Companies
Sompo America
South Carolina Farm Bureau Mutual Insurance Company
Southern Farm Bureau Casualty Insurance Company
State Farm Insurance Companies
Stillwater Insurance Group
Tennessee Farmers Mutual Insurance Company
Texas Farm Bureau Insurance Companies
The Travelers Companies
United Educators
USAA
Utica National Insurance Group
Virginia Farm Bureau Mutual Insurance
West Bend Mutual Insurance Company
Western National Insurance Group
Westfield Insurance

Funding associations
American Insurance Association
National Association of Mutual Insurance Companies
Property Casualty Insurers Association of America

Haddon matrix

Recognizing opportunities to make a difference

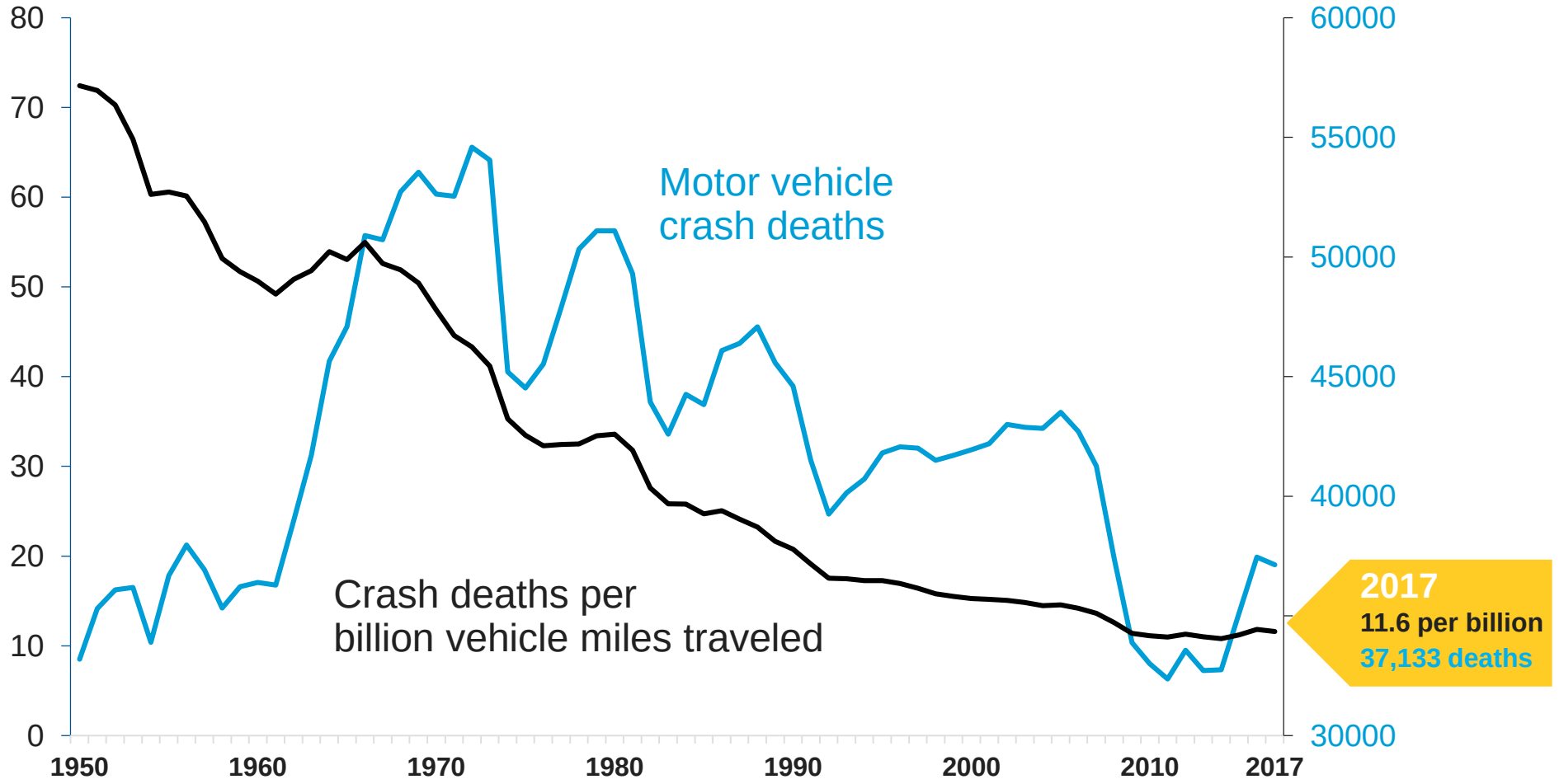
	pre-crash	during crash	after crash
people	graduated licensing impaired driving laws automated enforcement	safety belts helmets	medical bracelets general health
vehicles	crash avoidance technology	airbags crashworthiness truck underride guards	automatic collision notification fuel system integrity
environment	roundabouts rumble strips	roadside barriers breakaway poles	emergency medical services long-term rehabilitation


CBS Evening News
55 MPH
MAXIMUM

Crash Trends

U.S. motor vehicle crash deaths and deaths per billion vehicle miles traveled

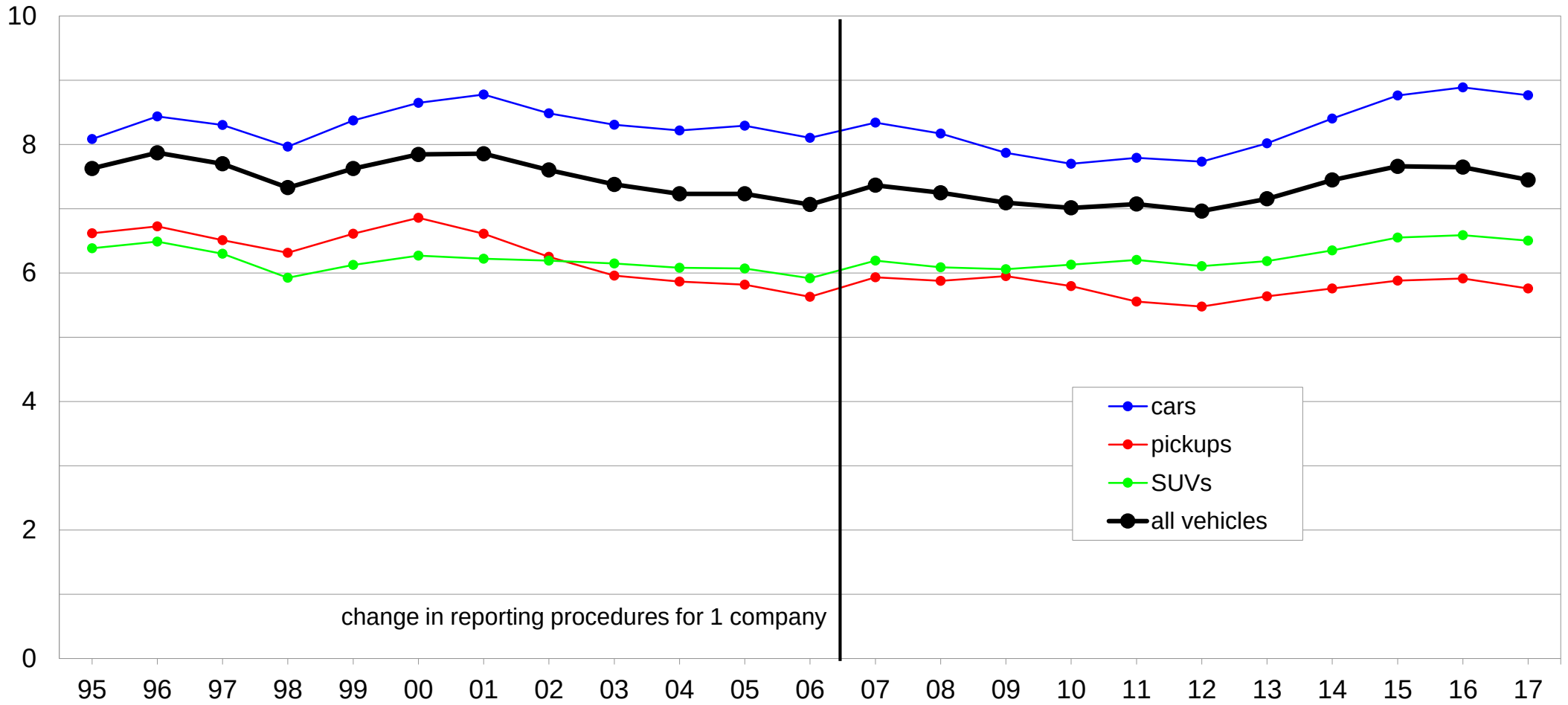
1950-2017




INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

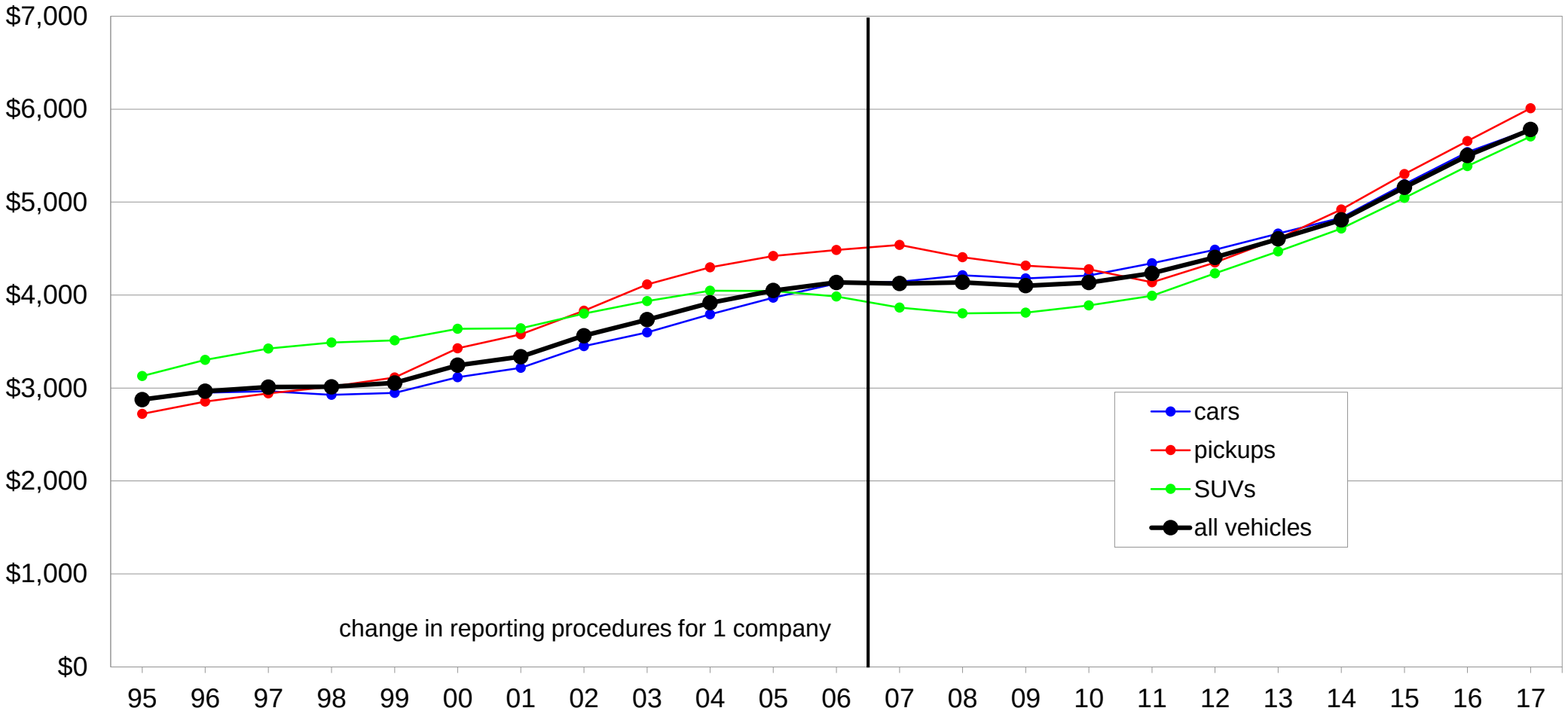
Collision claim frequencies

By calendar year and vehicle type, 4 most current model years



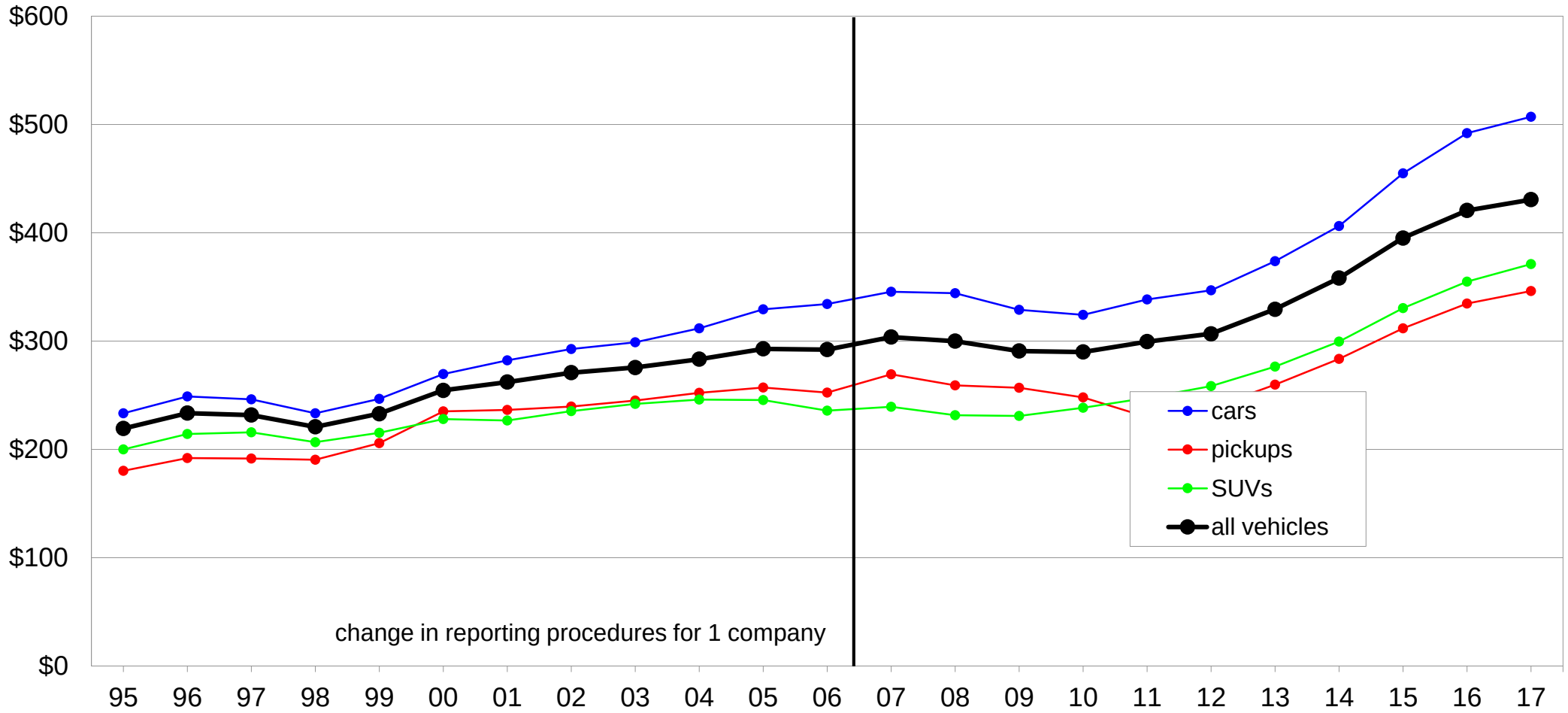
Collision claim severities

By calendar year and vehicle type, 4 most current model years

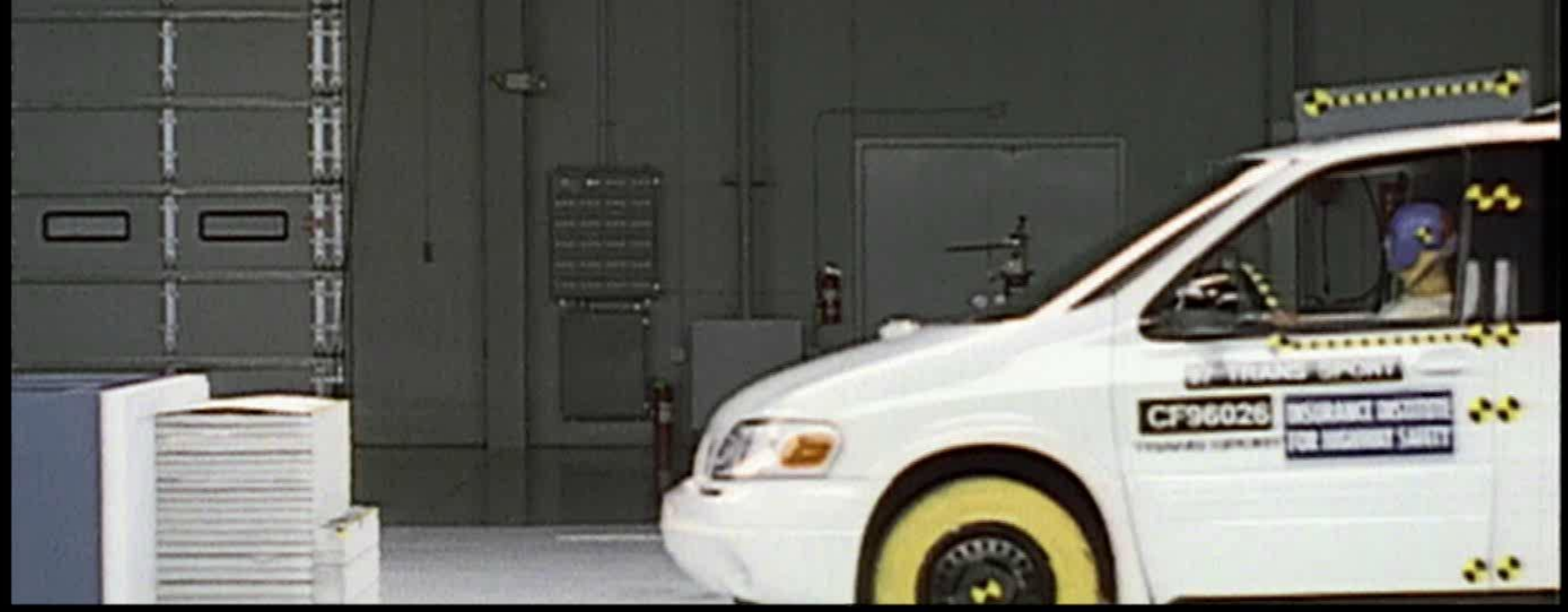


Collision overall losses

By calendar year and vehicle type, 4 most current model years



Vehicle crashworthiness


CF96026
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98 TOYOTA SIENNA LE
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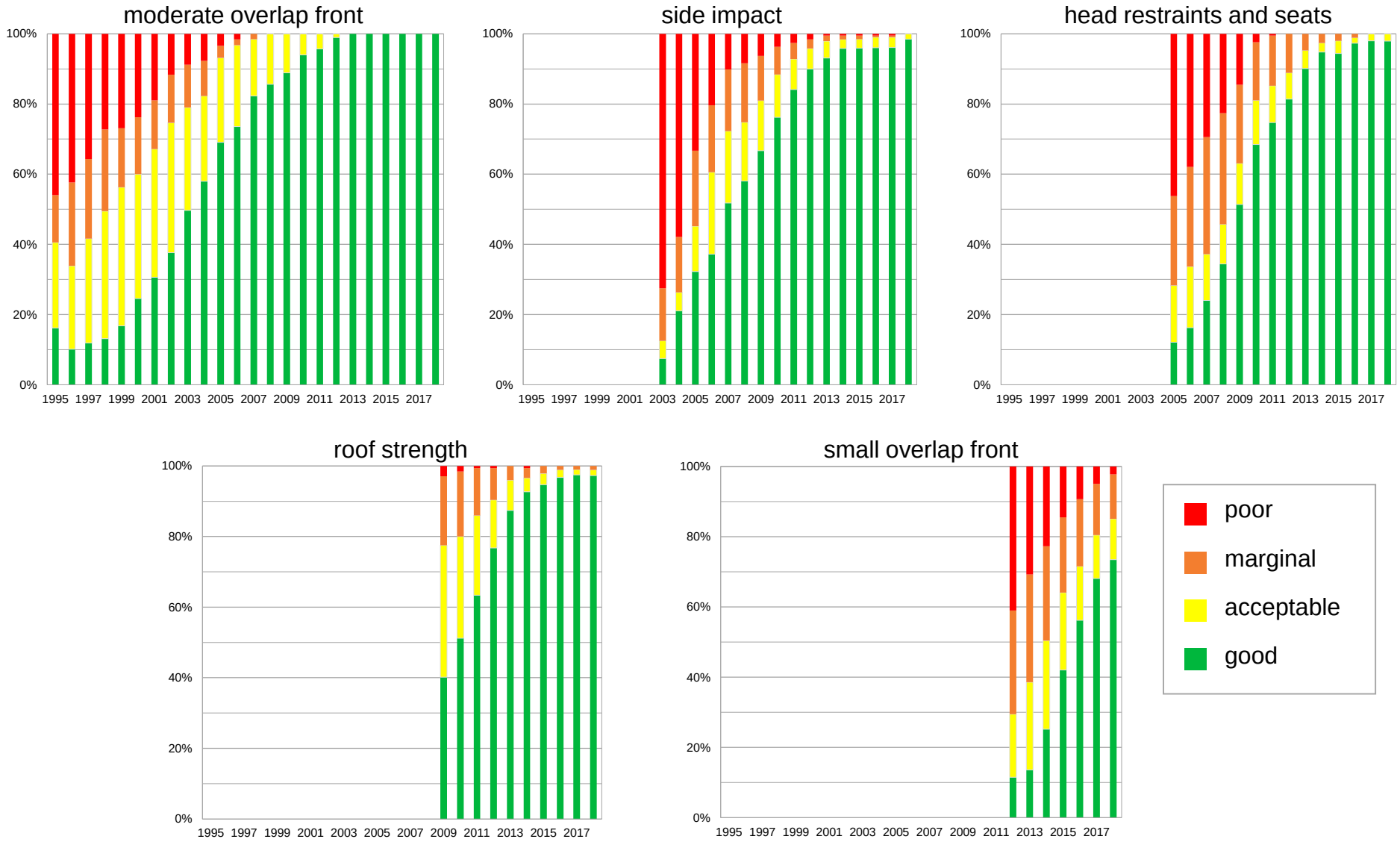
Crash protection ratings by model year

Improvements beginning in 1995



Death and injury reductions for good vs. poor rating

IIHS crashworthiness tests

Front moderate overlap, beginning 1995

Fatality risk in head-on crashes is 46 percent lower

50 percent of model year 2016 series is good rated

Side impact, beginning 2003

Fatality risk in side impact crashes 70 percent lower in addition to the benefit of adding side airbag protection for the head

46 percent of model year 2016 series is good rated

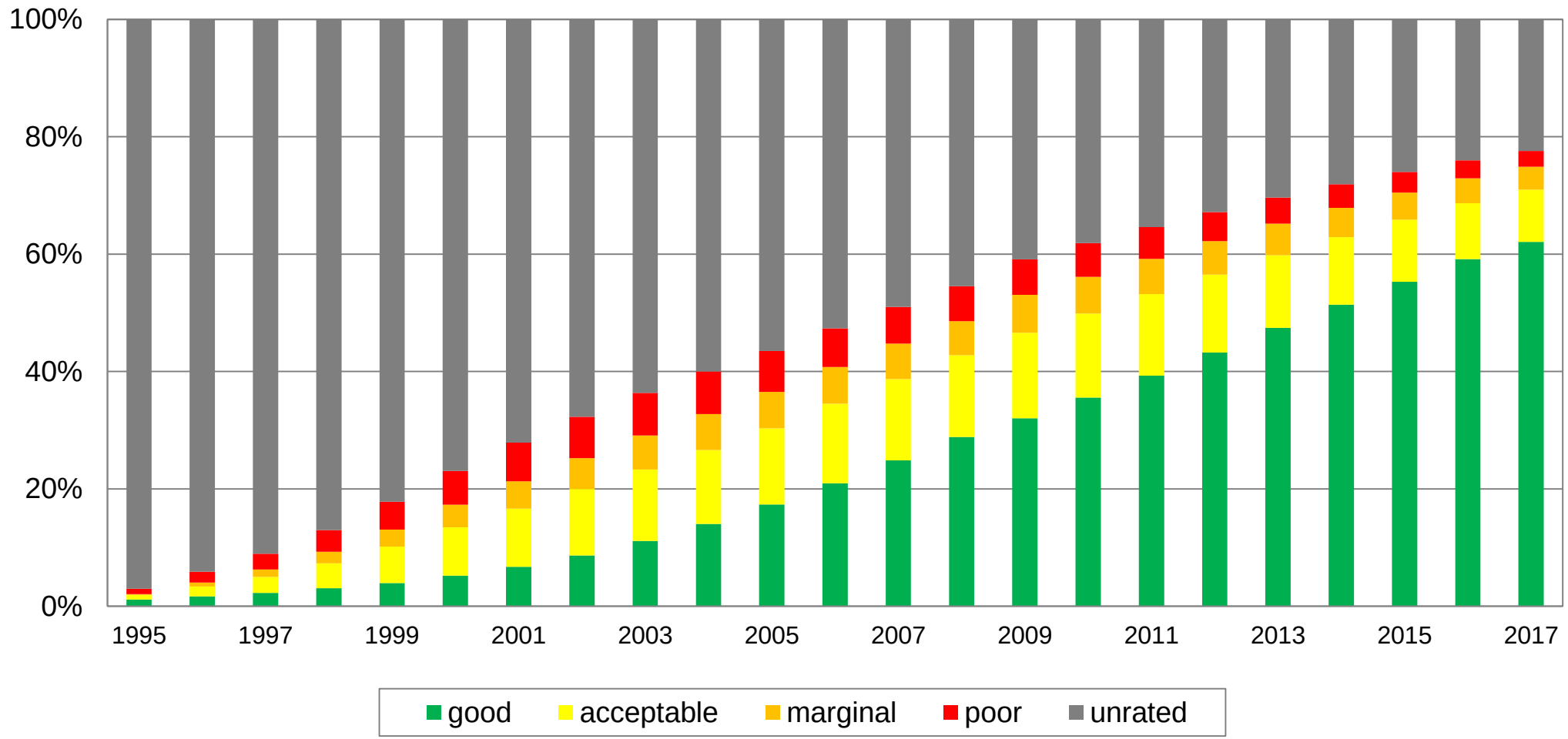

Rear crash (whiplash mitigation), beginning 2004

Neck injury risk in rear crashes is 15 percent lower

Risk of neck injury requiring 3+ months treatment is 35 percent lower

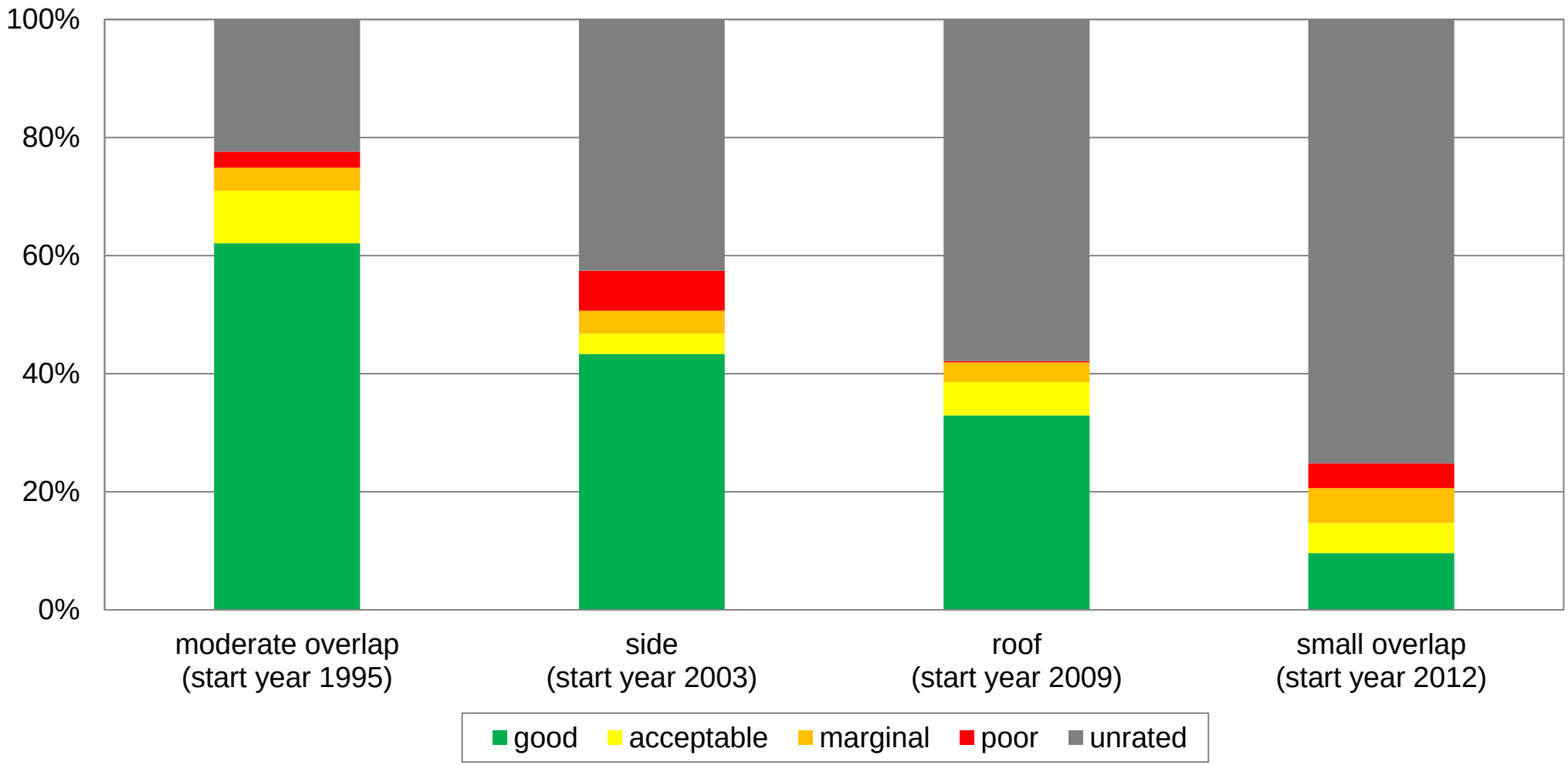
Registered vehicle moderate overlap front crash test ratings

All registered vehicles, by calendar year



2017 ratings for registered vehicles

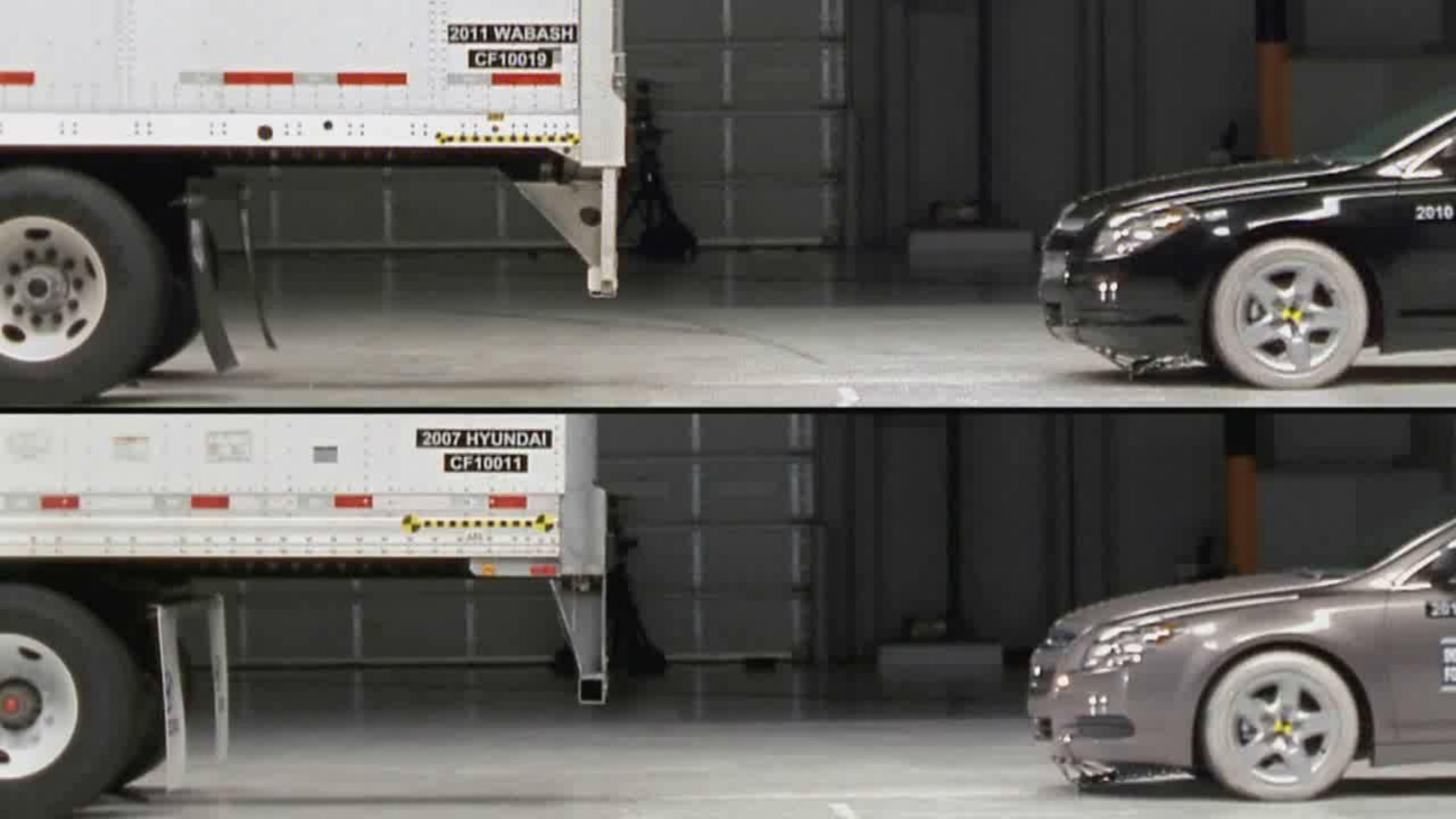
All registered vehicles



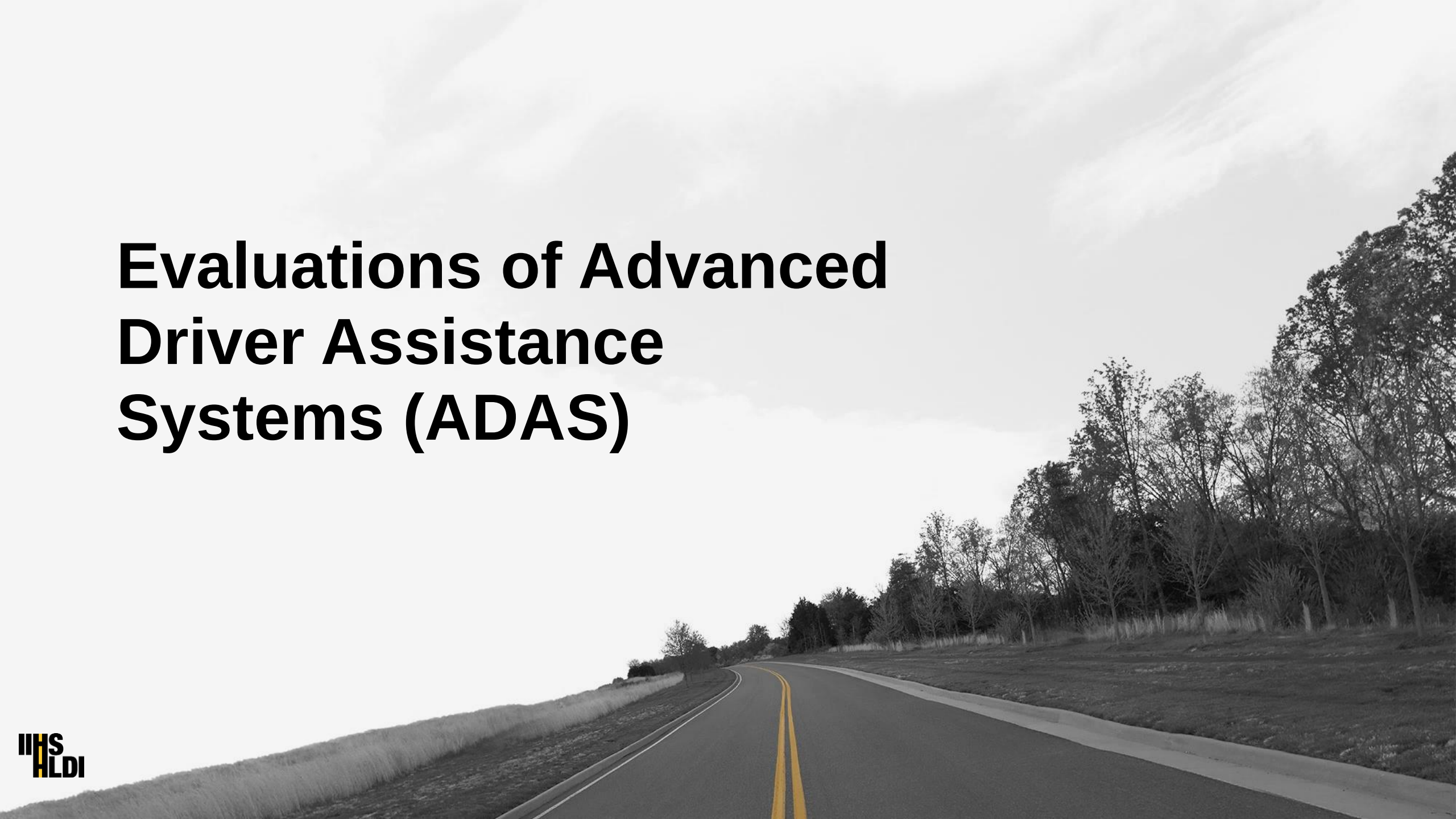
Advertisements:

TOP SAFETY PICK

2015 Nissan Tsuru and 2016 Nissan Sentra


2011 WABASH
CF10019
2010
2007 HYUNDAI
CF10011

Evaluations of Advanced Driver Assistance Systems (ADAS)

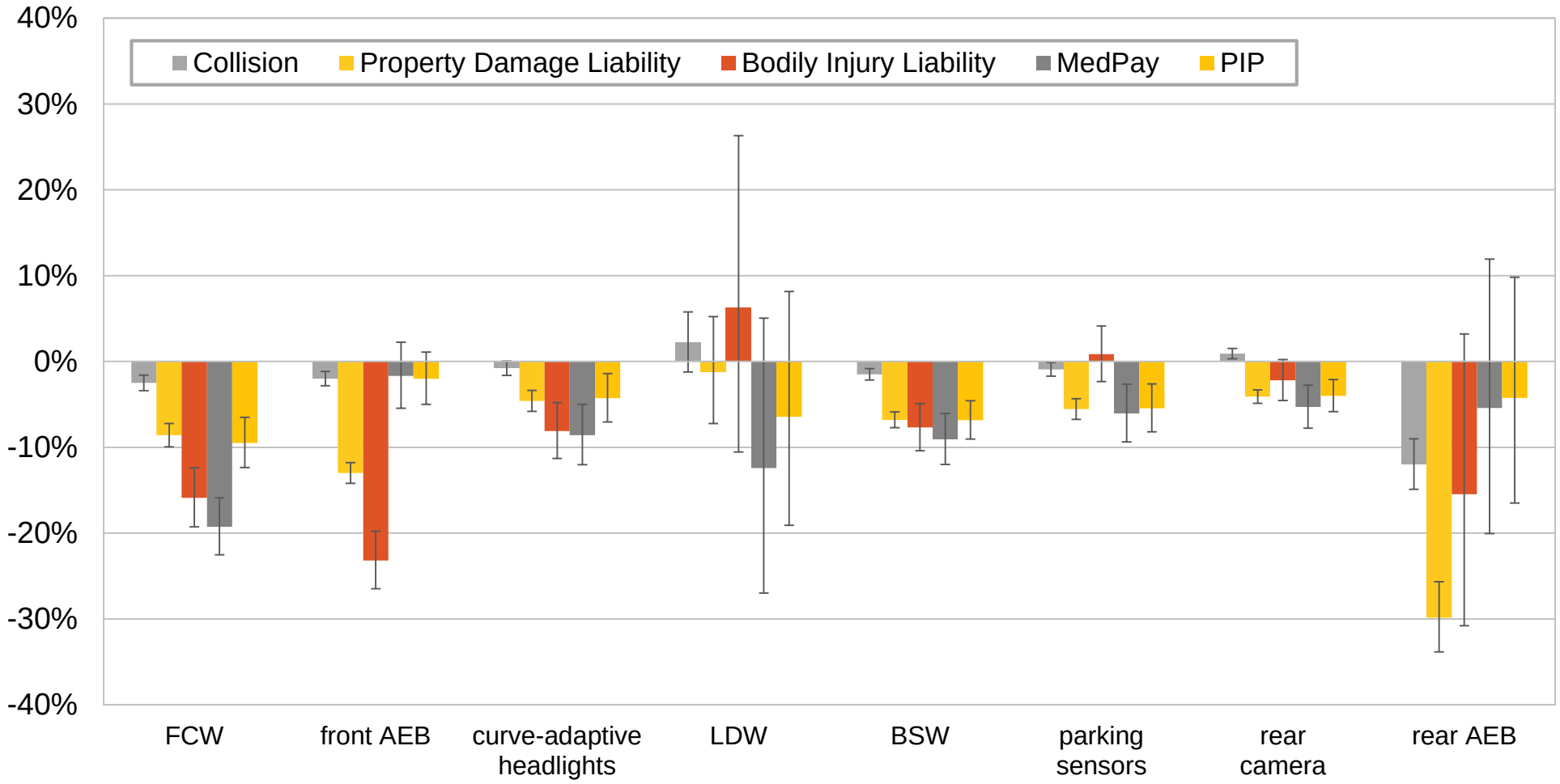


HLDI collision avoidance analysis

- The HLDI database includes data from companies that represent 85% of private passenger auto insurance in the U.S.
- On a monthly basis, HLDI processes 320 million insurance data transactions
- The insurance data includes the garaging zip code and rated driver demographics
- Manufacturers shared with us 17 digit VINs and information about collision avoidance systems fitted to those vehicles
- Our collision avoidance analysis used the manufacturer supplied feature data along with our geographic and demographic data
- Large amount of timely data
- Limited information on crash circumstances

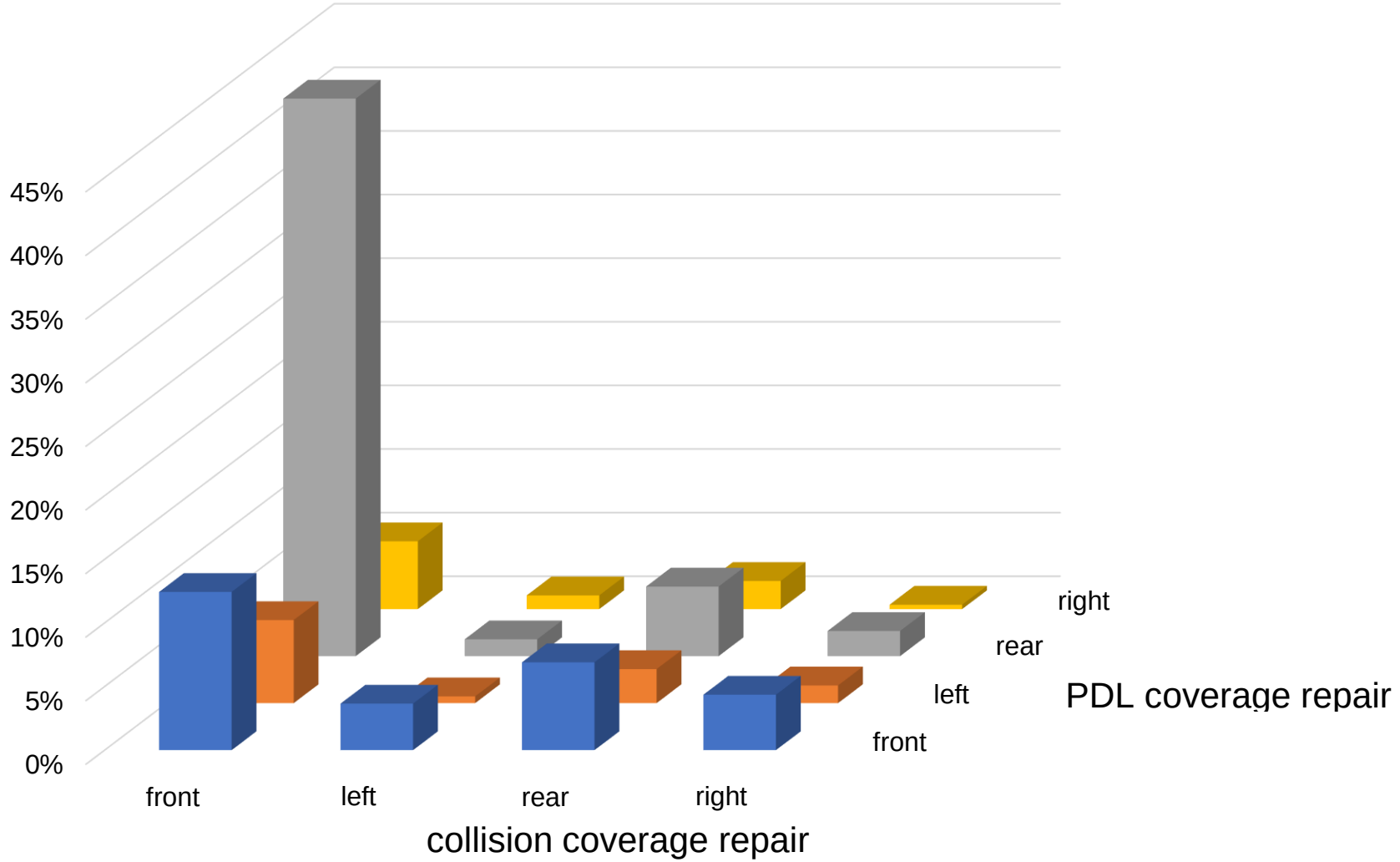
Summary of technology effects on insurance claim frequency

Results pooled across automakers



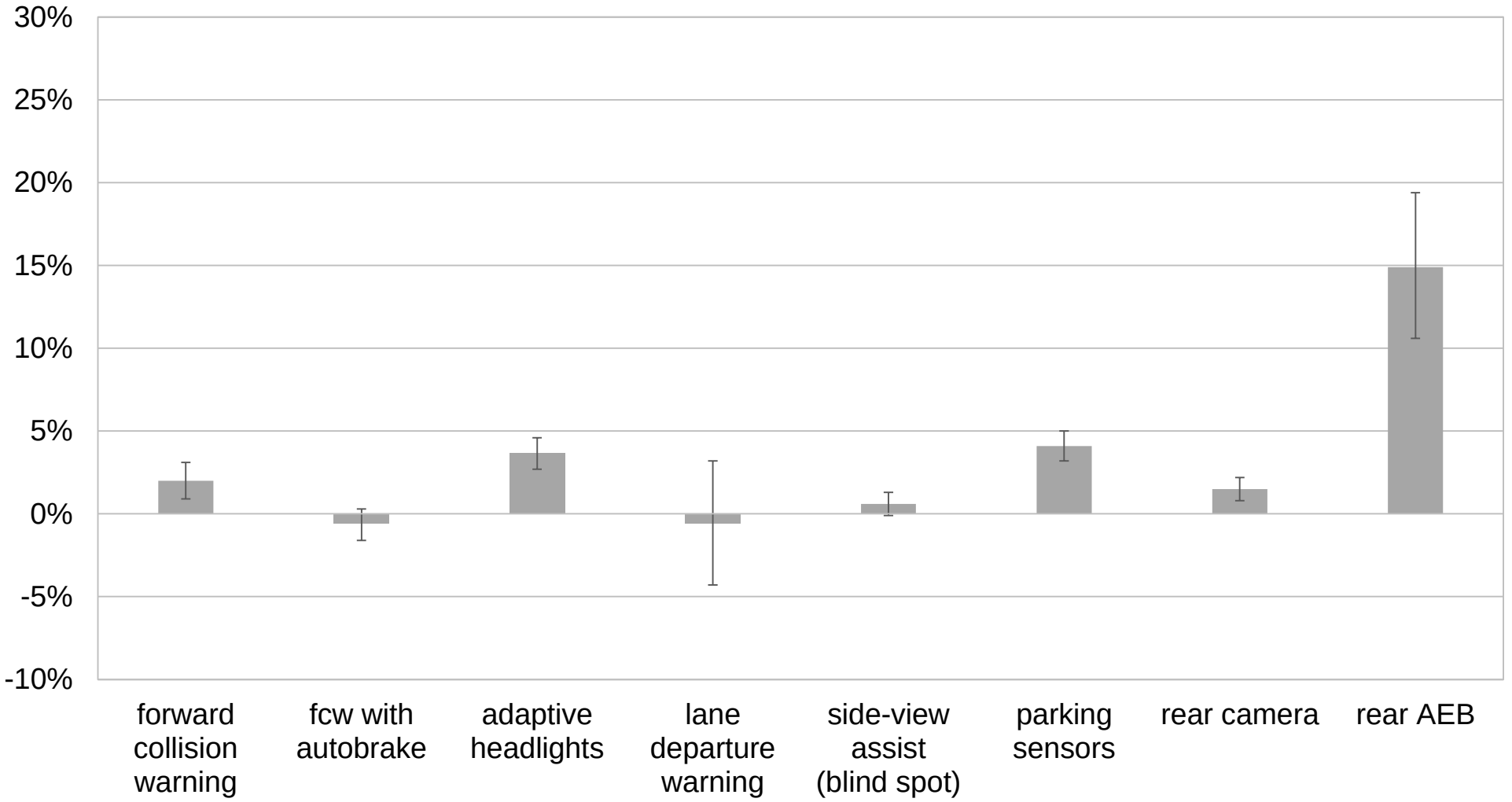
Percent distribution of matched pairs of collision & PDL estimates by point of impact

1981-2017 models, 2016 calendar year



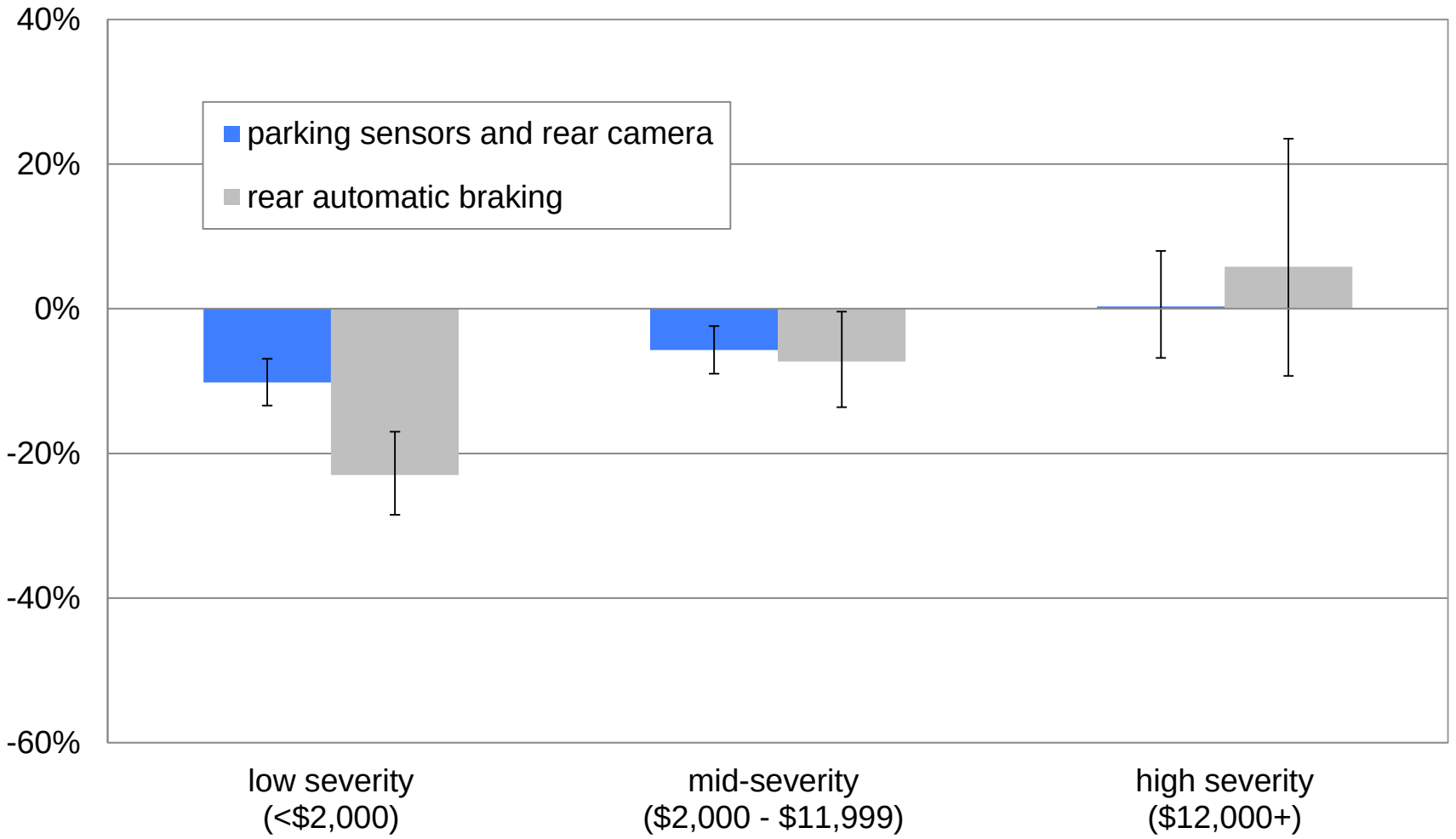
Summary of technology effects on collision claim severity

Results pooled across automakers



Change in collision claim frequency

By severity range



HLDI and police-reported crash data

Insurance data

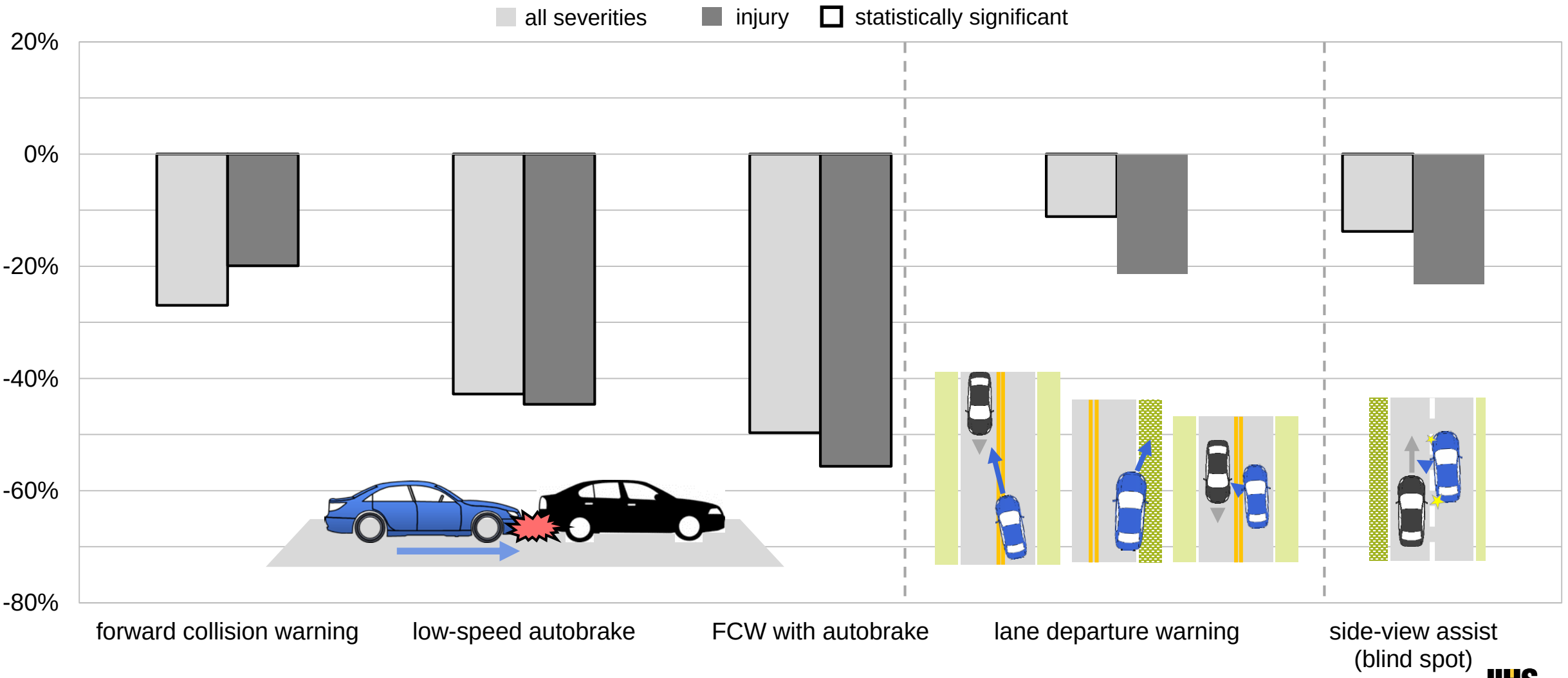
- Large amount of timely data
- Limited information on crash circumstances

Police-reported crash data

- More detailed information on crash type
- Limitations
  - Some crashes not reported to police
  - Delay in obtaining data
  - Data collected not uniform among states, and not all states have information to determine crash types

Most crash avoidance technologies are living up to expectations

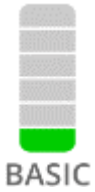
Effects on relevant police-reported crash types



Front crash prevention testing and rating

Front crash prevention ratings

vehicles without forward collision warning or autobrake; or vehicles equipped with a system that doesn't meet NHTSA or IIHS criteria



vehicles earning 1 point for forward collision warning or 1 point in either 12 or 25 mph test

vehicles with autobrake that achieve 2-4 points for forward collision warning and/or performance in autobraking tests

vehicles with autobrake that achieve 5-6 points for forward collision warning and/or performance in autobraking tests

25 mph

$28,131

12 mph

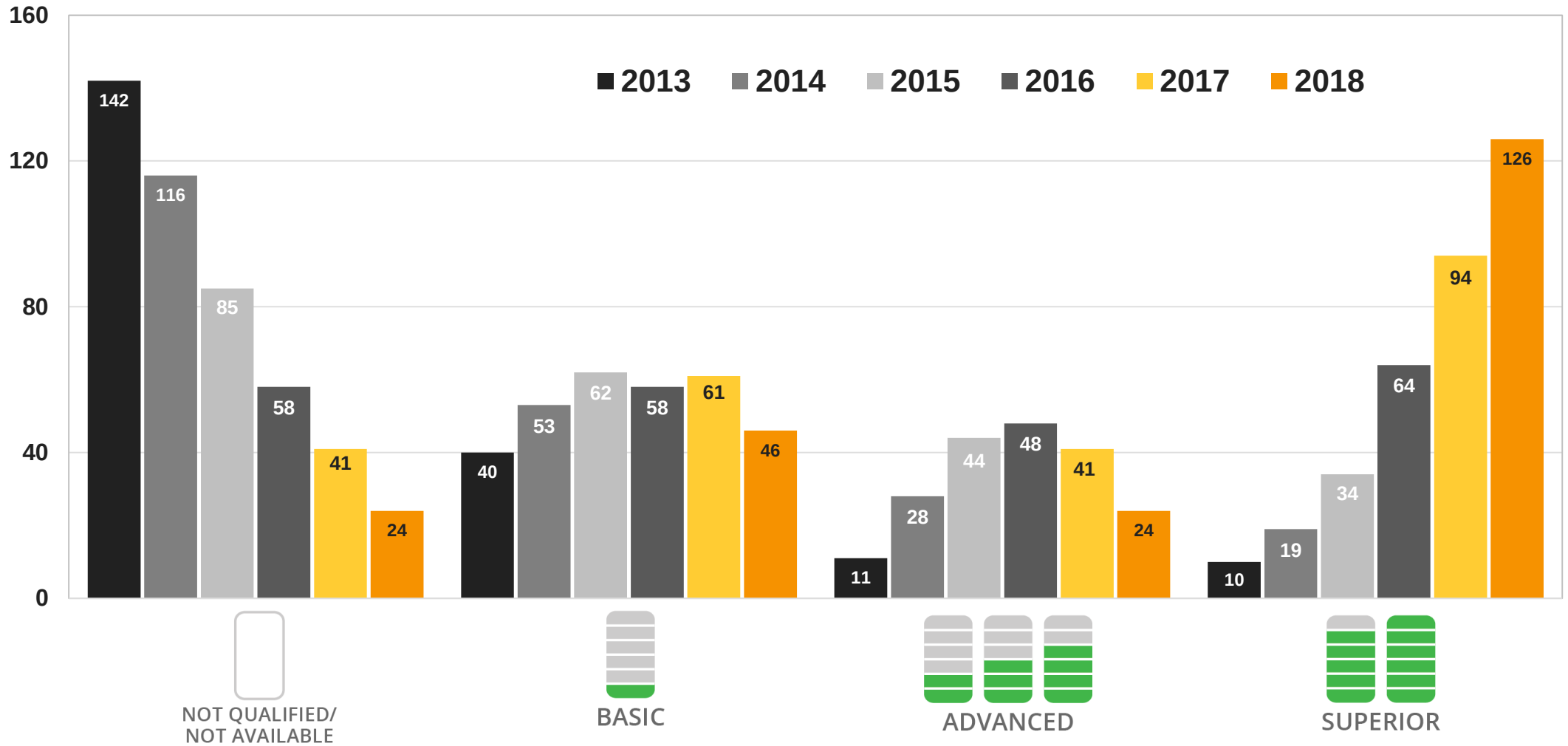
$5,715

Speed reduction in 12 and 24 mph tests

Volvo S60 2 point advanced	Dodge Durango 3 point advanced	Subaru Outback 6 point superior
		
		

Front crash prevention ratings

2013-18 models



20 automakers have committed to make AEB a standard feature by September 2022

99+% of U.S. market


Hyundai
advertisement

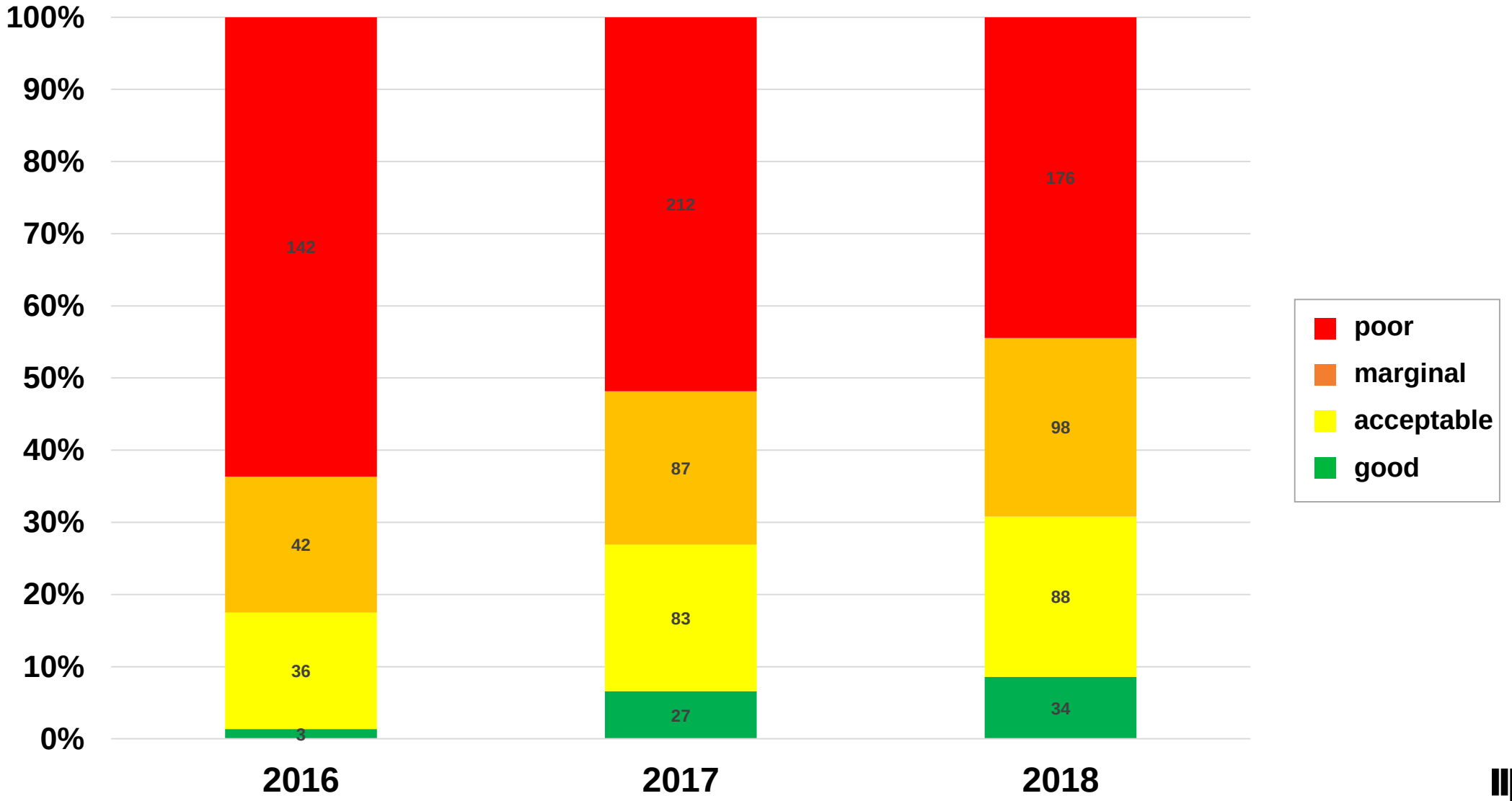
Headlight testing and ratings

Toyota Prius v LED and BMW 3 series halogen

On-road comparison

Headlight ratings

2016-2018 model years – all headlight variants



Evaluations of system status

On-off status of front crash prevention systems

By manufacturer

	percent with system on	number observed
Cadillac	92	206
Chevrolet	87	142
Honda	98	239
Mazda	95	20
Volvo	94	52
total	93	659

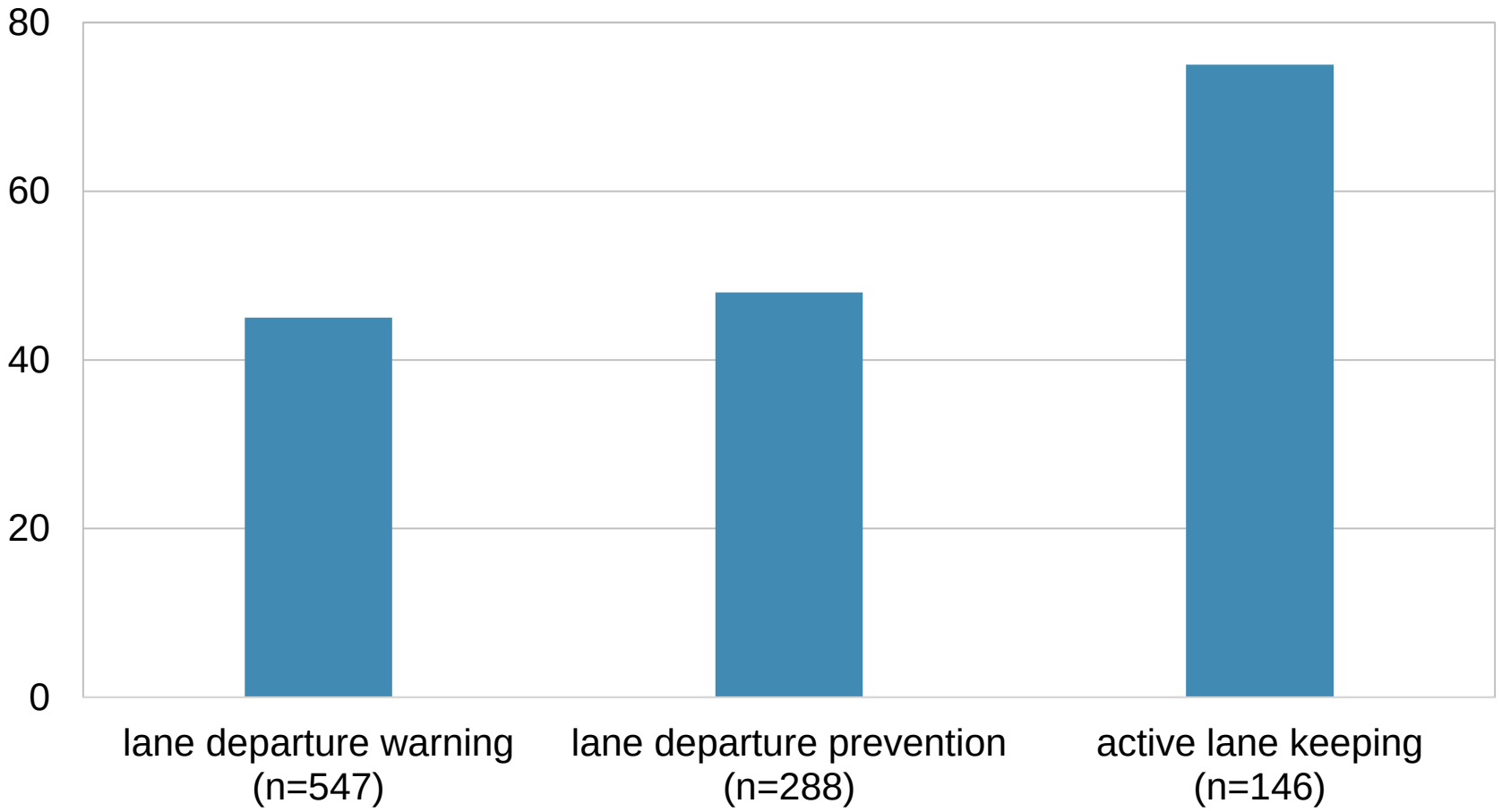
On-off status of lane-maintenance systems

By manufacturer

	percent with system on	number observed
Cadillac	56	204
Chevrolet	50	147
Ford/Lincoln	21	115
Honda	36	239
Lexus/Toyota	68	147
Mazda	77	26
Volvo	75	105
total	51	983

On-off status by maximum observable lane-maintenance intervention level

Percent with system on



GM lane departure warning on-off status by warning modality

		percent with system on	number observed
beep	Cadillac	33	18
	Chevrolet	39	66
	total	38	84
vibrating seat	Cadillac	58	142
	Chevrolet	49	49
	total	56	191


Advertisement:
Lane valet

Park assist systems

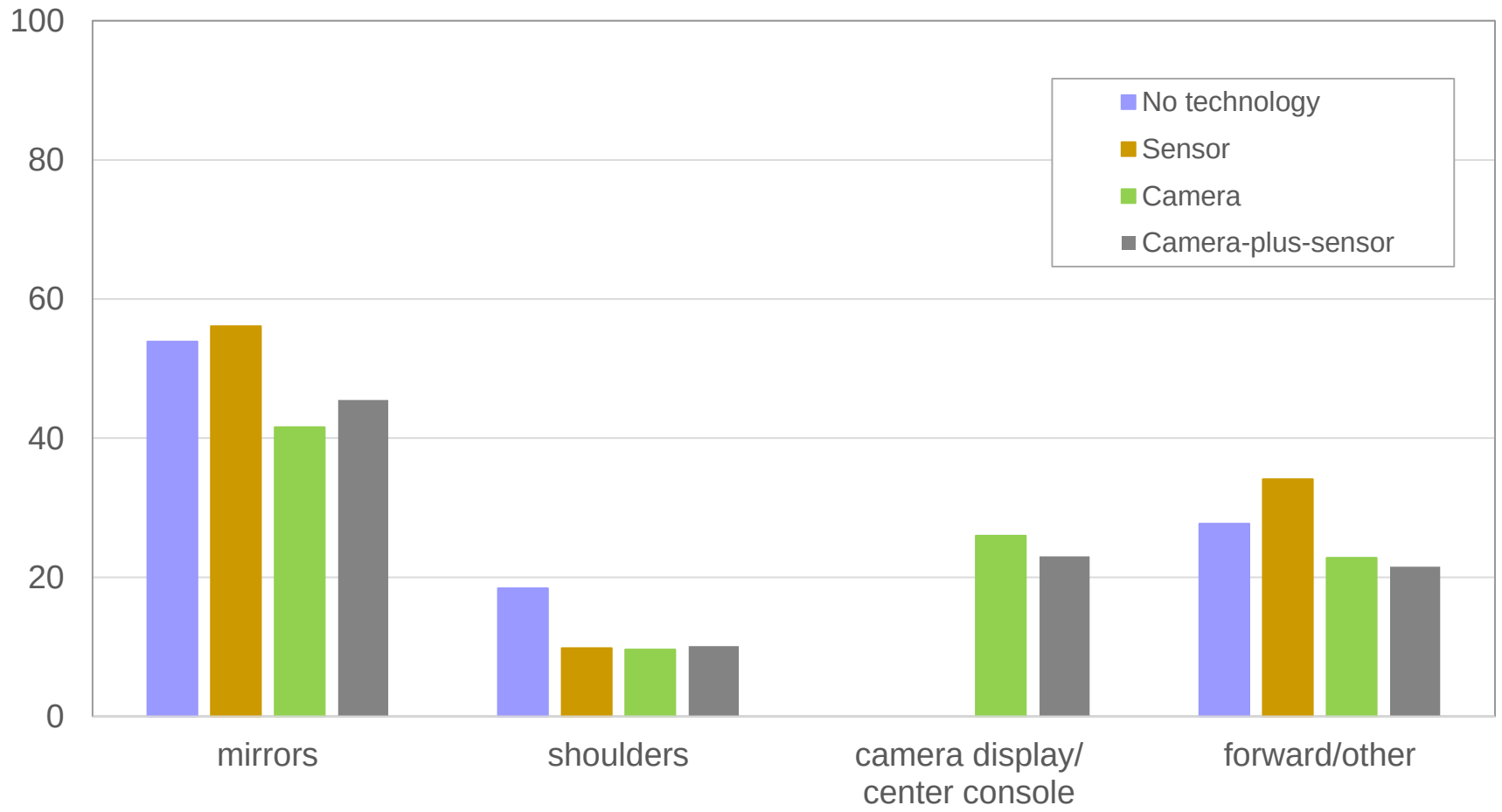
Drivers must respond to sensors for them to work

Objects are not always easy to see in the camera display

Rearview cameras can help drivers avoid backing over objects in reverse

Technology influences the way we look around the vehicle while backing

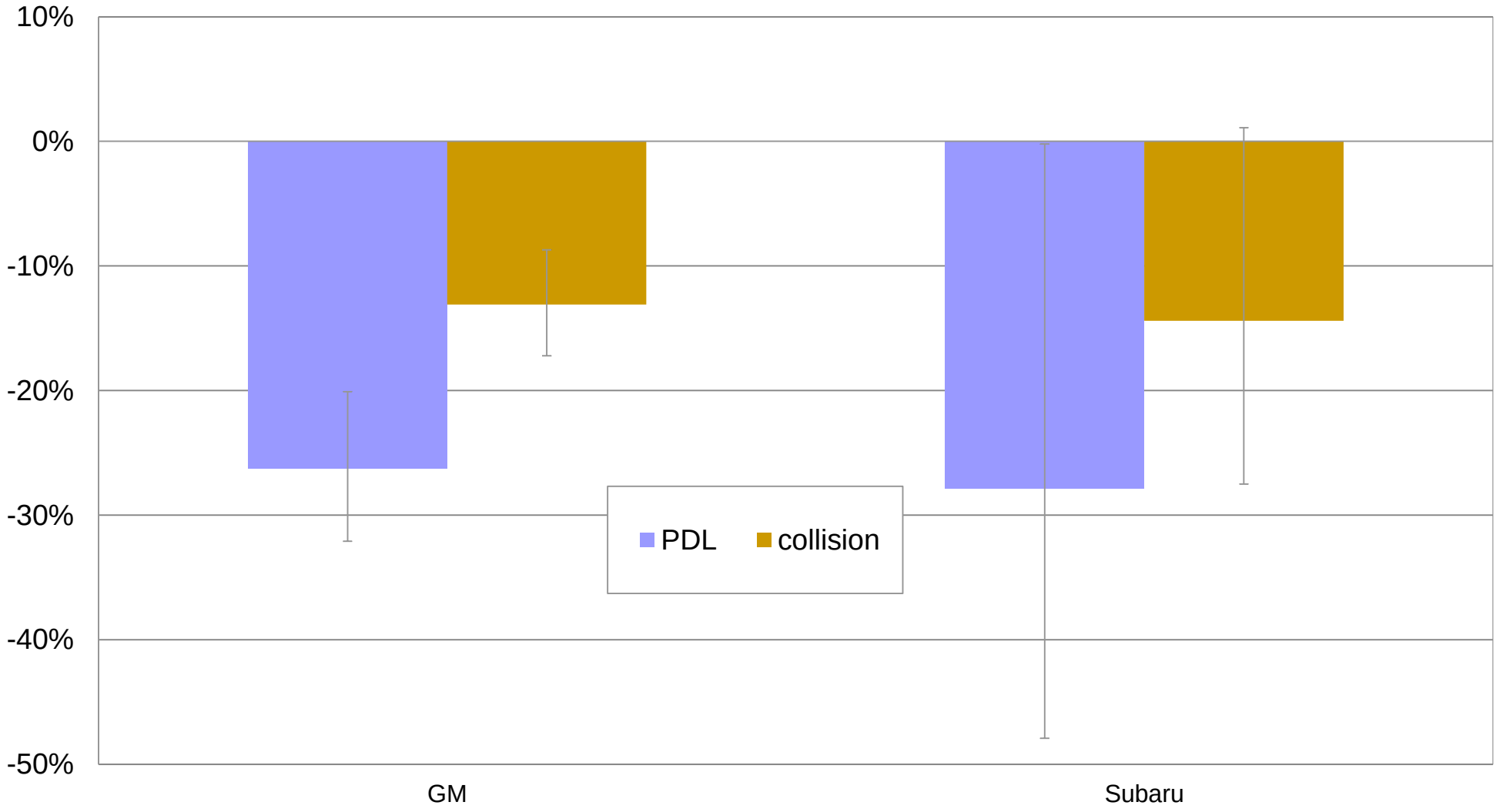
Percentage of time spent looking at different fields of view



Rear automatic braking

Rear automatic braking

Change in claim frequency



Test vehicles

2017 BMW 5 series

2017 Cadillac XT5

2017 Infiniti QX60

2017 Jeep Cherokee

2017 Subaru Outback

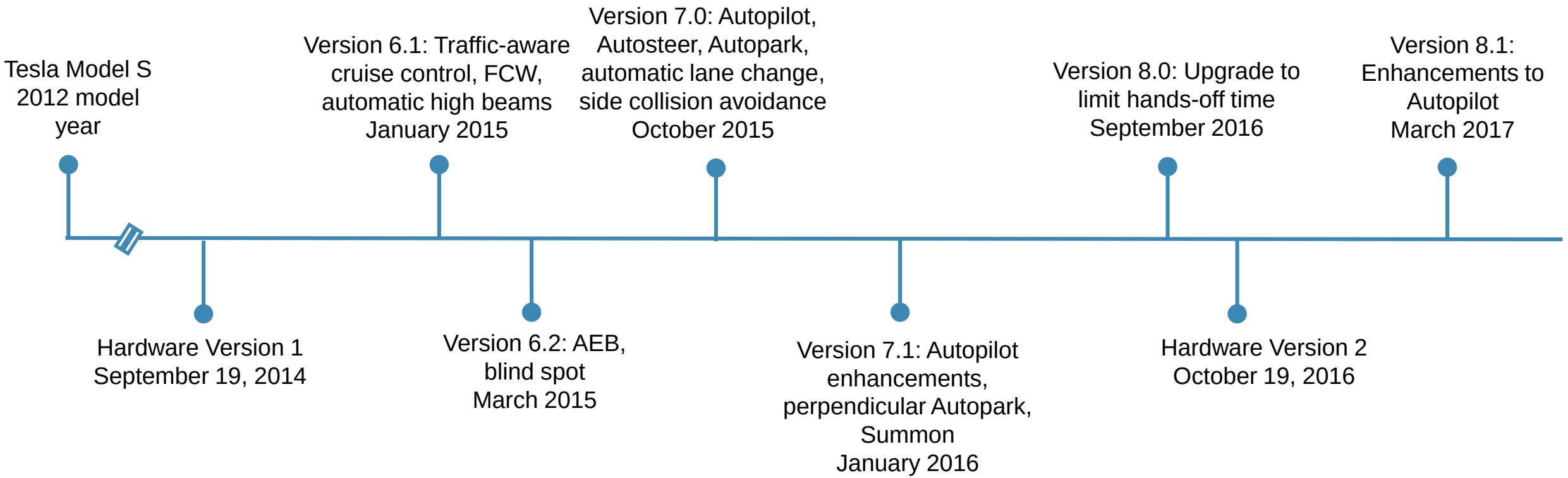
2017 Toyota Prius

Benefit of rear autobrake

Benefit of rear autobrake

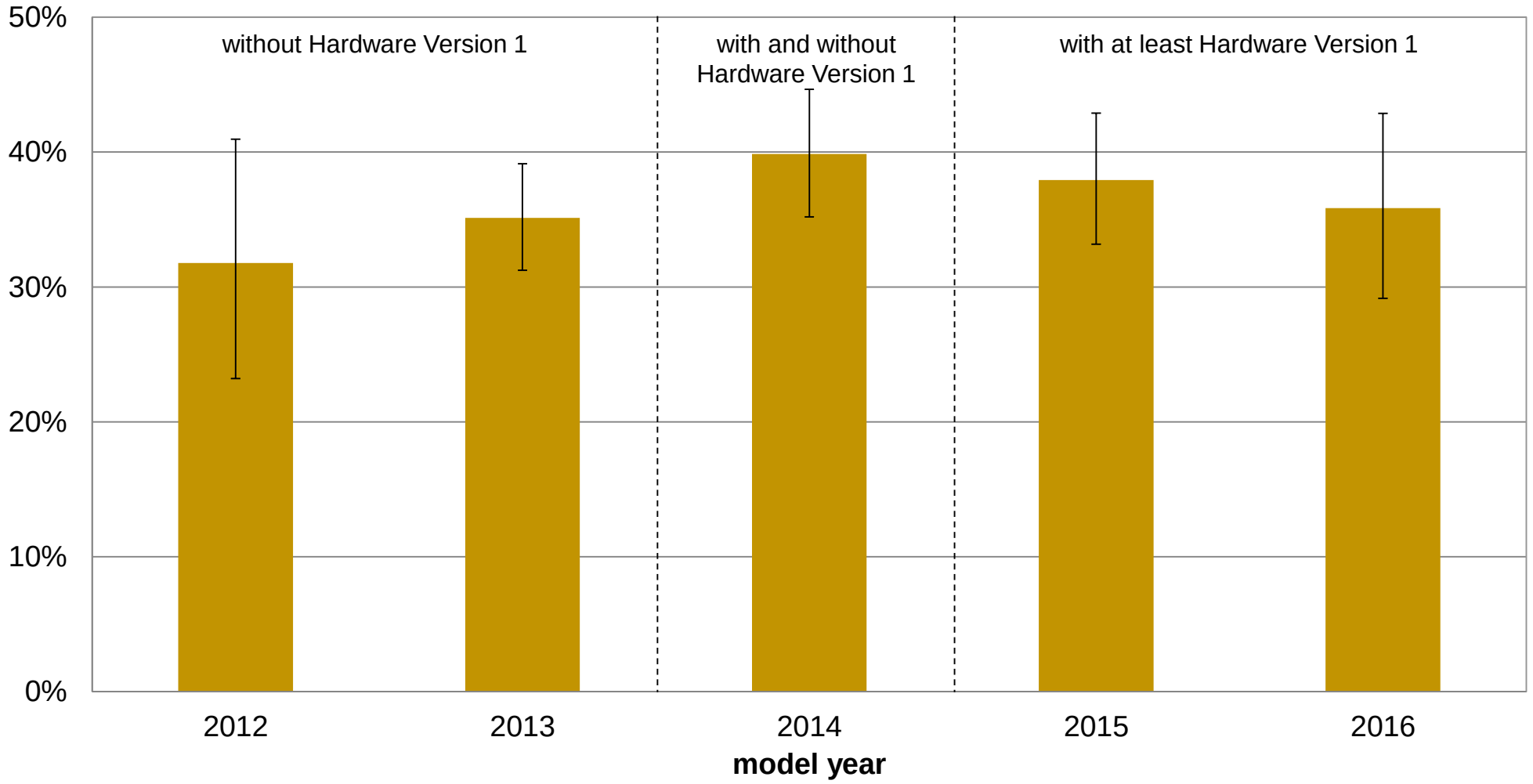
Tesla Model S driver assistance technologies

Tesla timeline



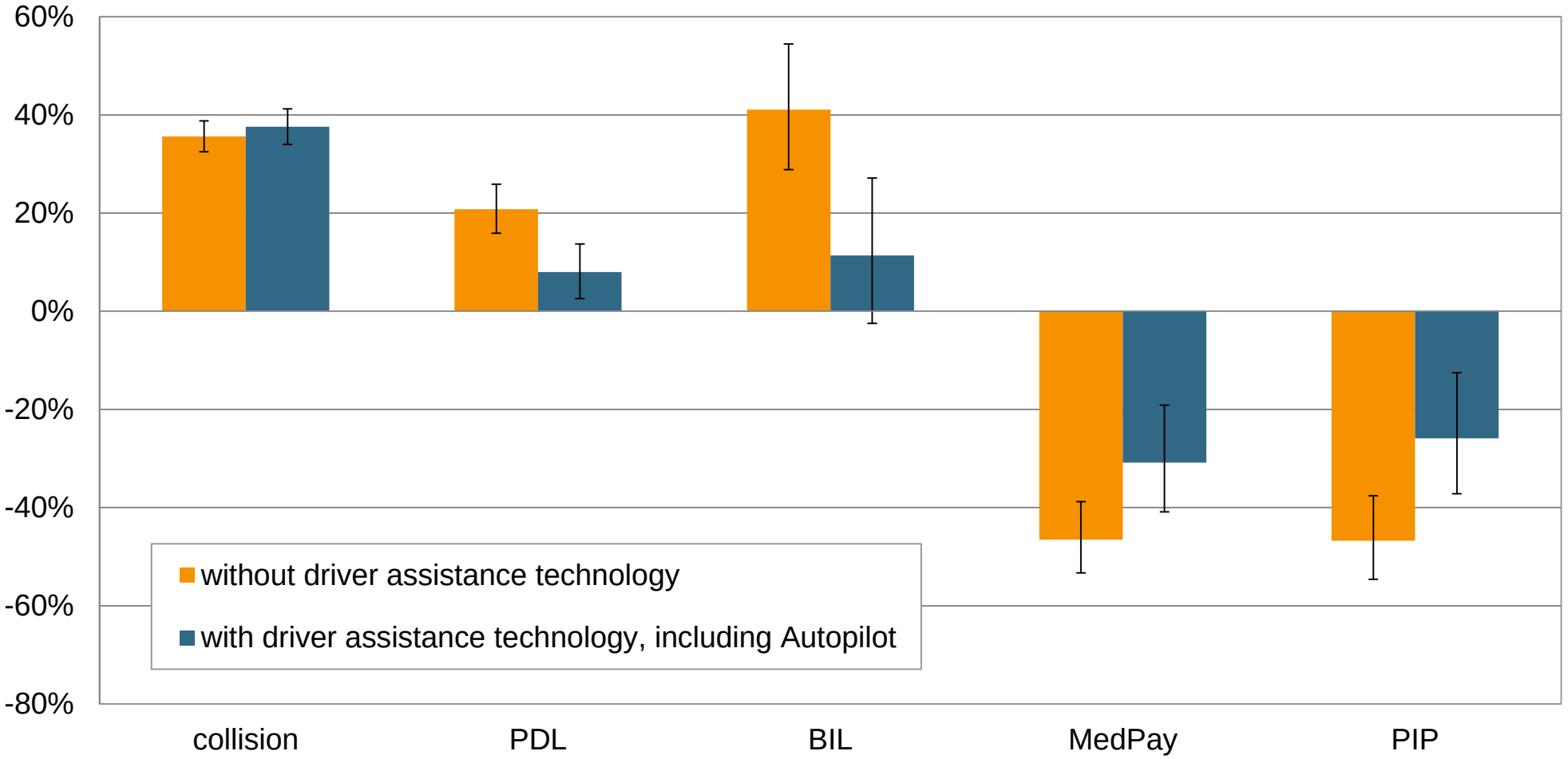
Tesla Model S versus large luxury vehicles

Collision claim frequency, by model year



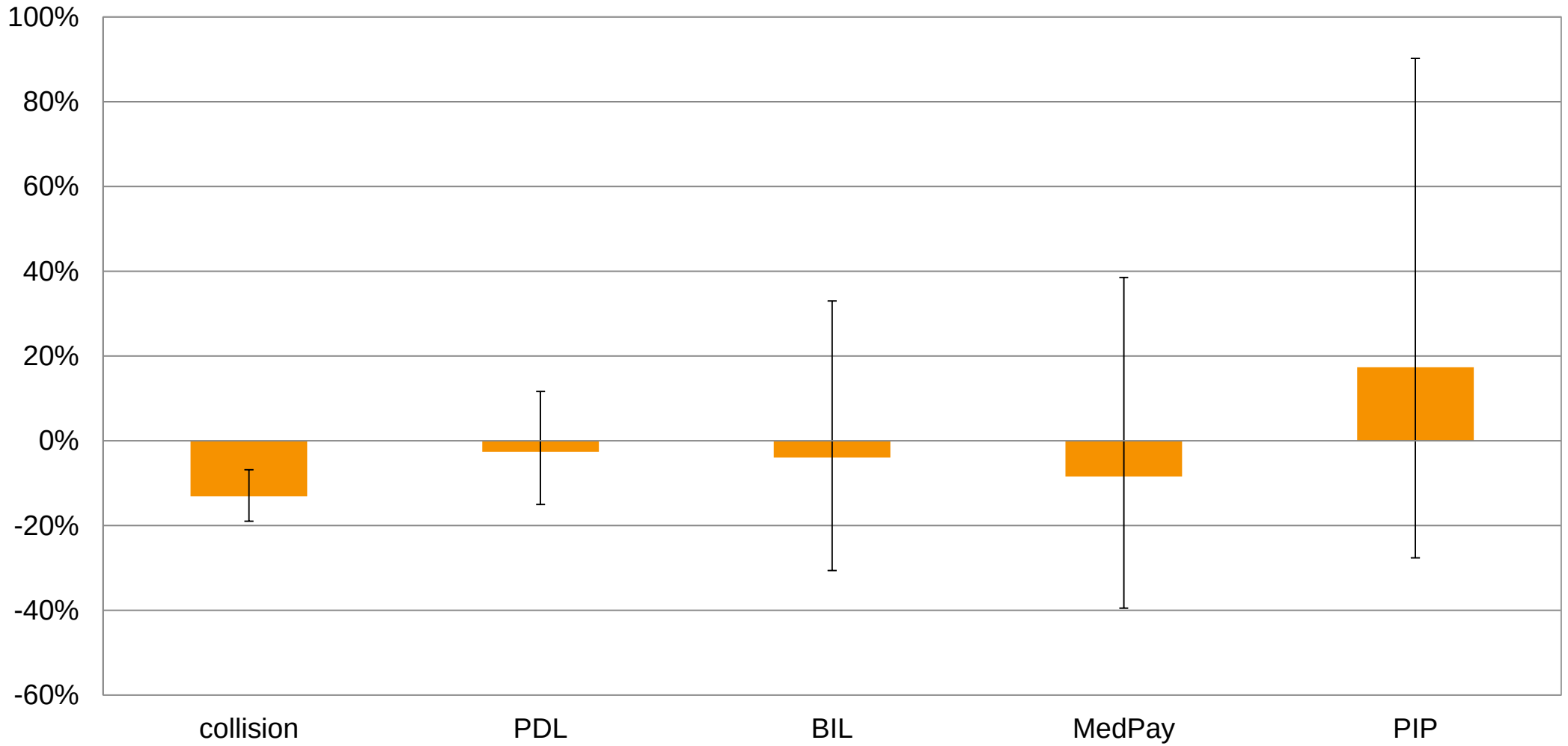
Tesla Model S claim frequencies with and without driver assistance technology versus large luxury vehicles

Effect of driver assistance technology, including Autopilot



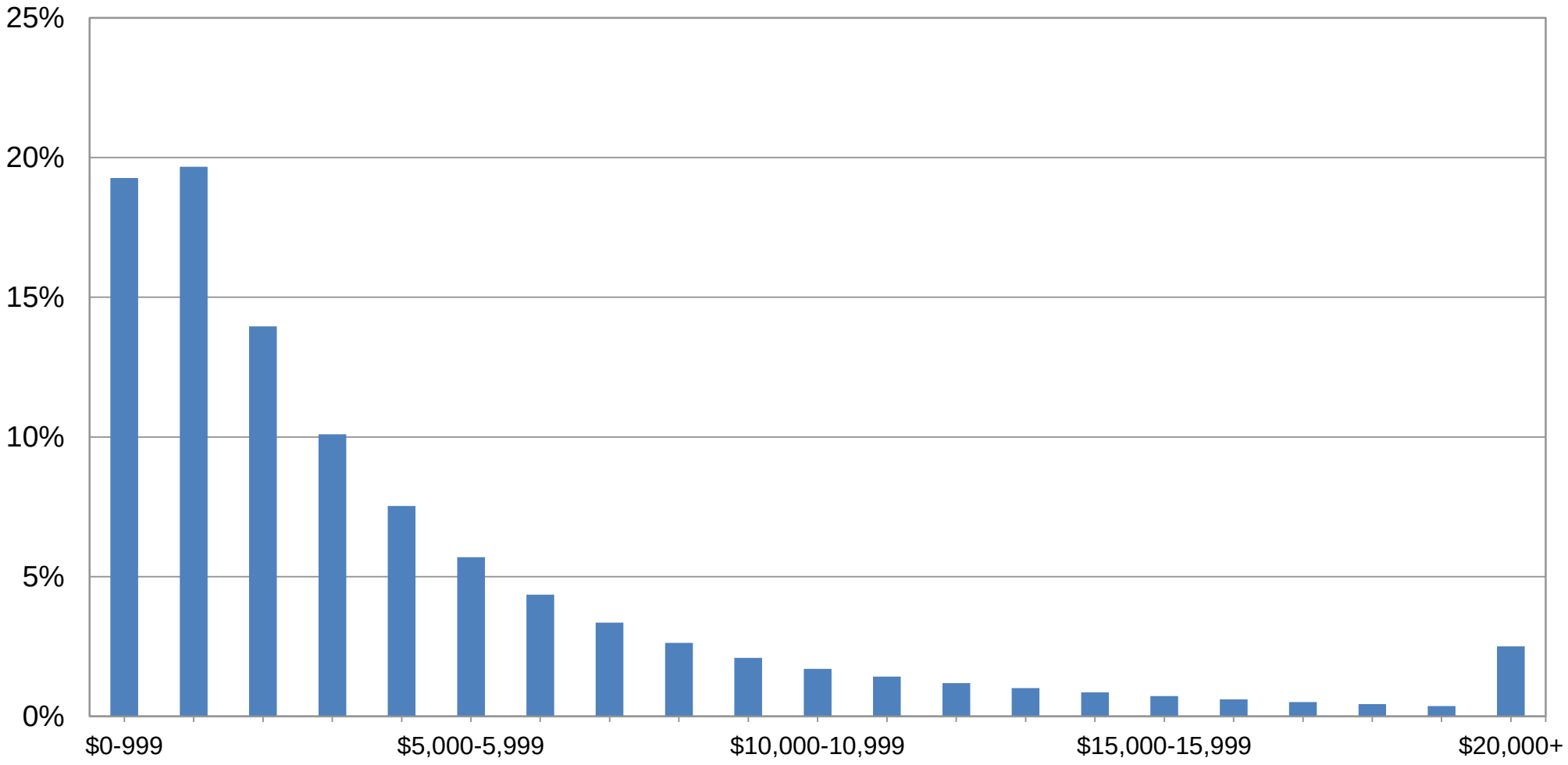
Estimated effect of Tesla Model S Autopilot on claim frequency

Driver assistance technology plus Autopilot vs. early driver assistance technology alone



Distribution of collision claims, 2016 calendar year

By claim size, 1981-2017 models



Level 2 automation

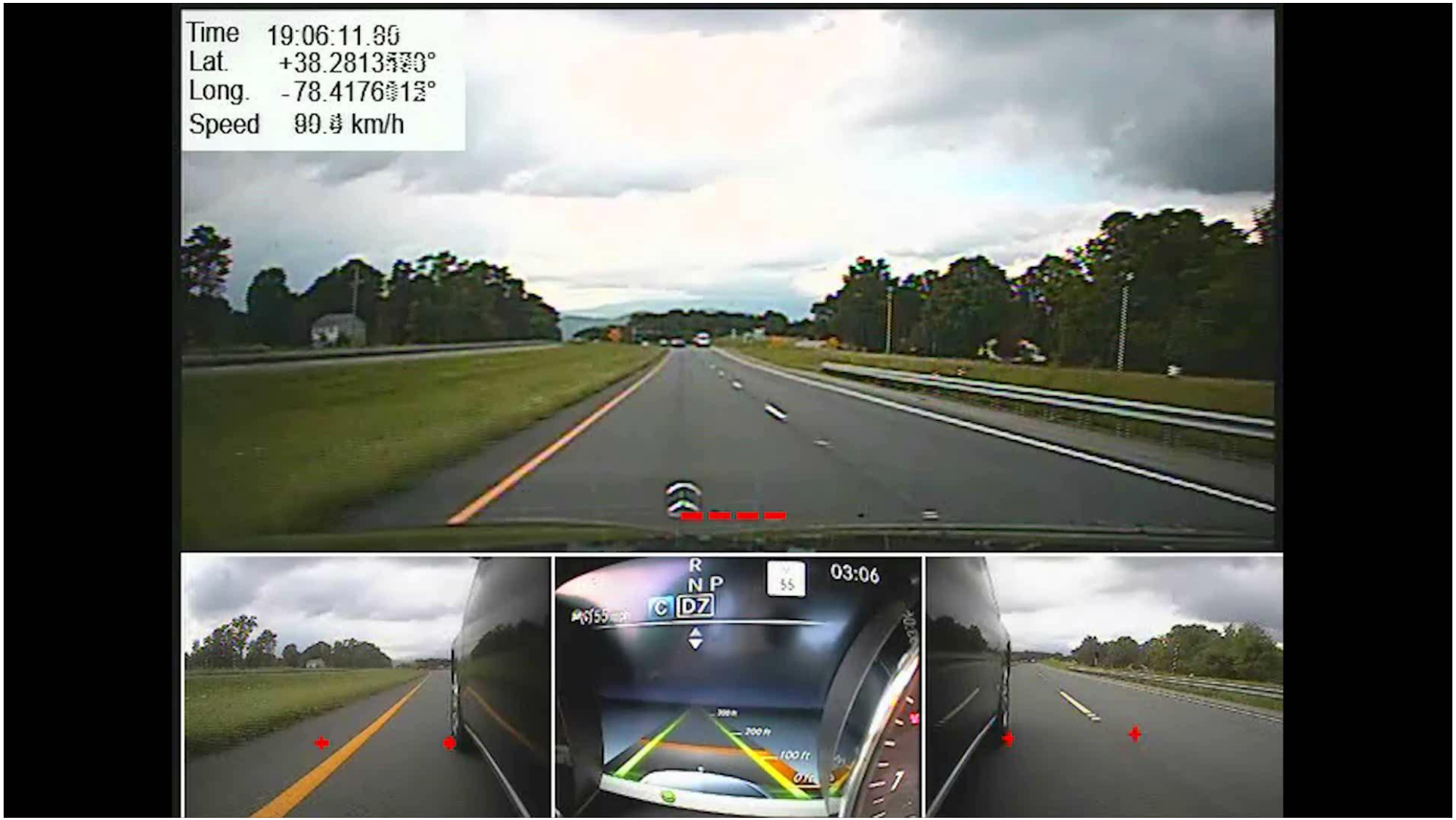
Lane keeping on hills

On-road testing – Tesla Model S

Tesla “Autopilot” – IIHS examples

Problems: stopped lead vehicle

On-road testing – Mercedes-Benz E-Class



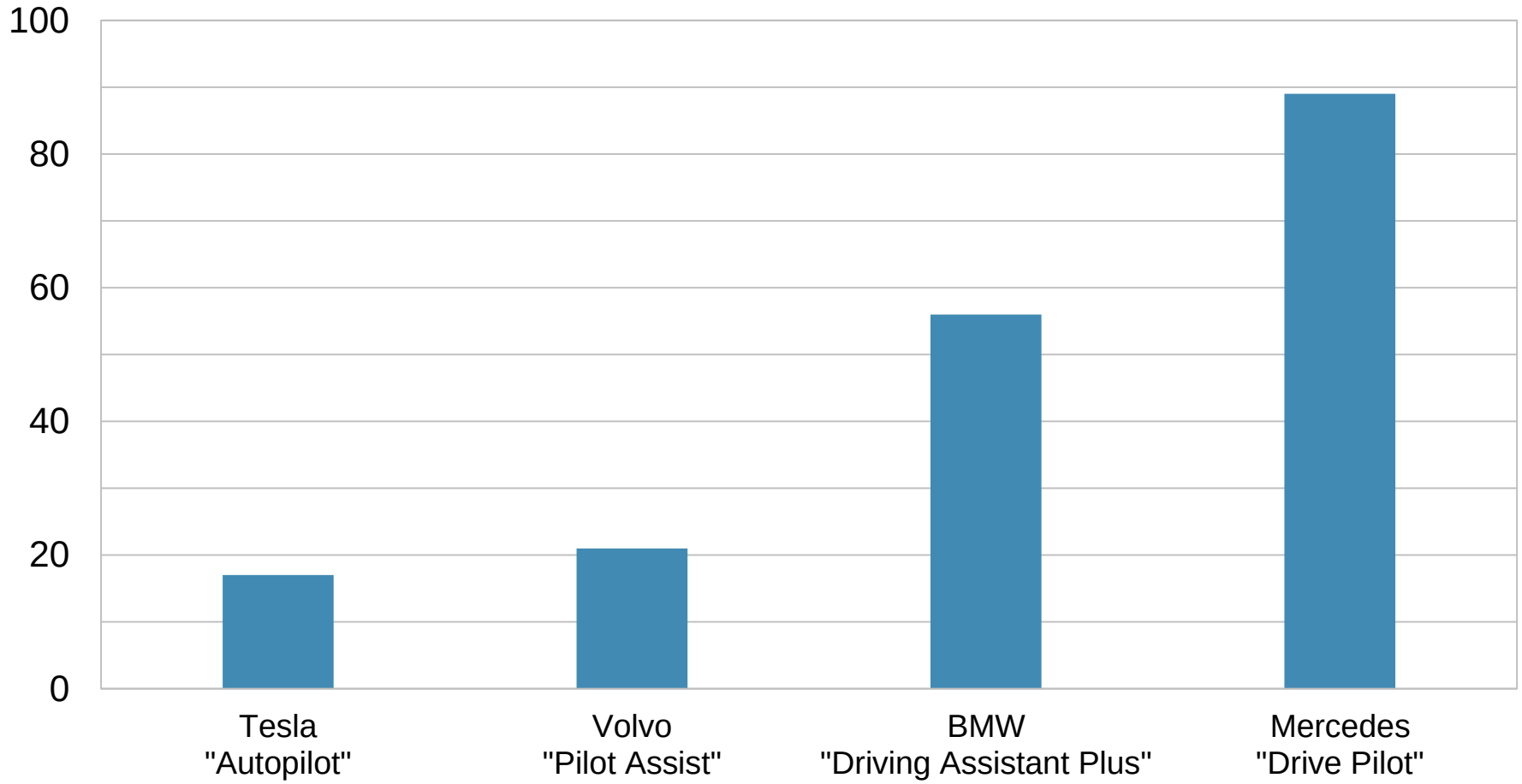
Problems: turn lanes

On-road testing – Mercedes-Benz E-Class

Experiences with driving automation

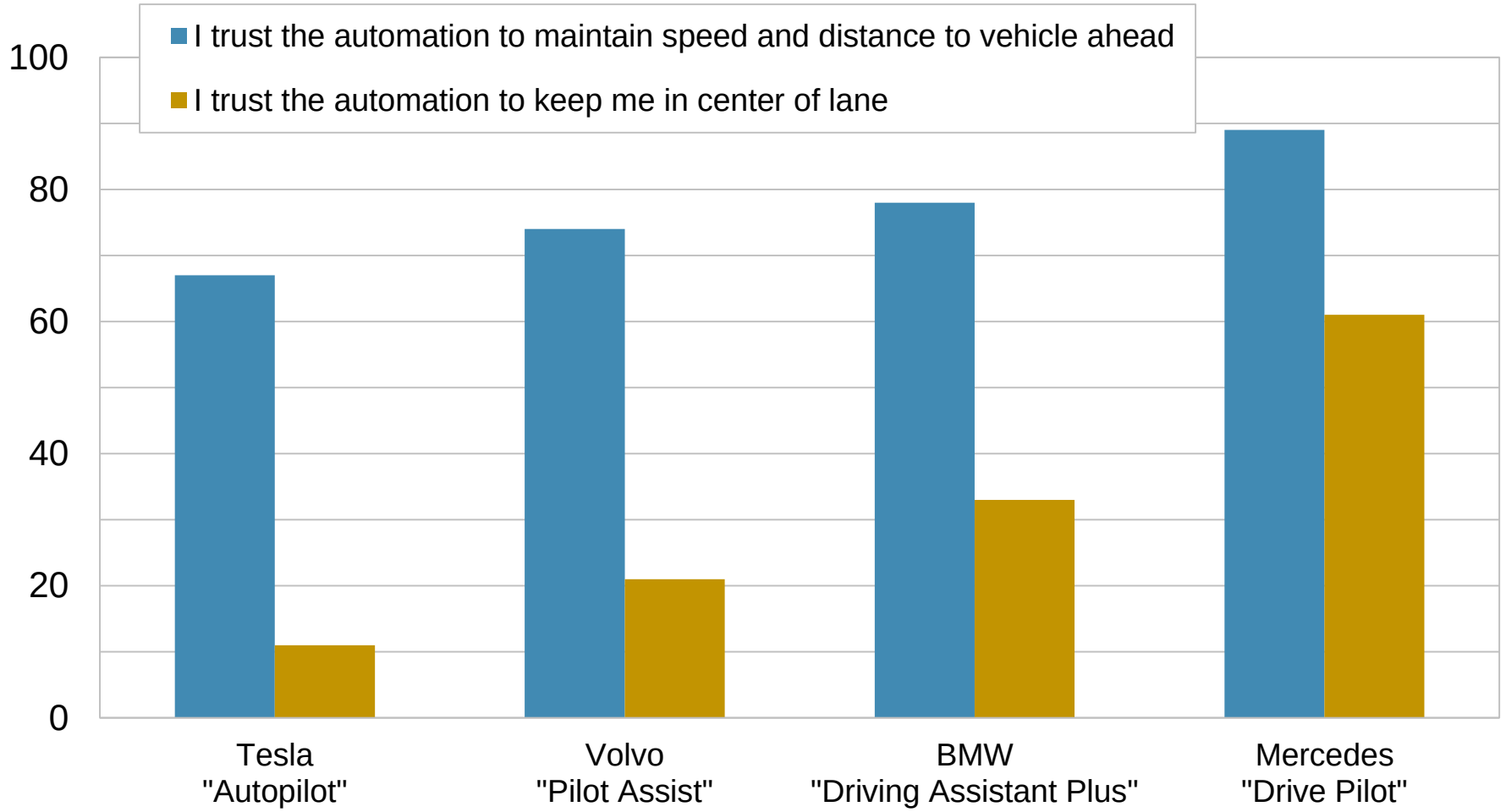
The automation made smooth, gentle steering corrections

Percentage of drivers who agreed or strongly agreed

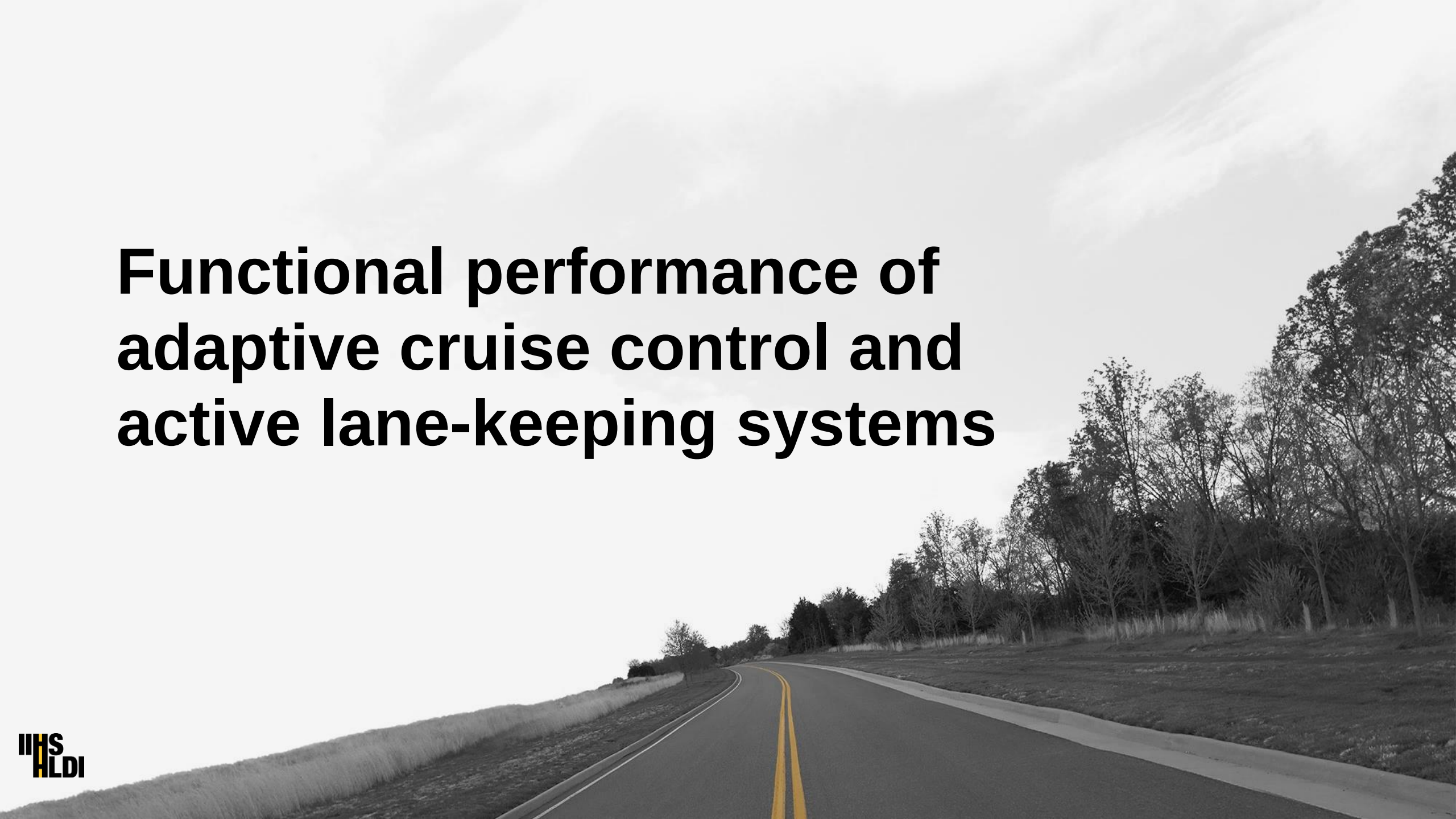


Adaptive cruise control trusted more than active lane keeping

Percentage of drivers who agreed or strongly agreed



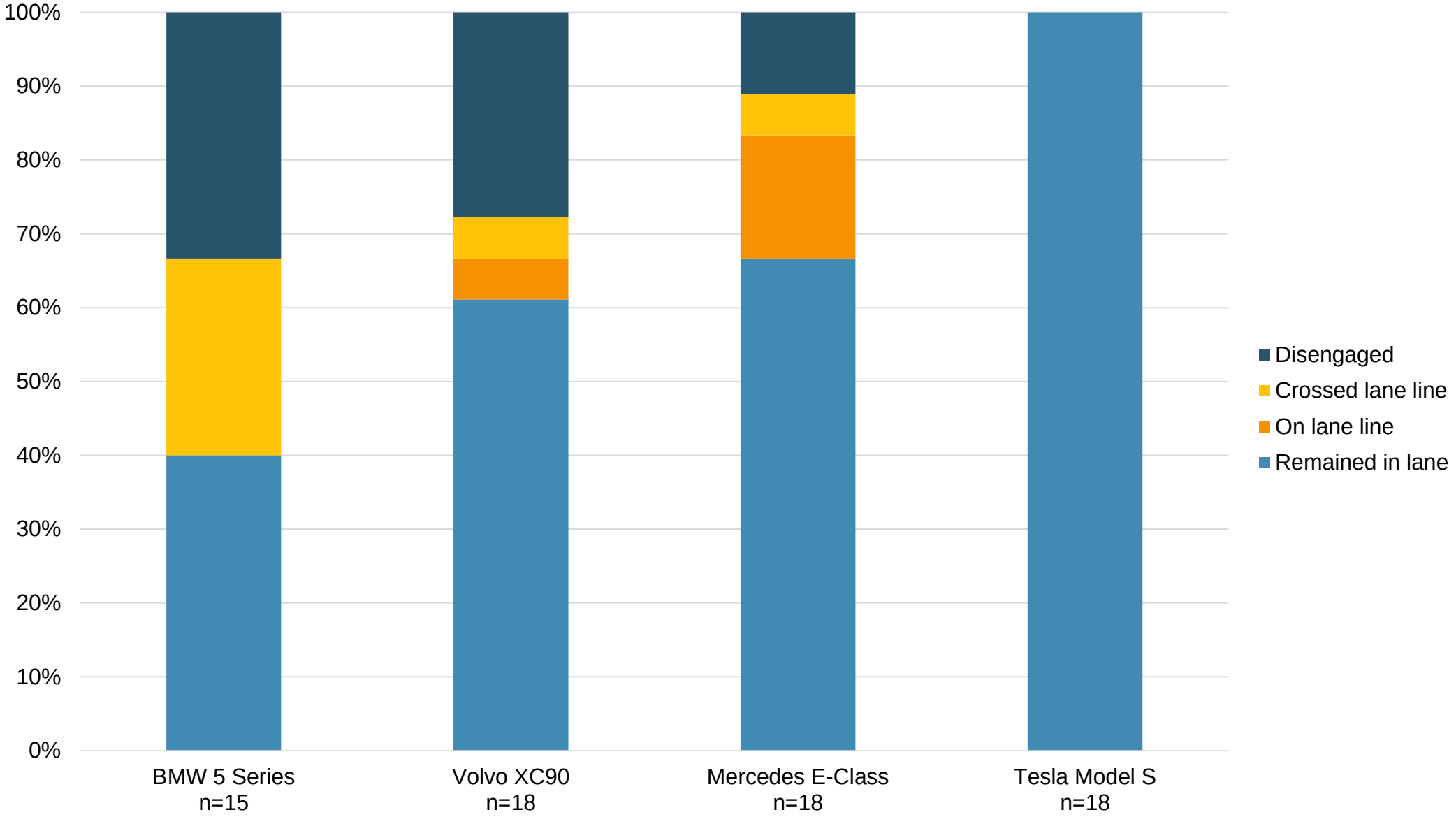
Functional performance of adaptive cruise control and active lane-keeping systems



Lane keeping in curves - Tesla

Lane keeping in curves - BMW

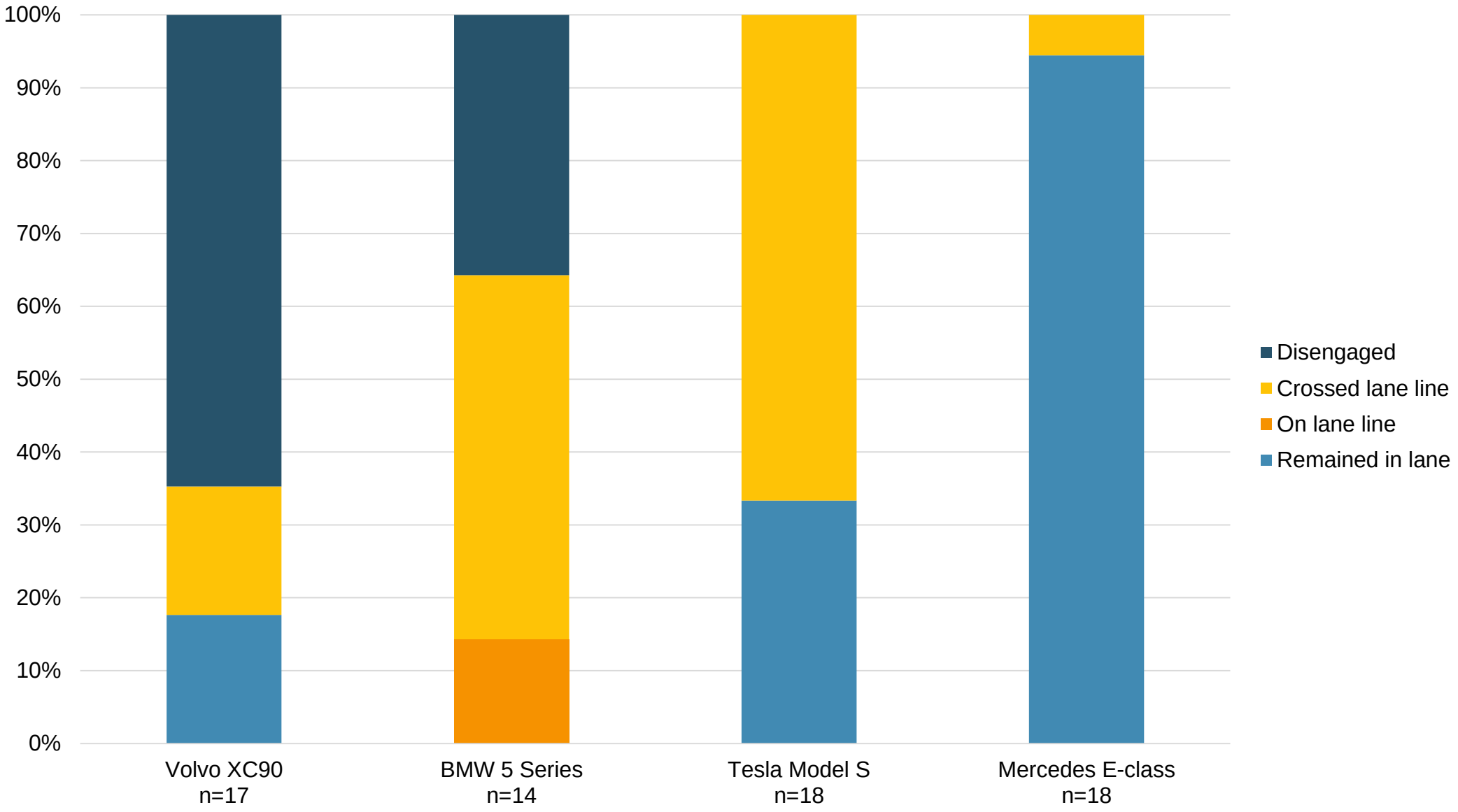
Lane keeping in curves



Lane keeping on hills - Mercedes

Lane keeping on hills - Volvo

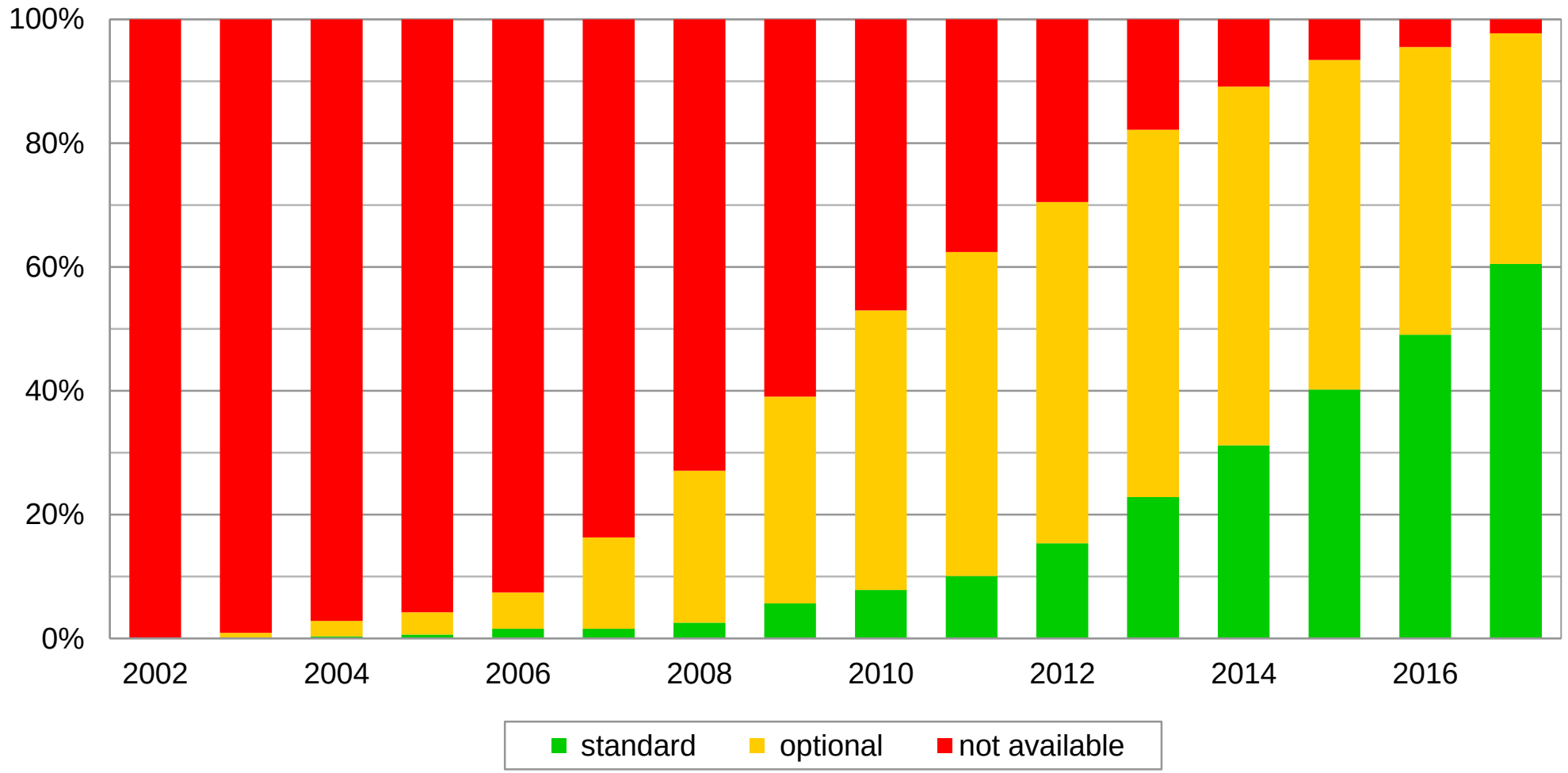
Lane keeping on hills



Phase in of collision avoidance systems

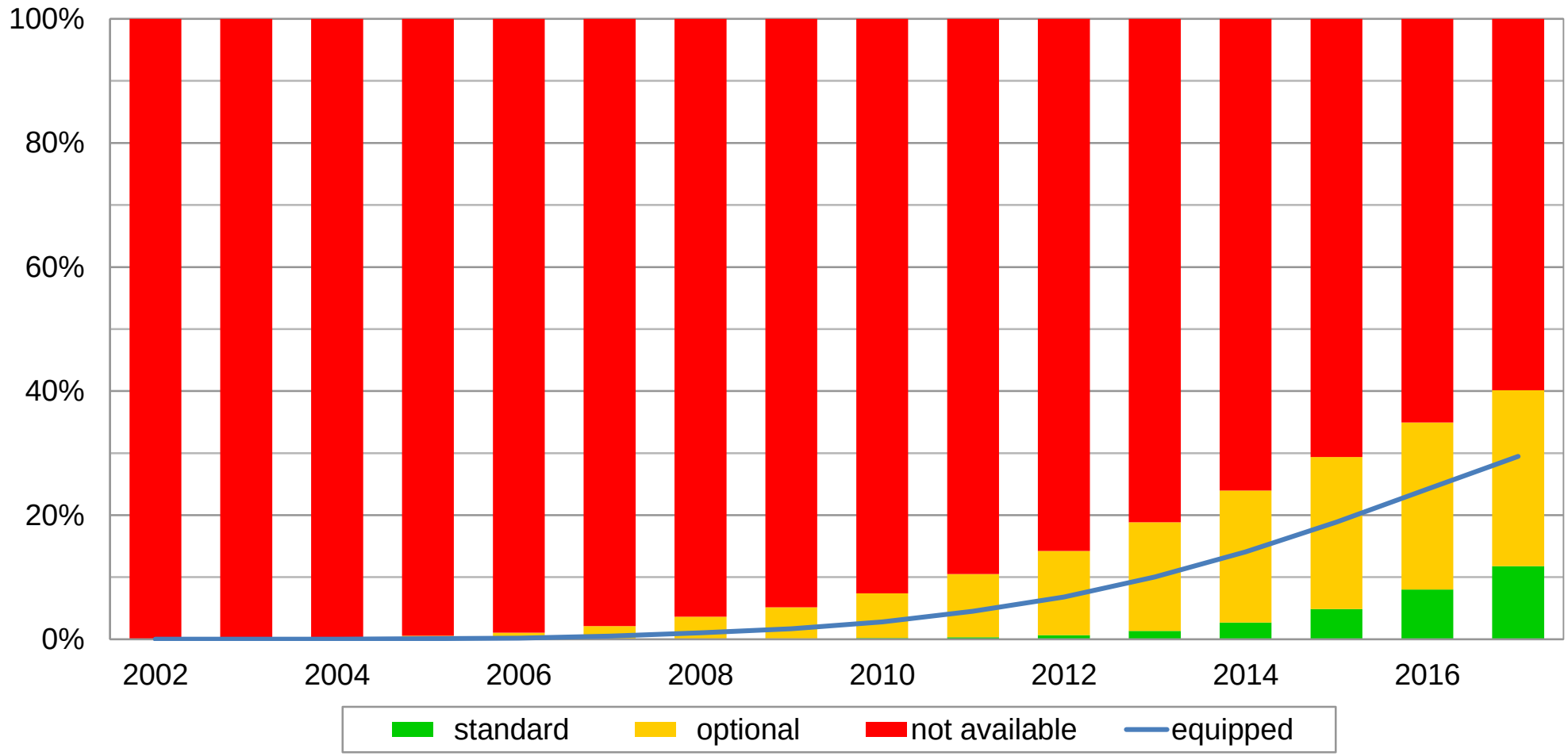
New vehicle series with rear camera

By model year



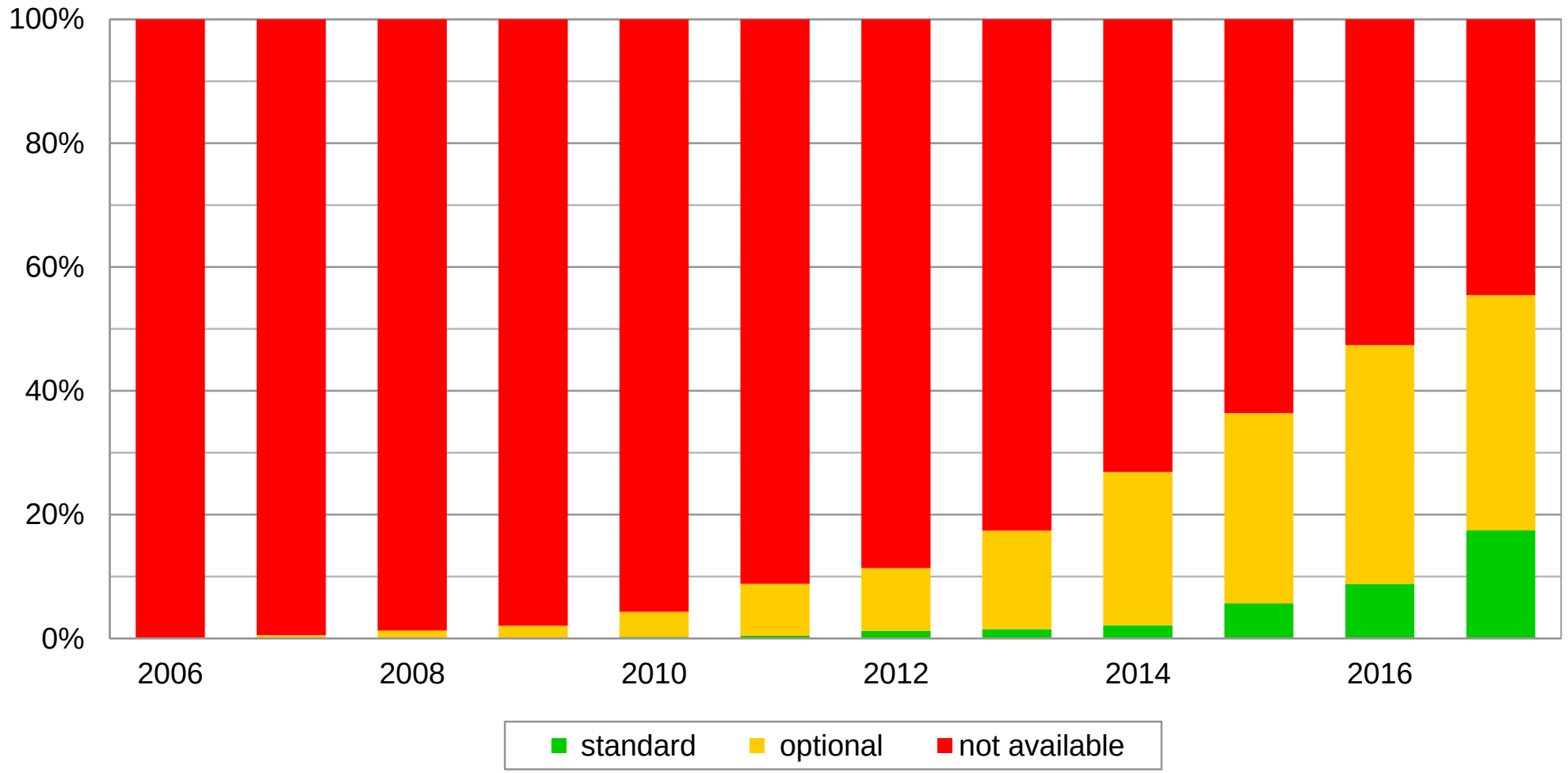
Registered vehicles with rear camera

By calendar year



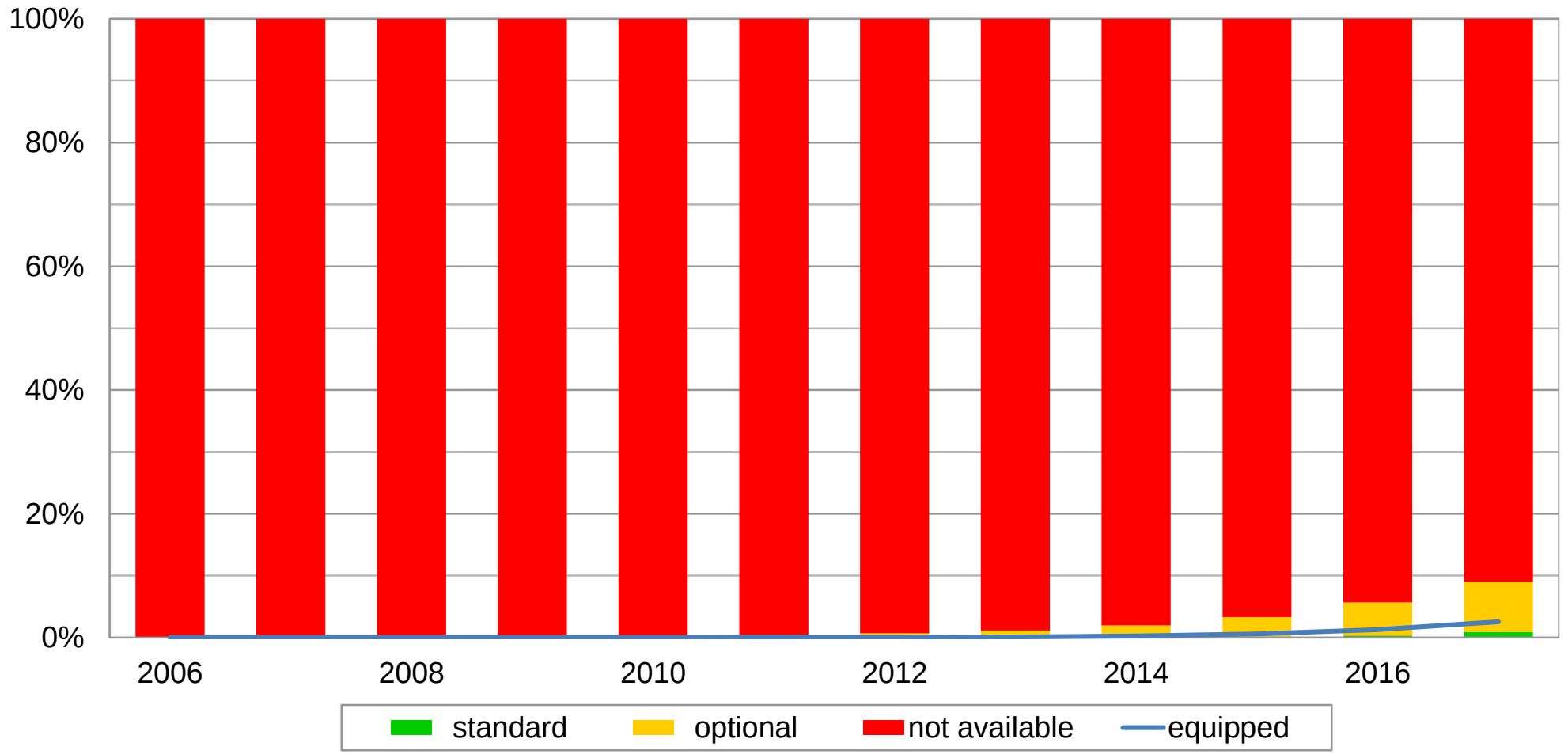
New vehicle series with autonomous emergency braking

By model year



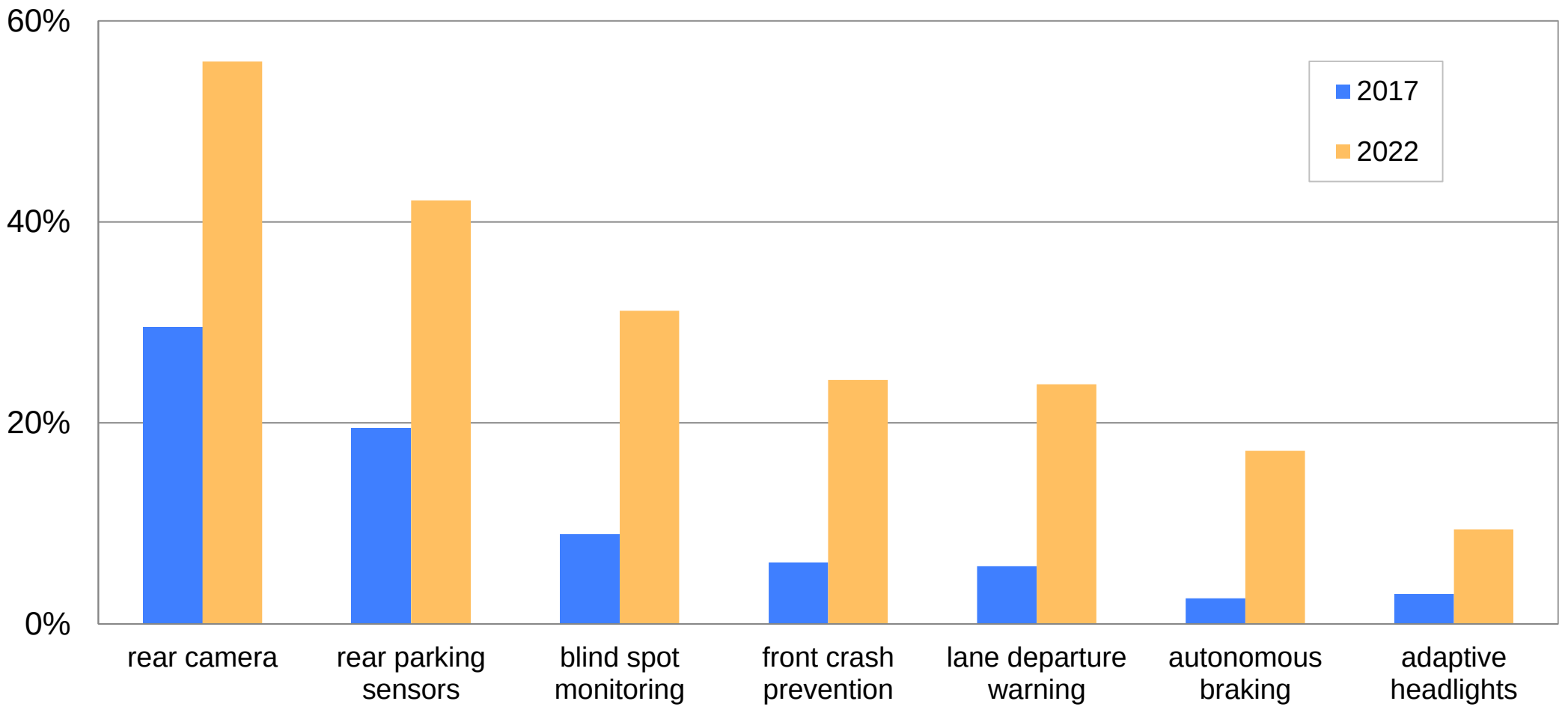
Registered vehicles with autonomous emergency braking

By calendar year



Estimated registered vehicles by feature

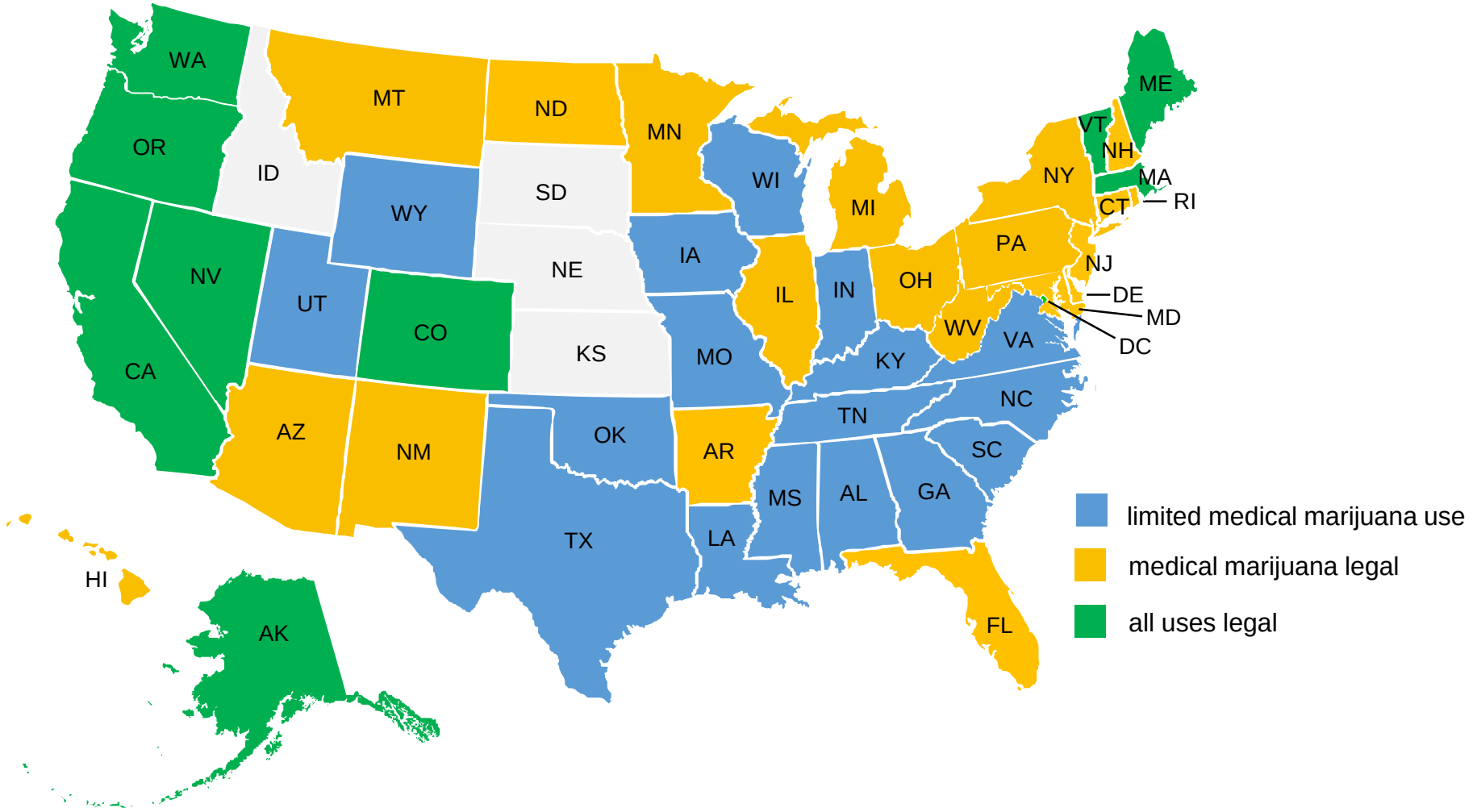
Calendar years 2017 and 2022



HLDI analysis of marijuana legalization

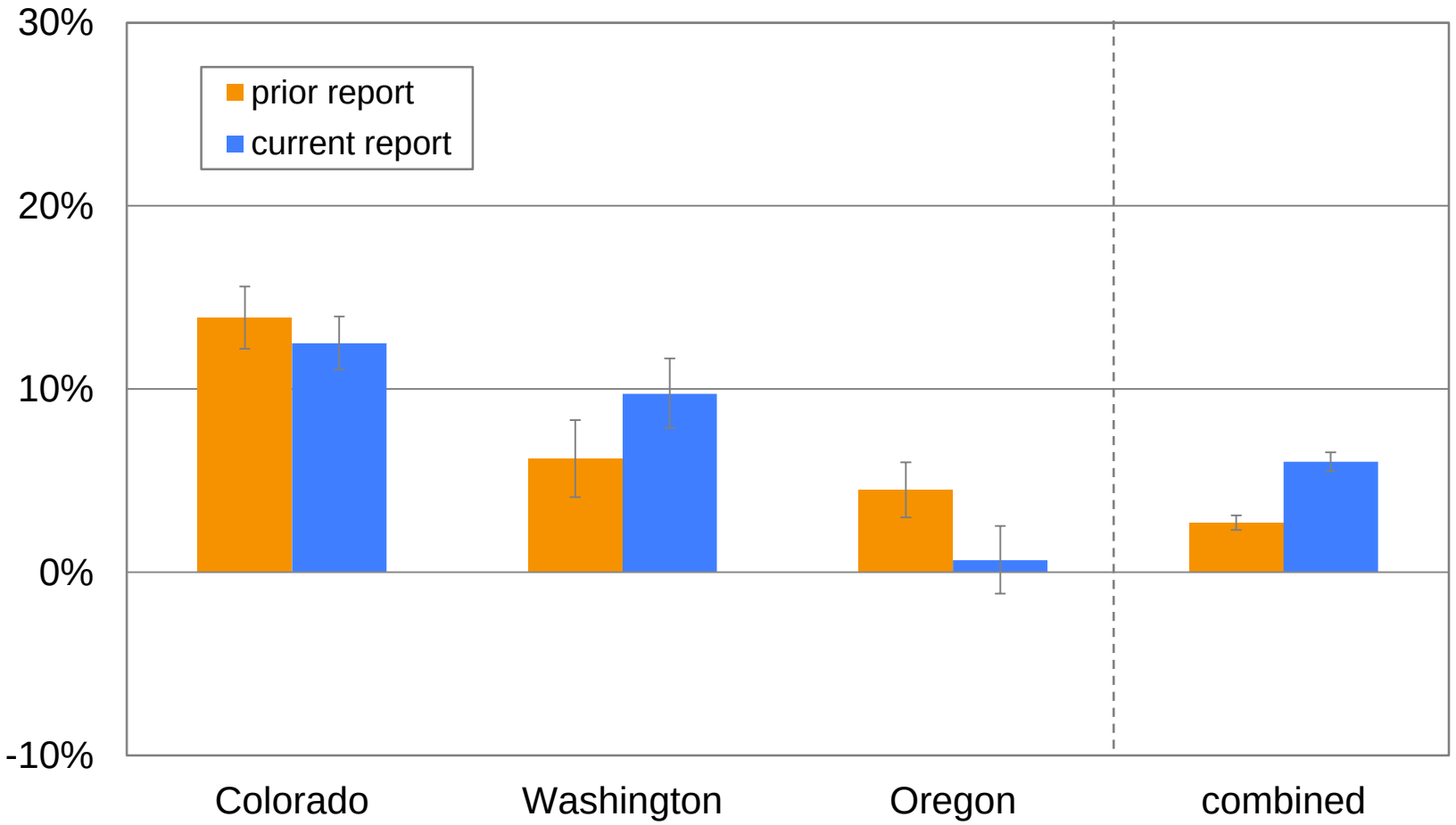
Laws legalizing some uses of marijuana

March 2018



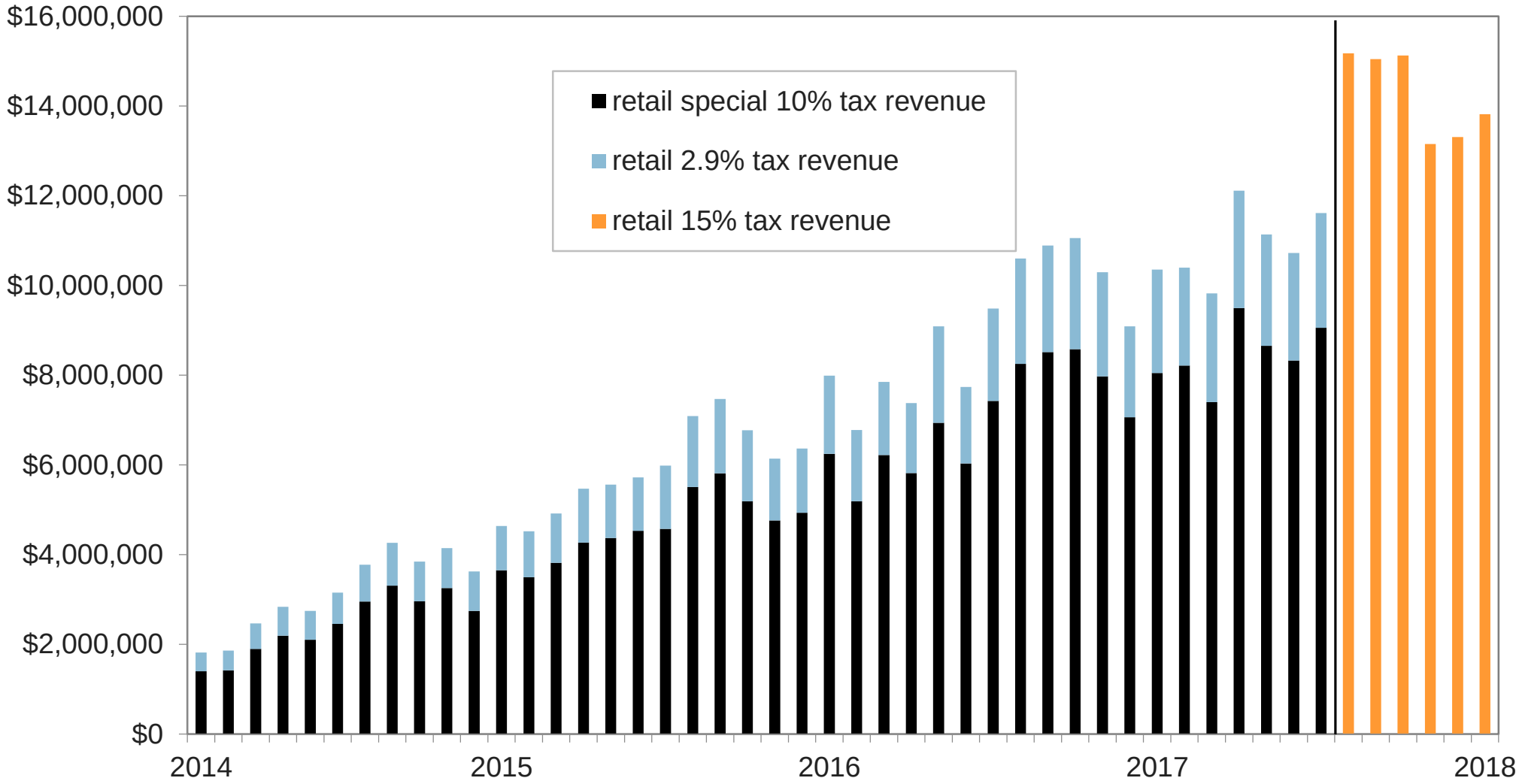
Estimated effect of marijuana sales

Collision claim frequencies for vehicles up to 33 years old
Calendar years 2012–17



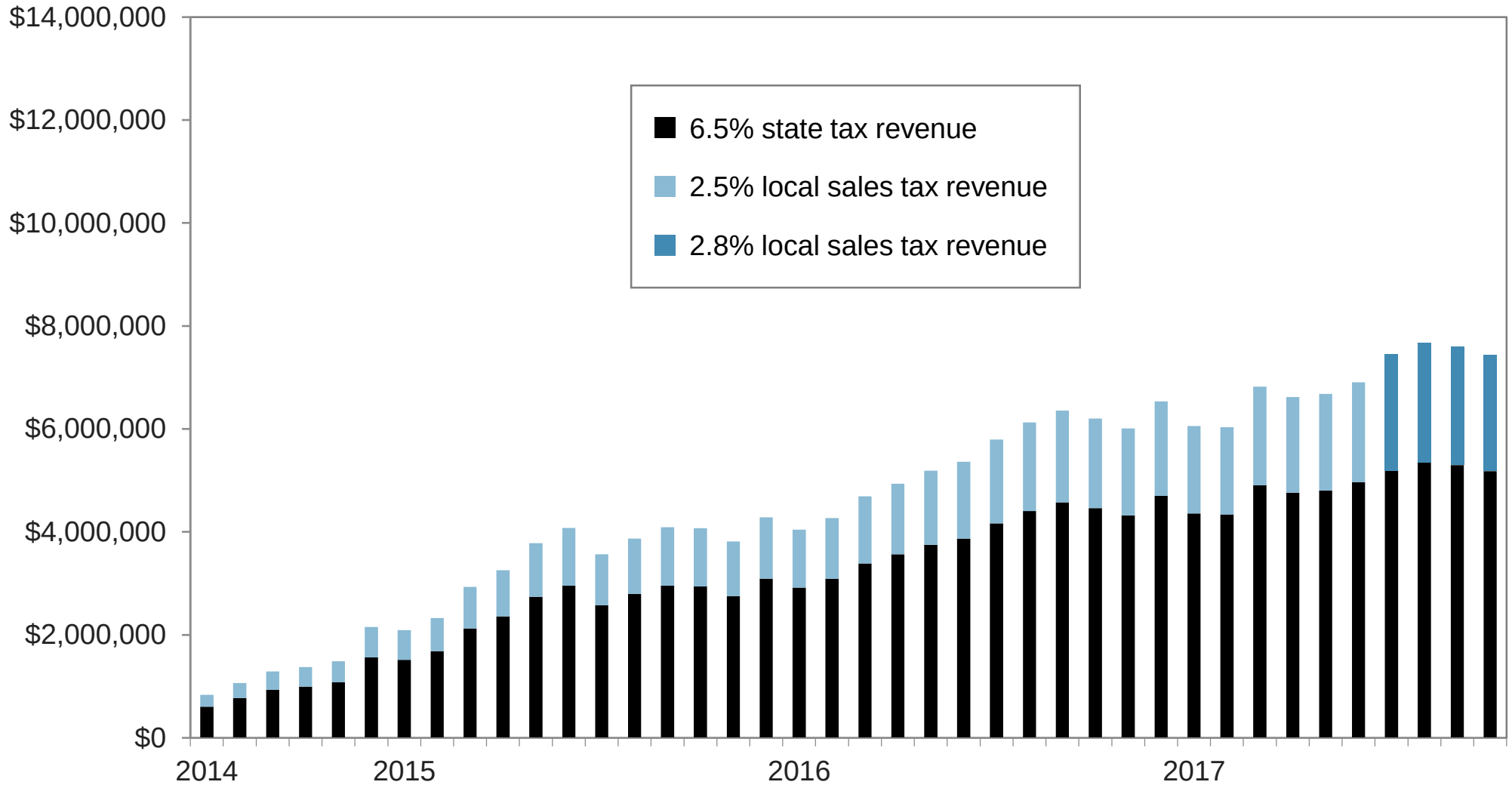
Colorado marijuana retail tax revenue

February 2014–January 2018



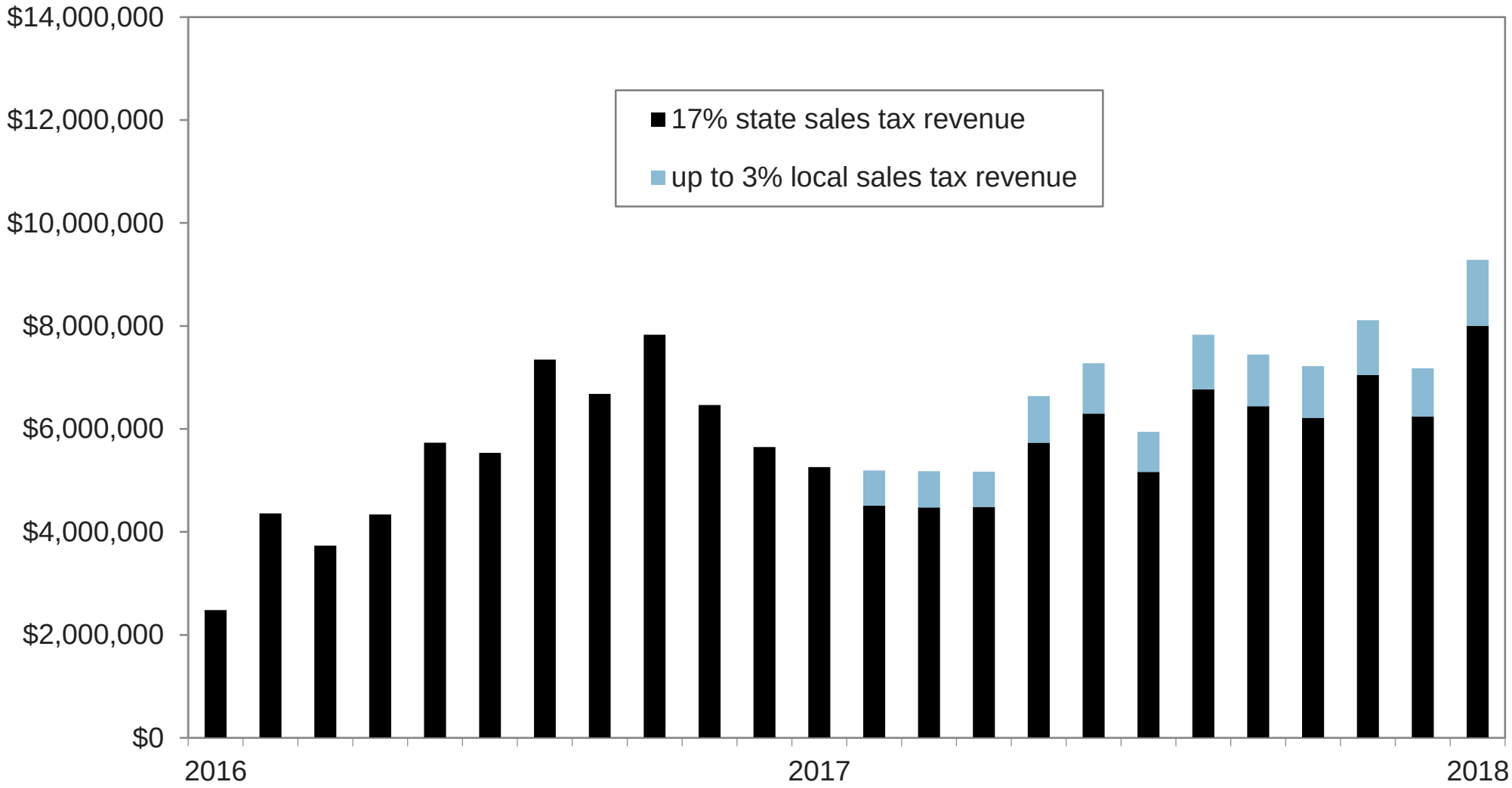
Washington marijuana retail tax revenue

July 2014–October 2017



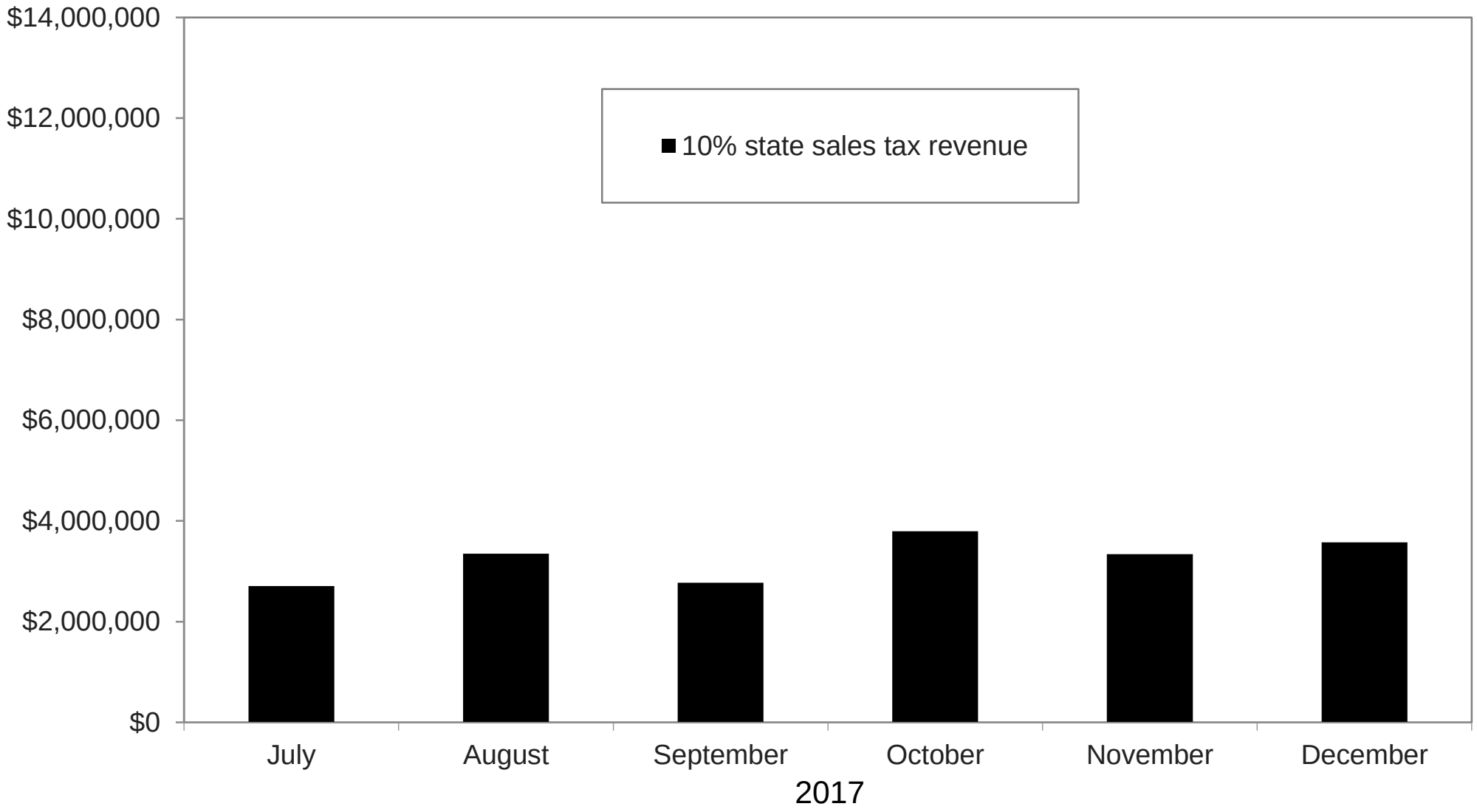
Oregon marijuana retail tax revenue

February 2016–January 2018



Nevada marijuana retail tax revenue

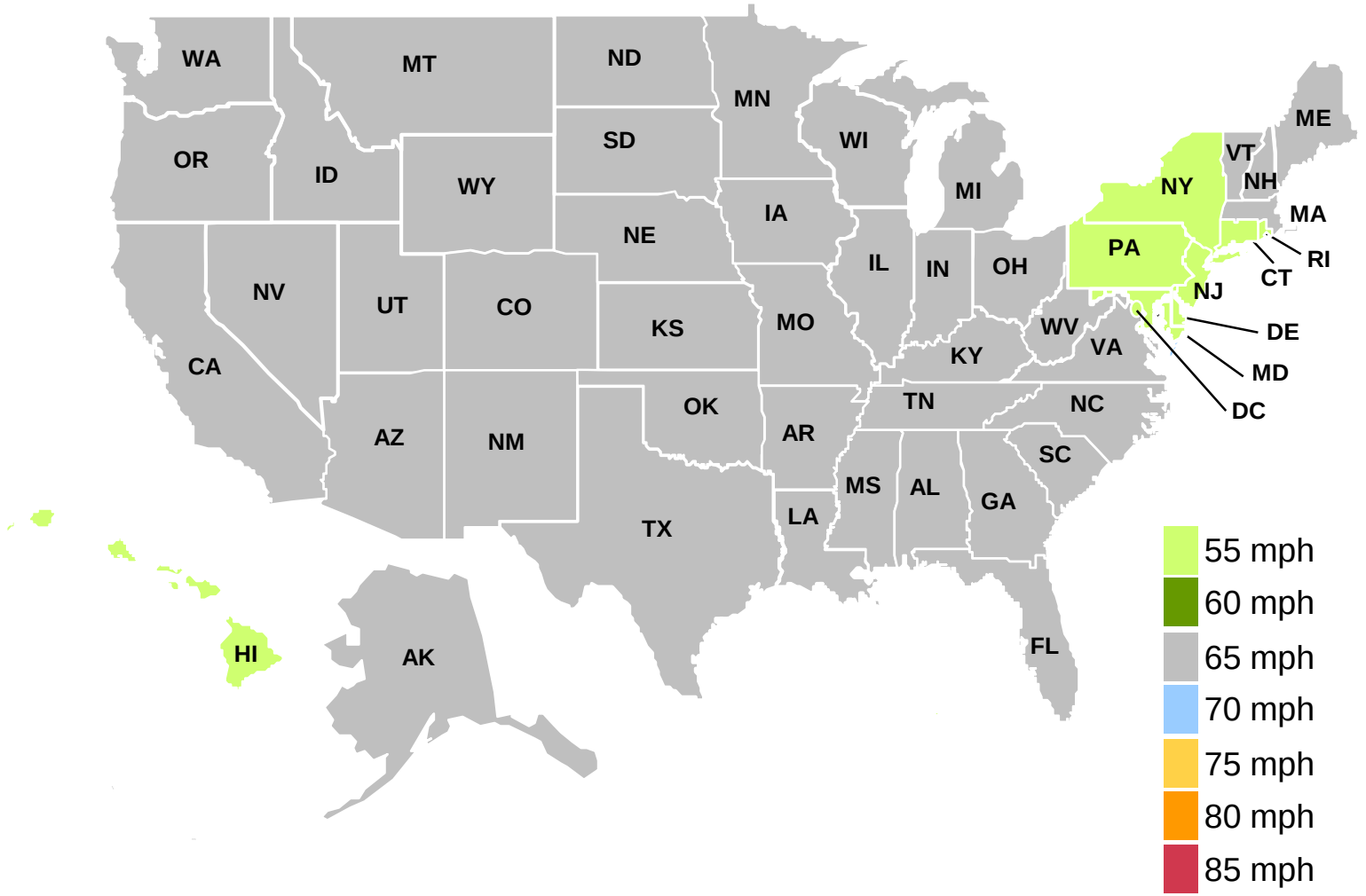
July 2017–December 2017



Speed limits and traffic fatalities

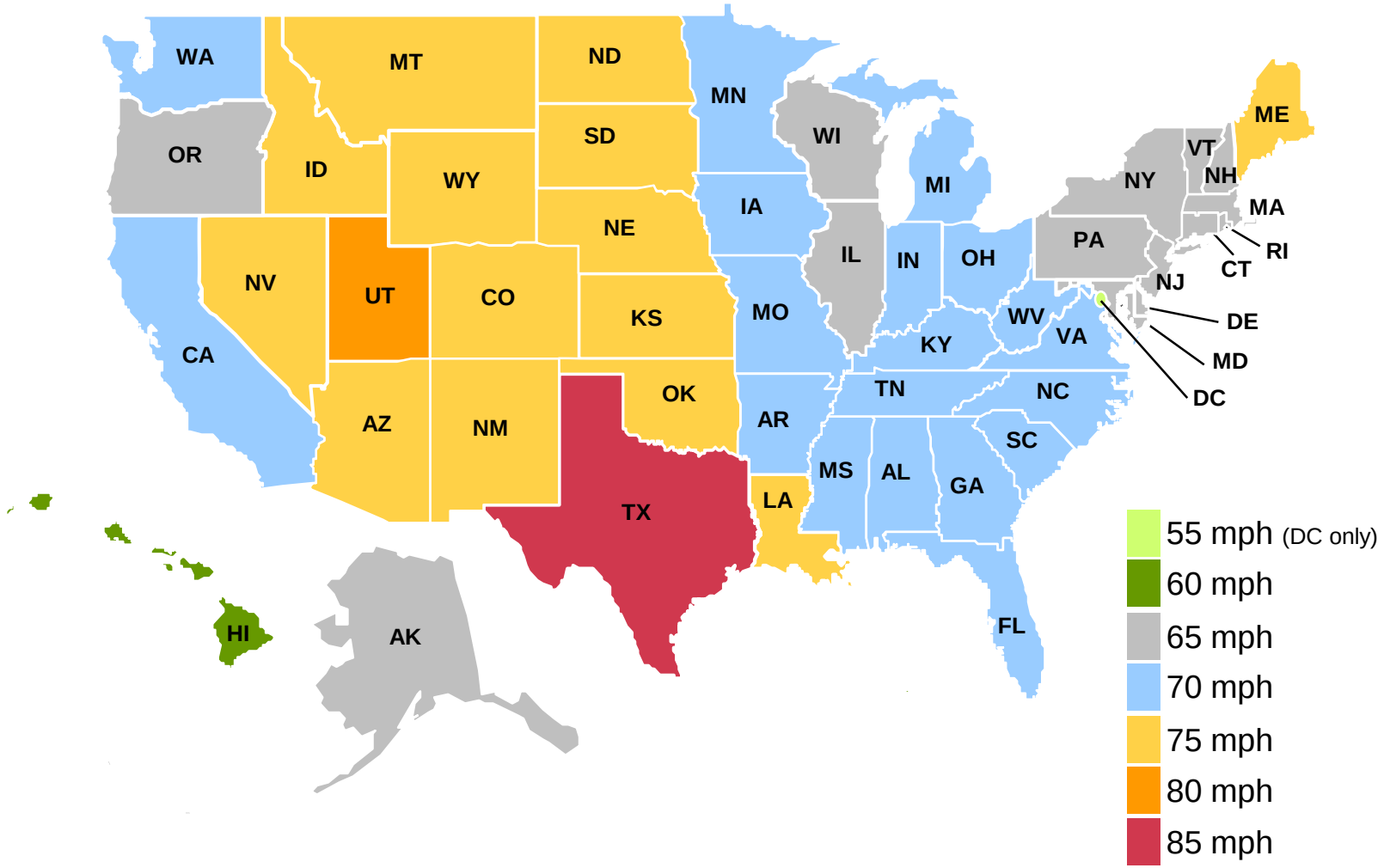
Maximum speed limits

January 1993



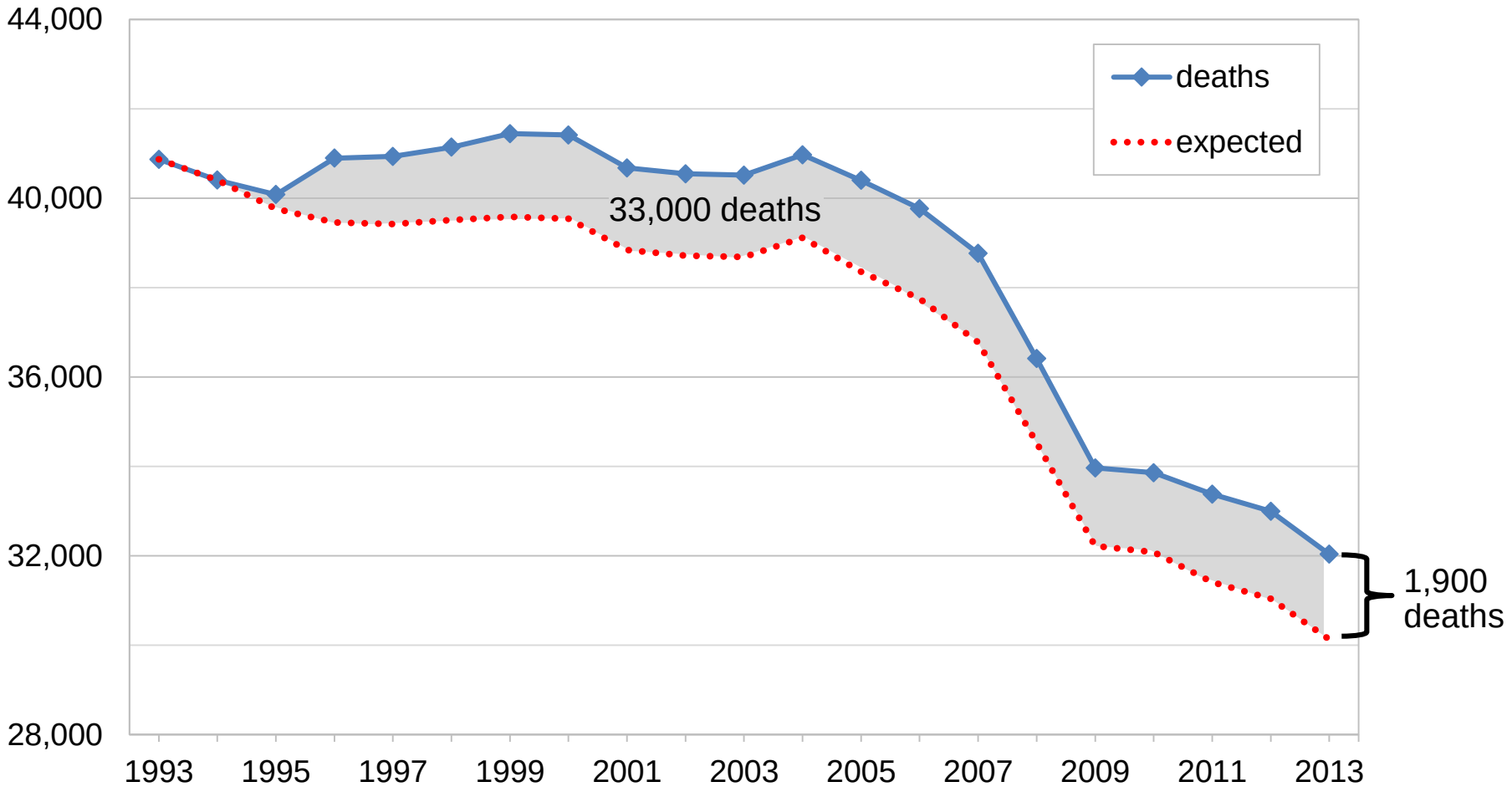
Maximum speed limits

January 2013



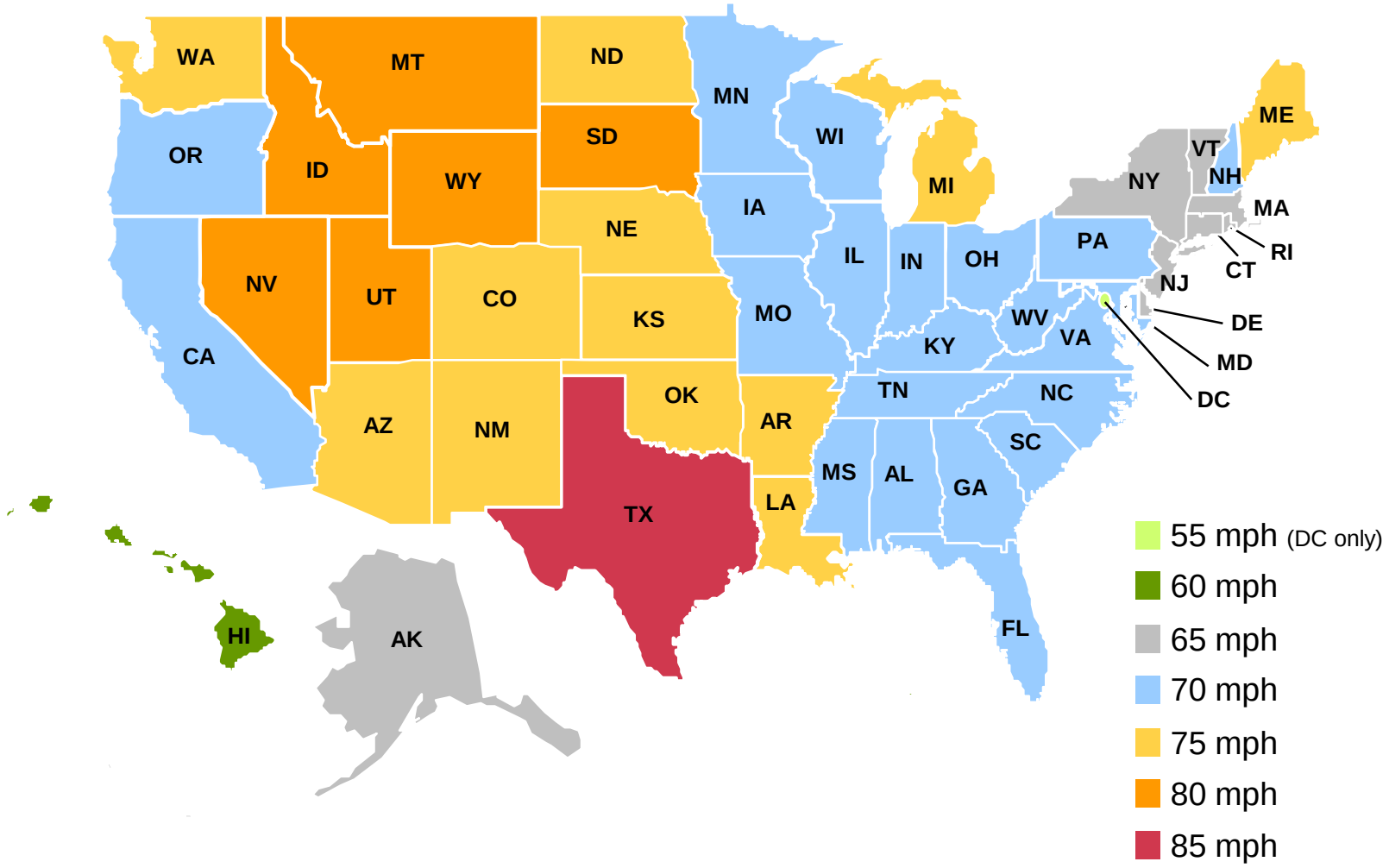
Deaths and expected deaths if maximum speed limits had not increased

1993-2013



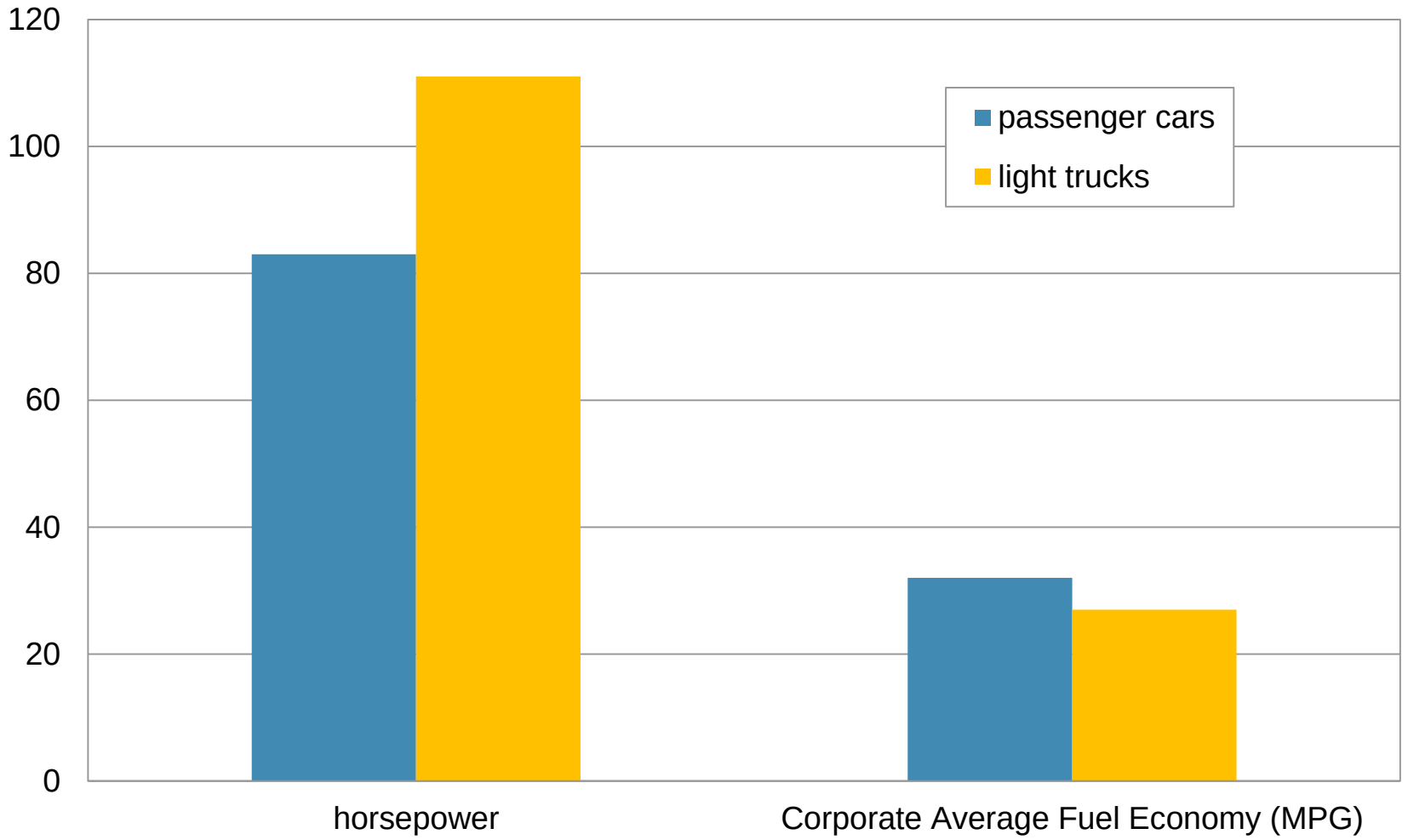
Maximum speed limits

June 2017



Percent change in mean horsepower and fuel economy

1985-2014 models




Do not attempt. Professional driver on closed course.

Honda Accord

1981 Honda Accord
horsepower: 75
curb weight: 2,249 lbs.

3.3 horsepower per 100 lbs.

2015 Honda Accord base
horsepower: 185
curb weight: 3,254 lbs.

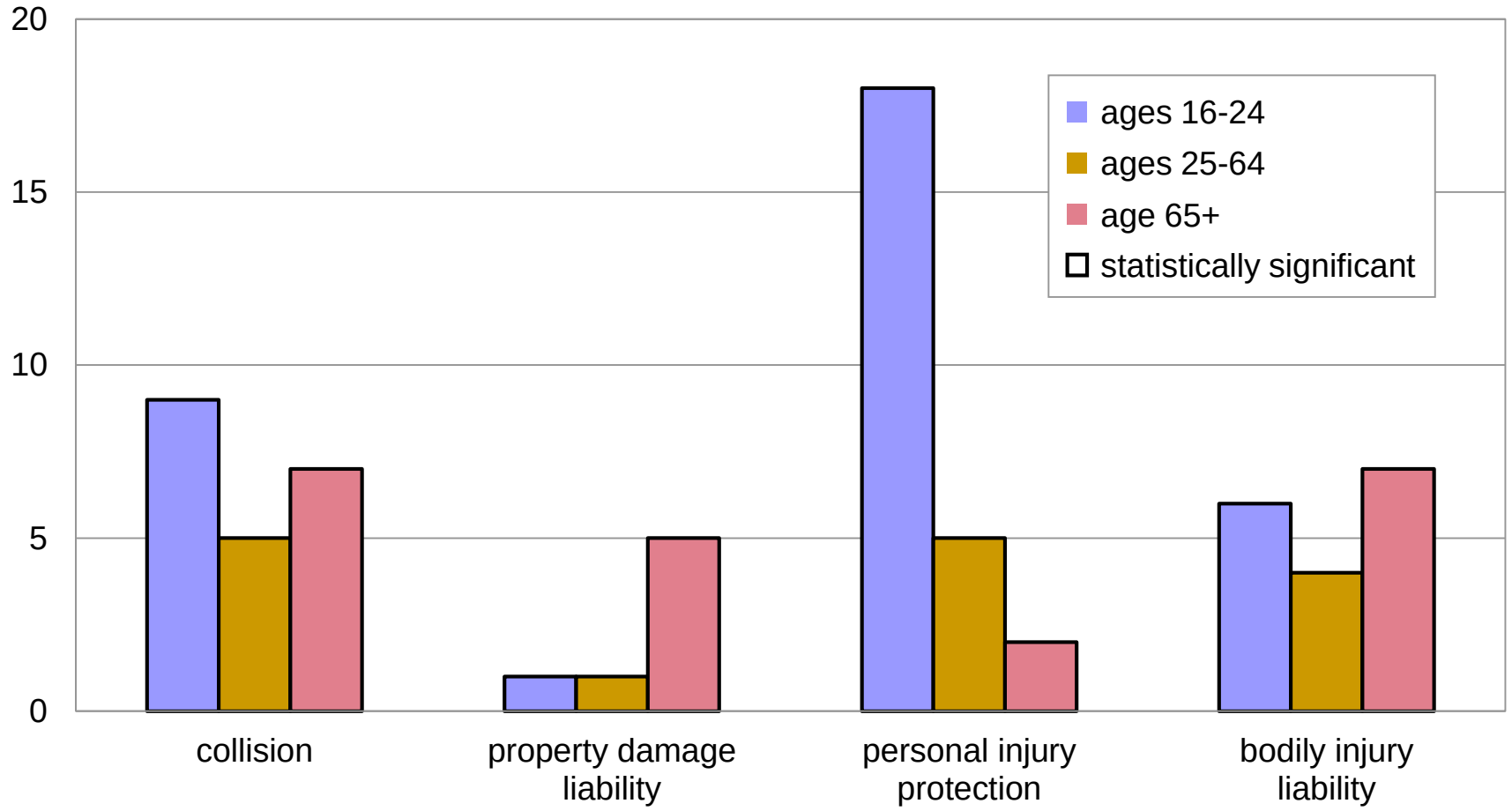
5.7 horsepower per 100 lbs.

2015 Honda Accord 6-cylinder
horsepower: 278
curb weight: 3,554 lbs.

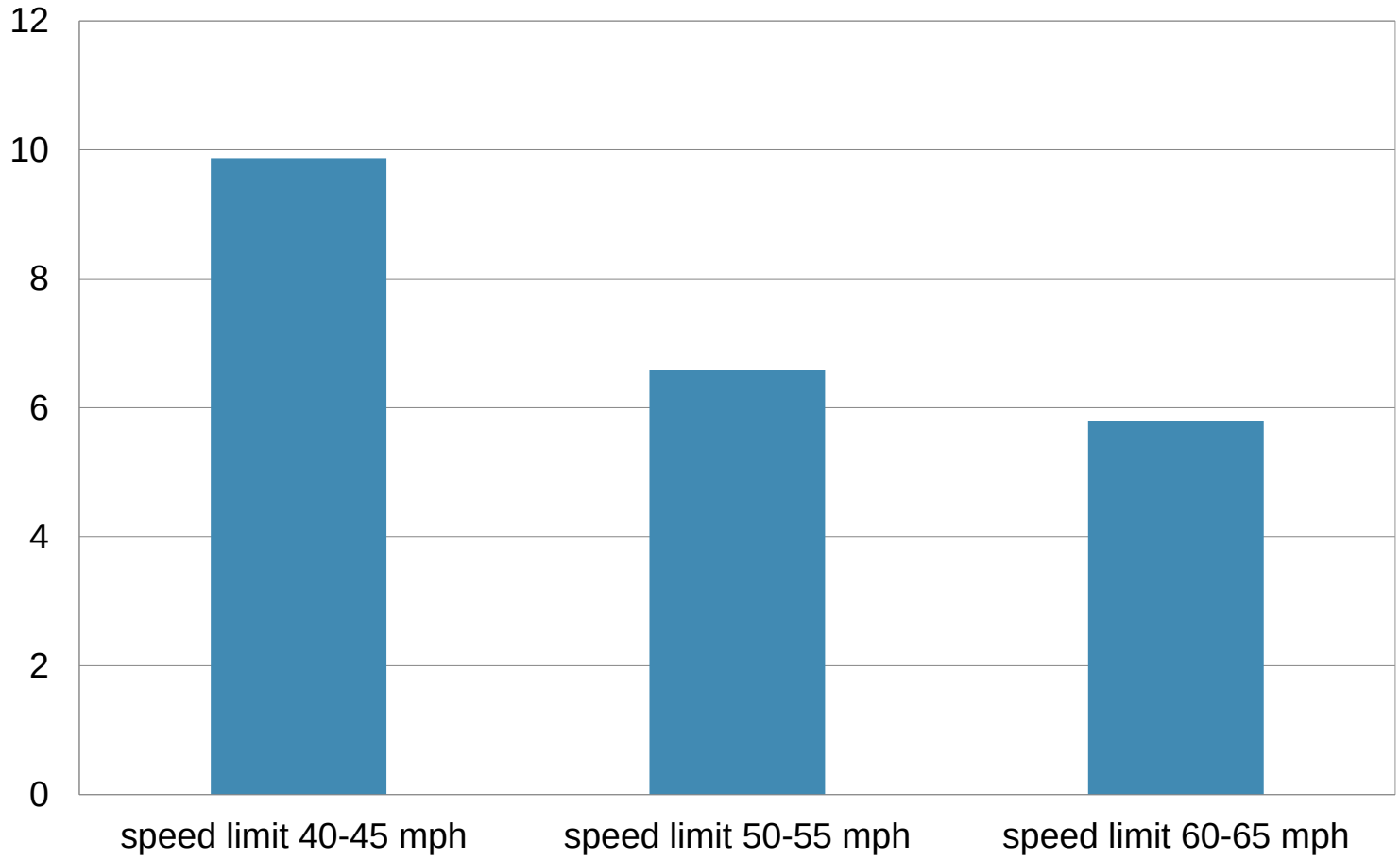
7.8 horsepower per 100 lbs.

Percent increase in overall insurance losses per unit of power by rated driver age

4-door cars, 2003-05 models



Percent increase in mean vehicle speed per 10 horsepower/100 lb. increase by speed limit



The costs of crashing

Turbo and supercharged engines

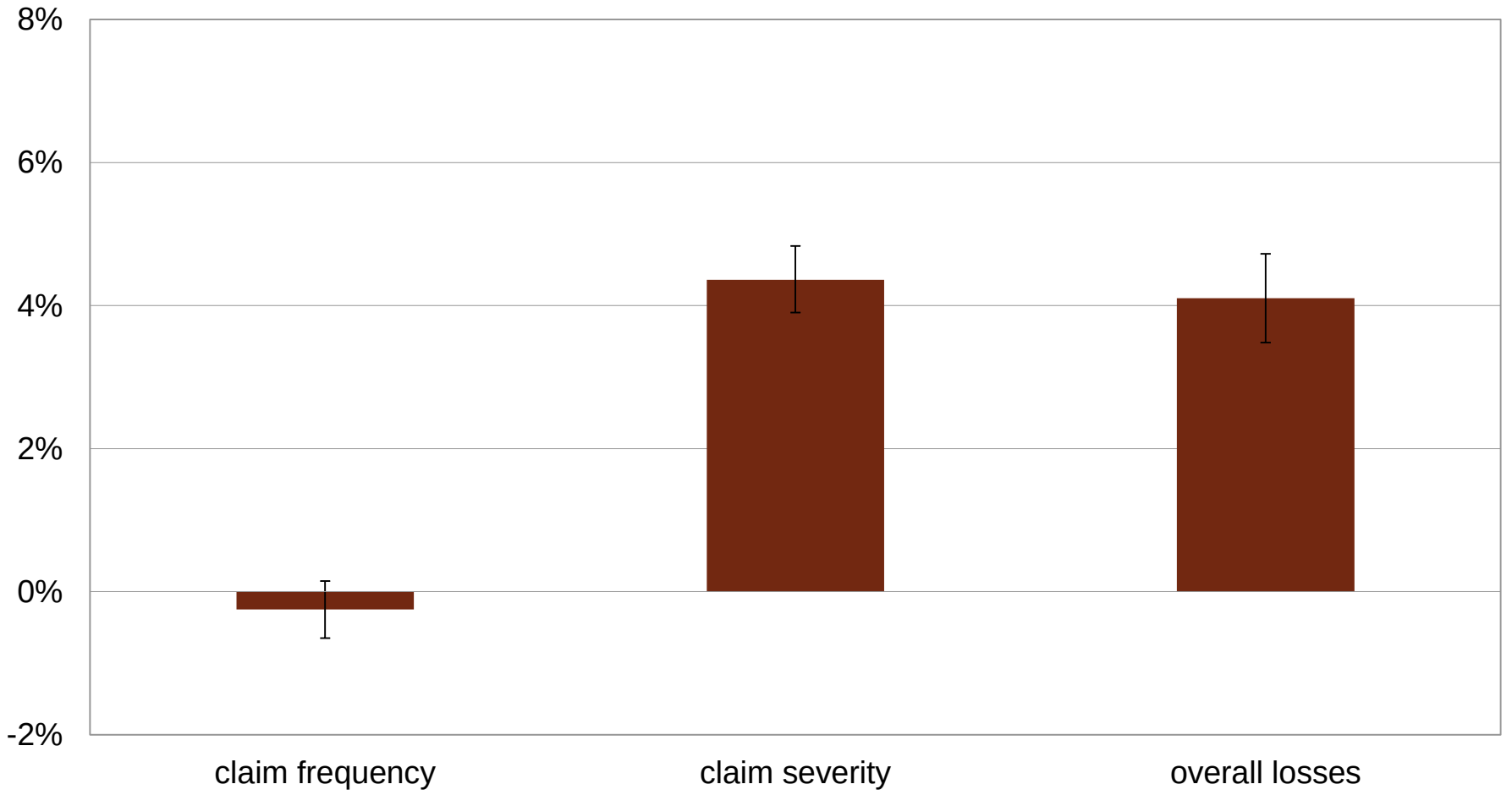
Turbo and supercharged engines

Pooled

turbo/supercharged exposure (years)	12,925,939
non-turbo/supercharged engines exposure (years)	21,967,095
calendar years	2005-16
unique make, series, model, engine price points	December 2016: 1,556 April 2017: 5,032
covariates	calendar year, model year, make, series, state, vehicle density, rated driver age group, gender, marital status, deductible, risk, base price, horsepower-to-curbweight ratio
method	vehicle series that have models with and without turbo/supercharged engines

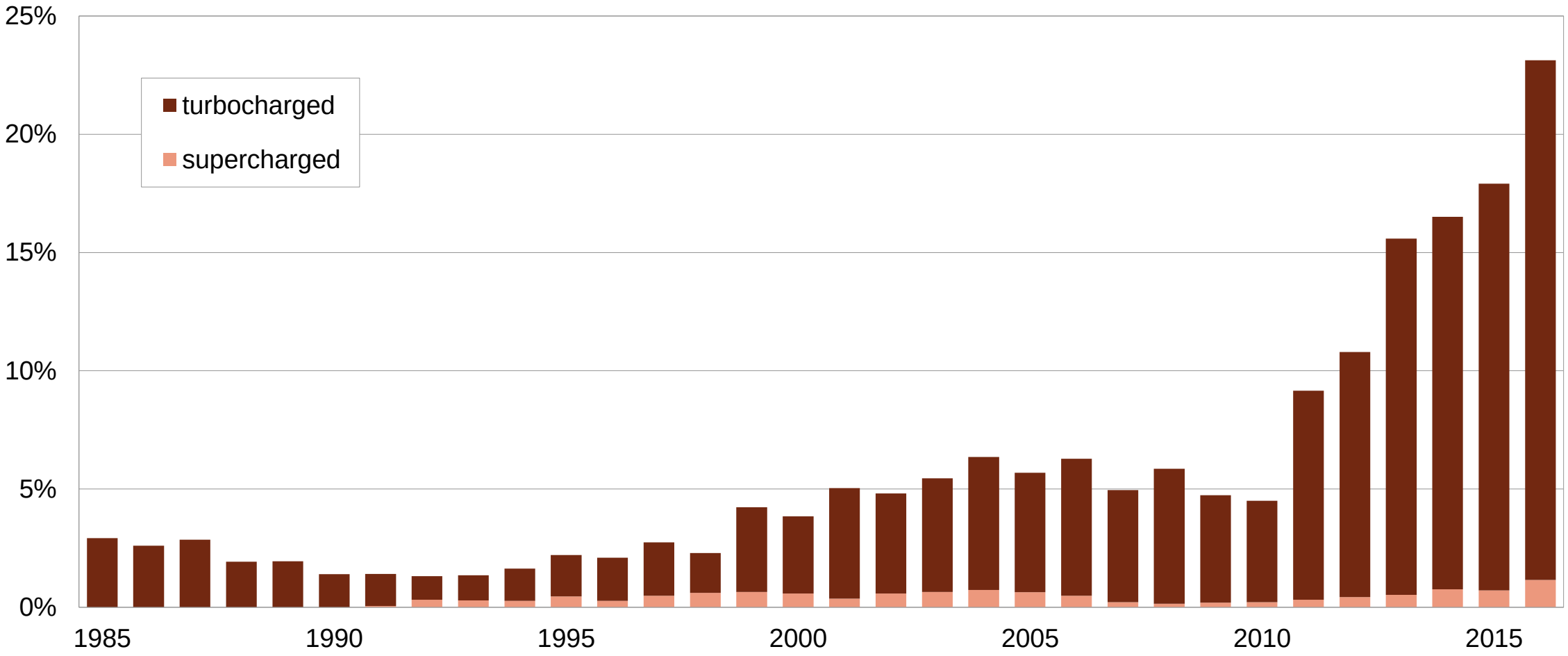
Turbo and supercharged engines

Collision losses

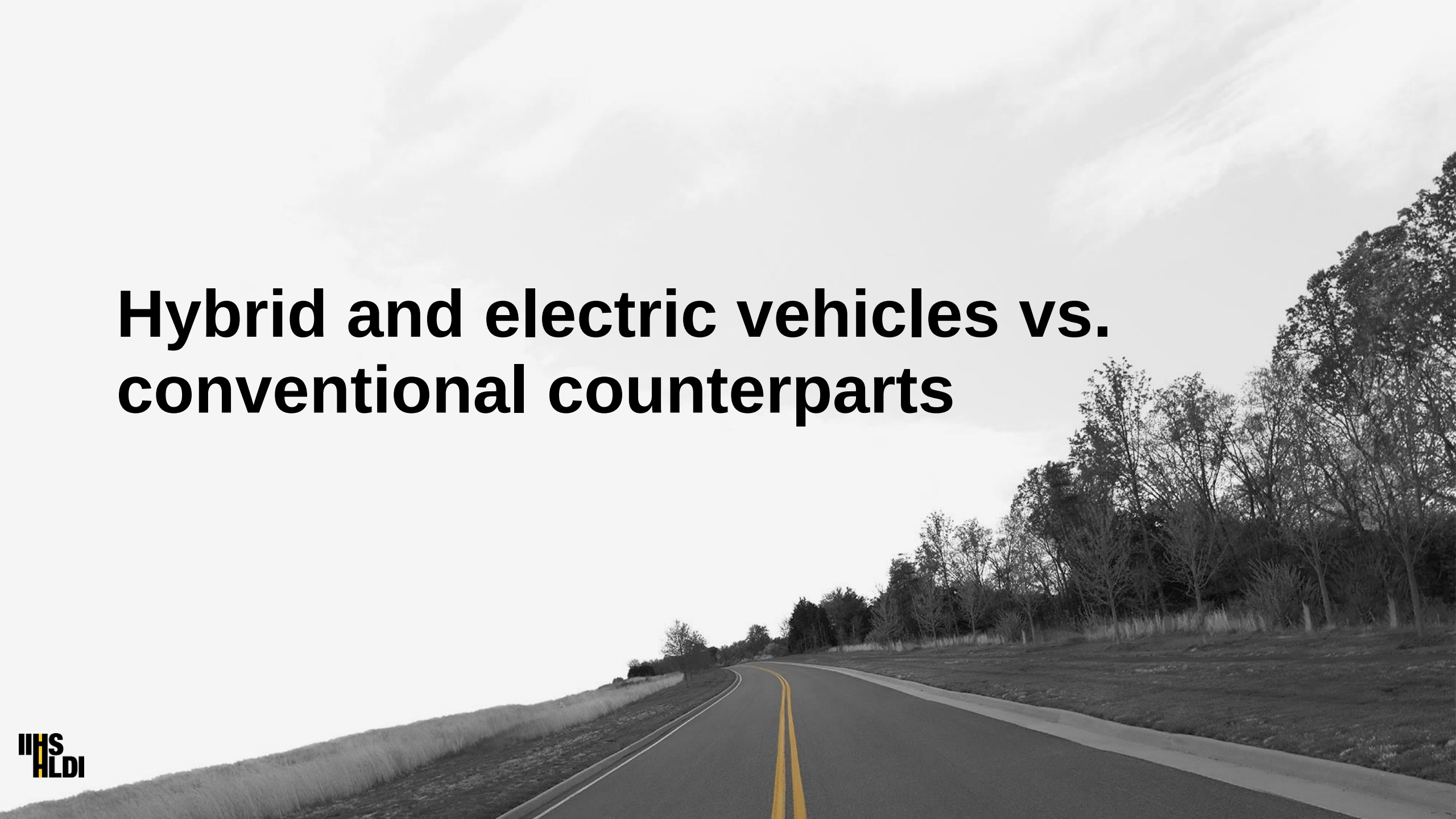


Percent of vehicles with turbo and supercharged engines

By model year

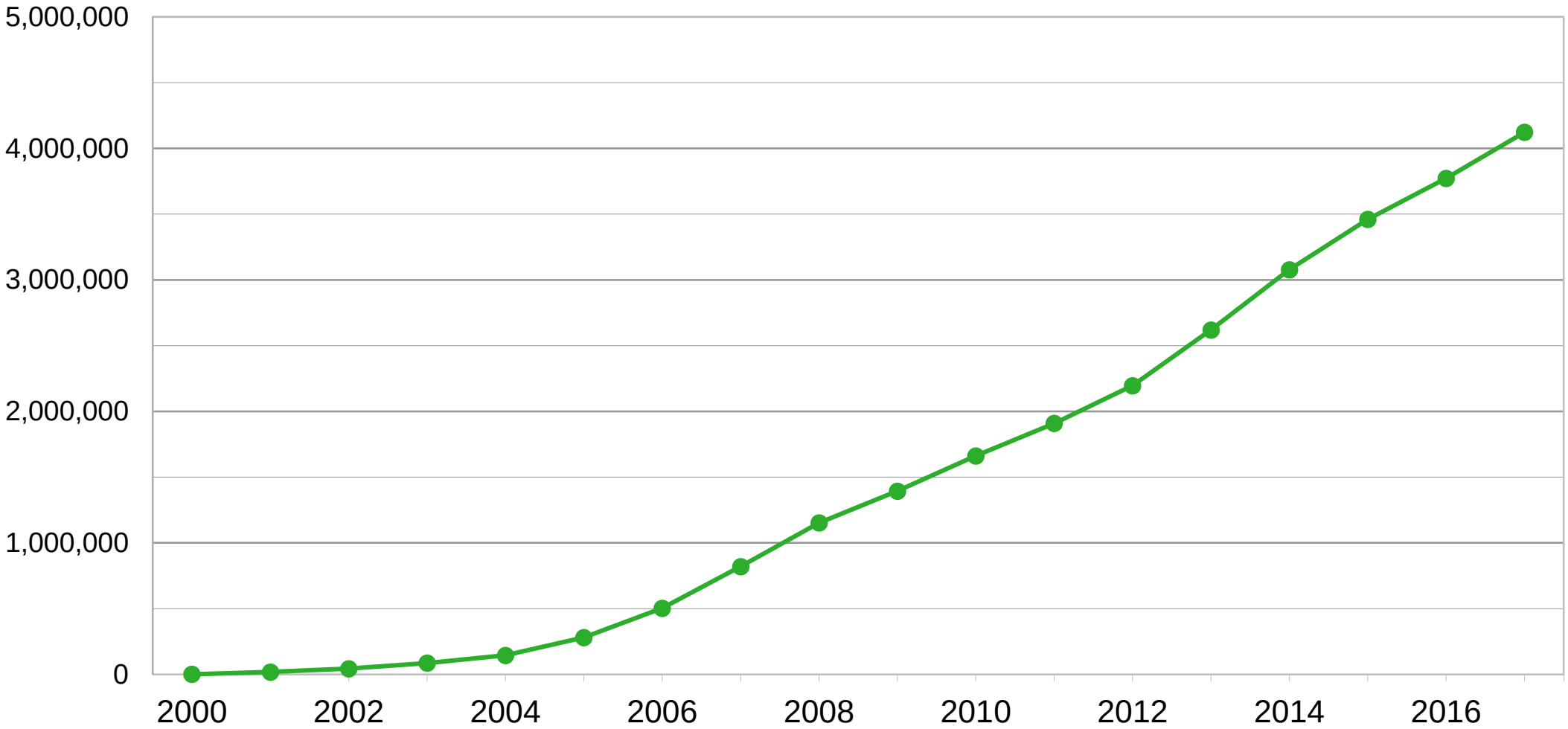


Hybrid and electric vehicles vs. conventional counterparts



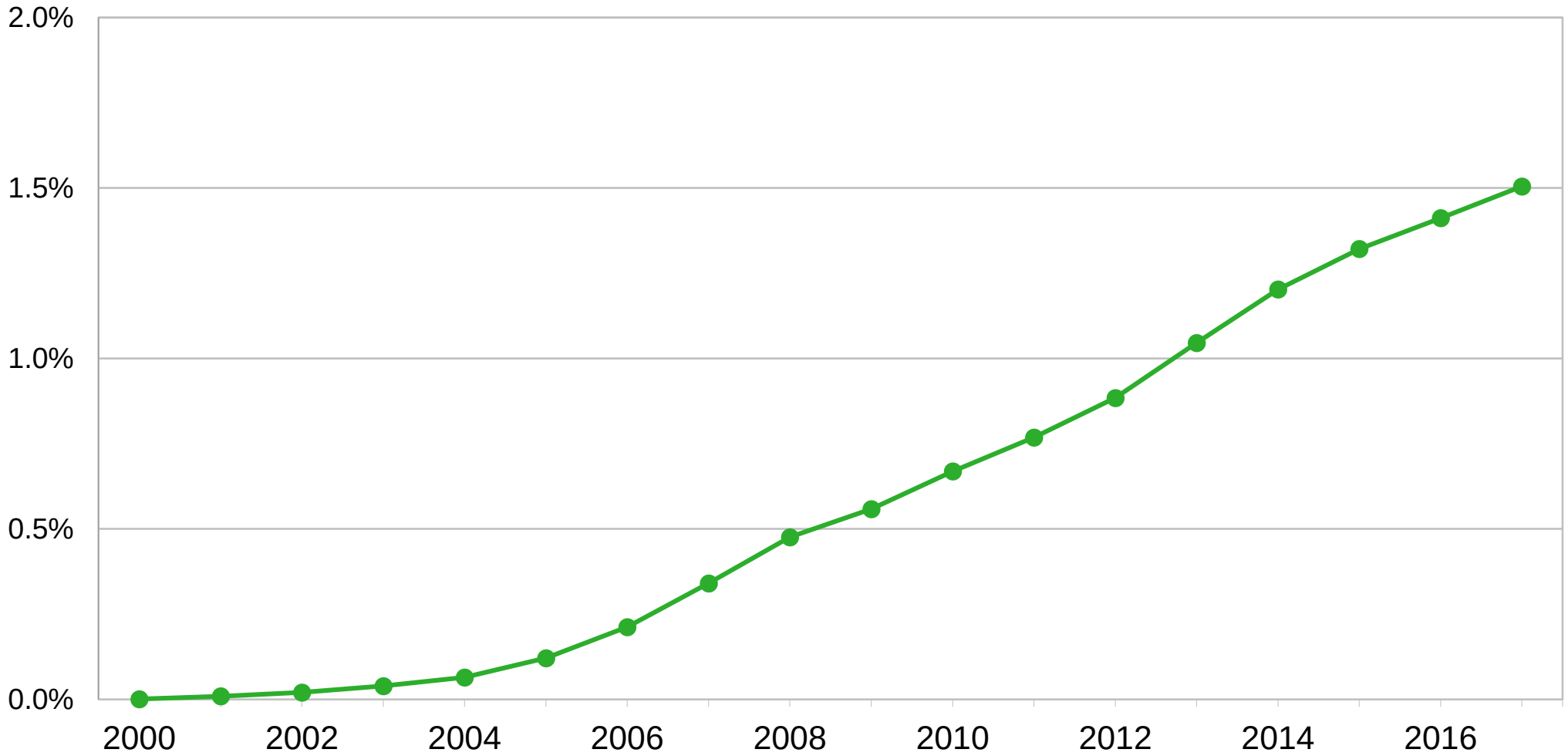
Registered hybrid vehicles

Calendar years 2000–17



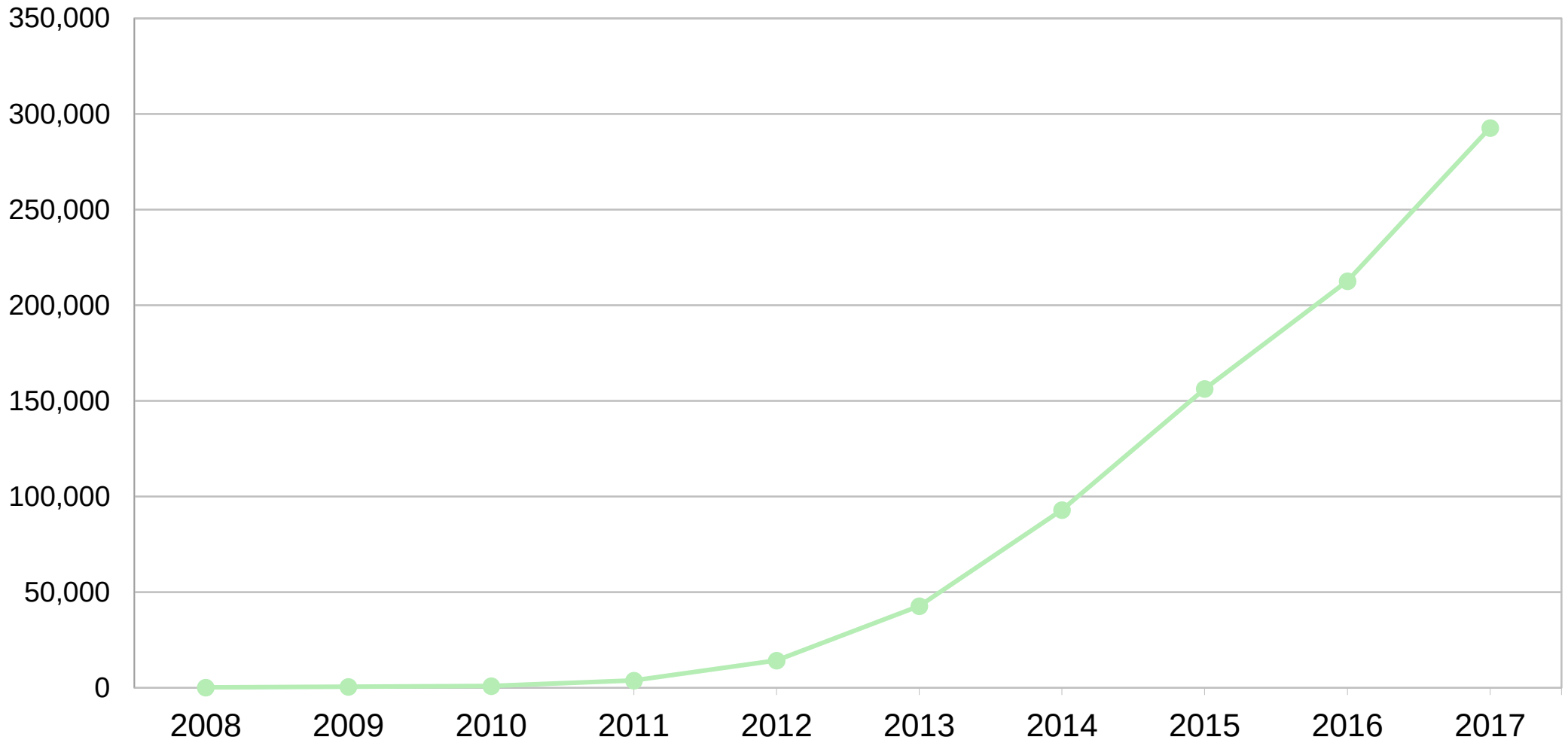
Percent of hybrid vehicles in registered vehicle fleet

Calendar years 2000–17



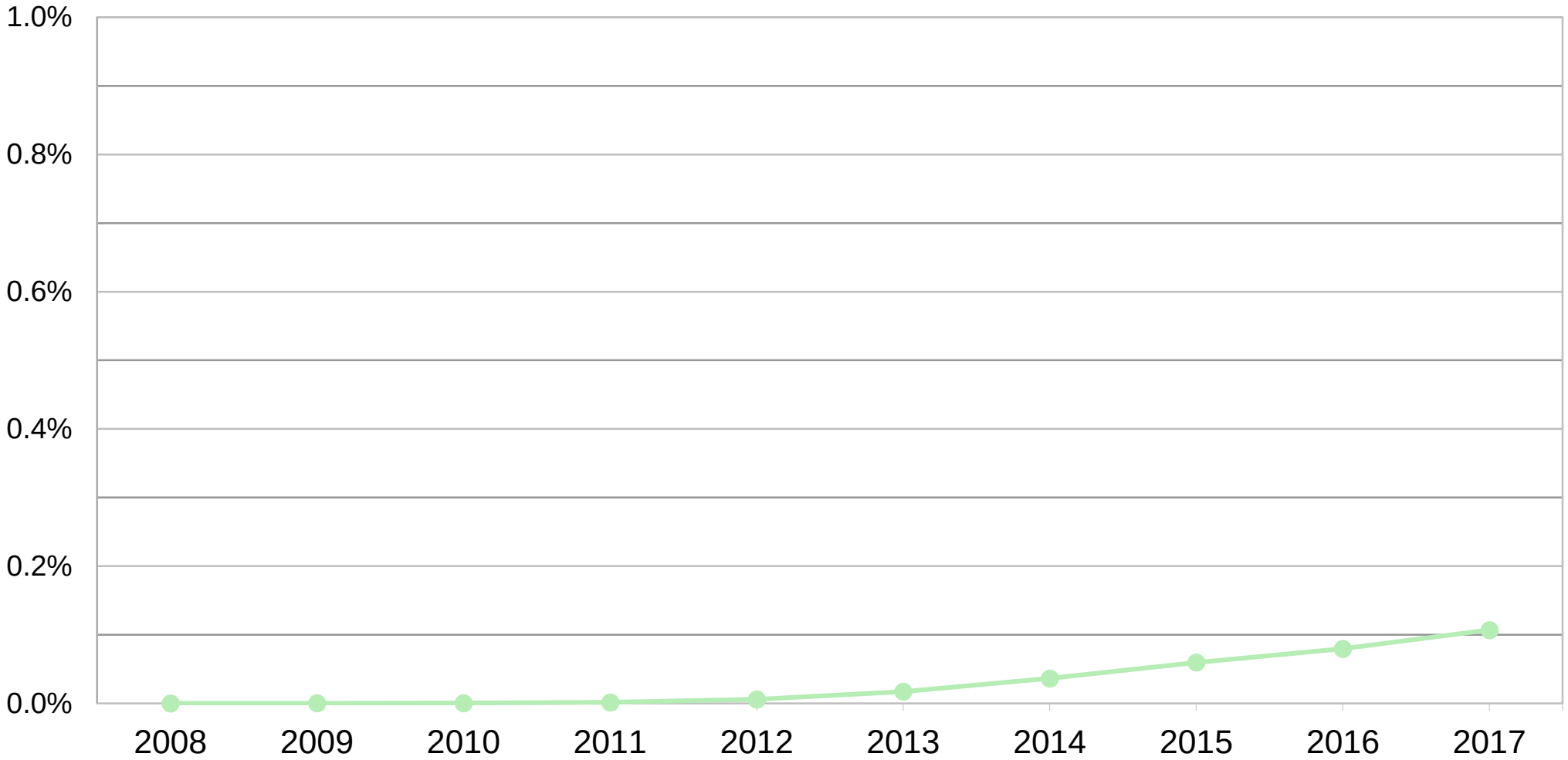
Registered electric vehicles

Includes all electric vehicles, calendar years 2008-17

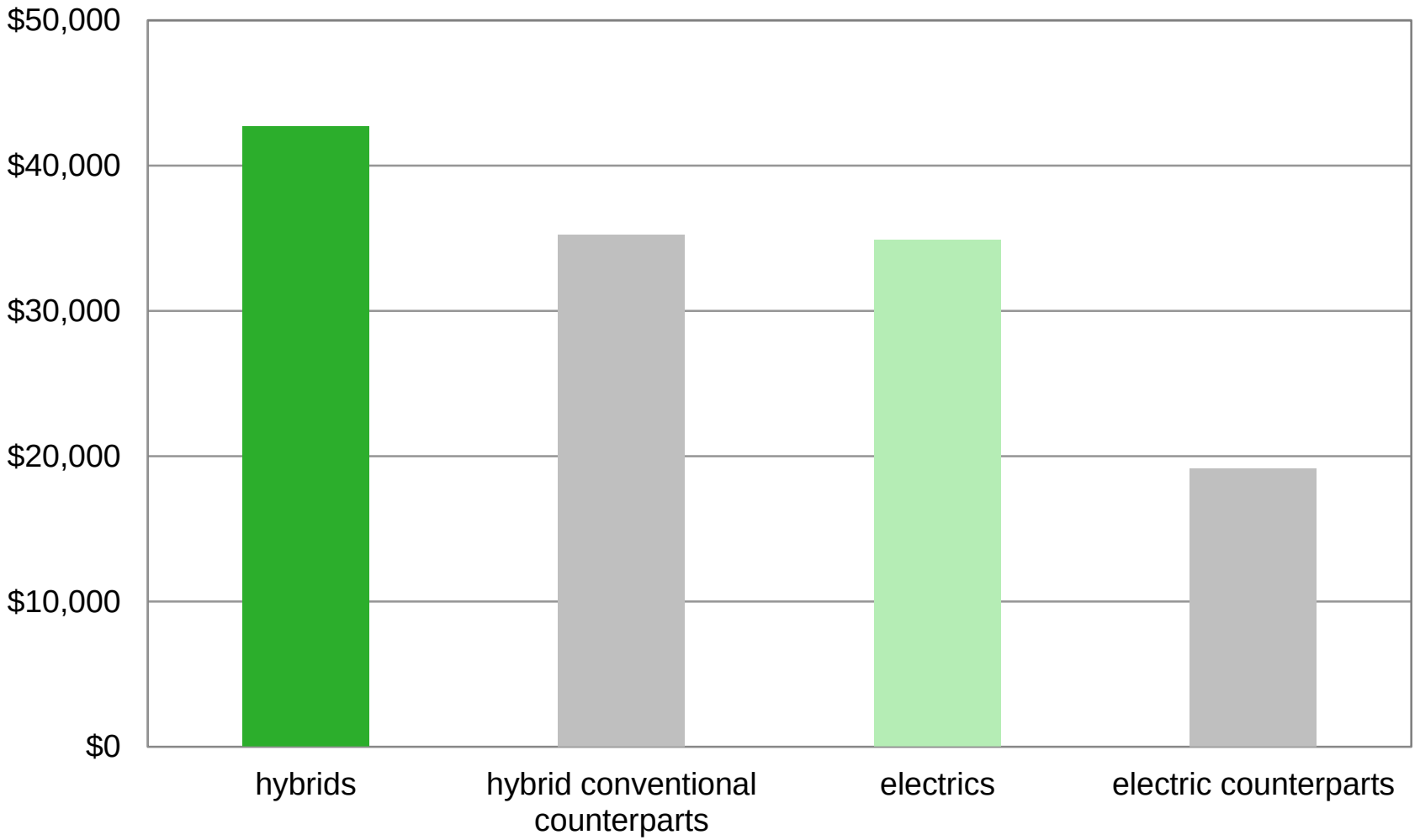


Percent of electric vehicles in registered vehicle fleet

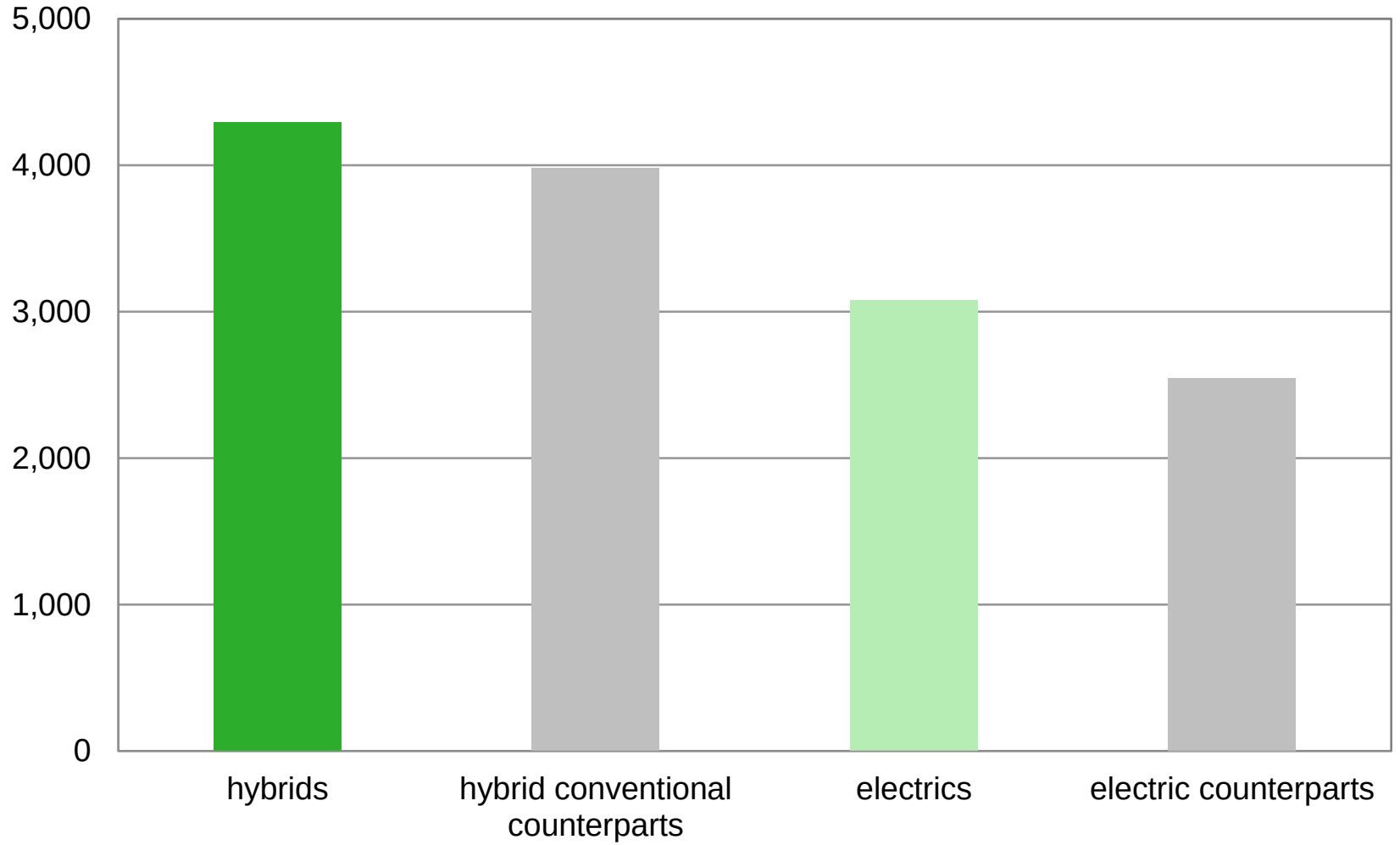
Includes all electric vehicles, calendar years 2008-17



Average base price



Average curb weight (lbs.)



2017 Porsche Cayenne 4WD

2017 Porsche Cayenne 4WD
Base price: $60,650
Curb weight: 4,488 lbs.

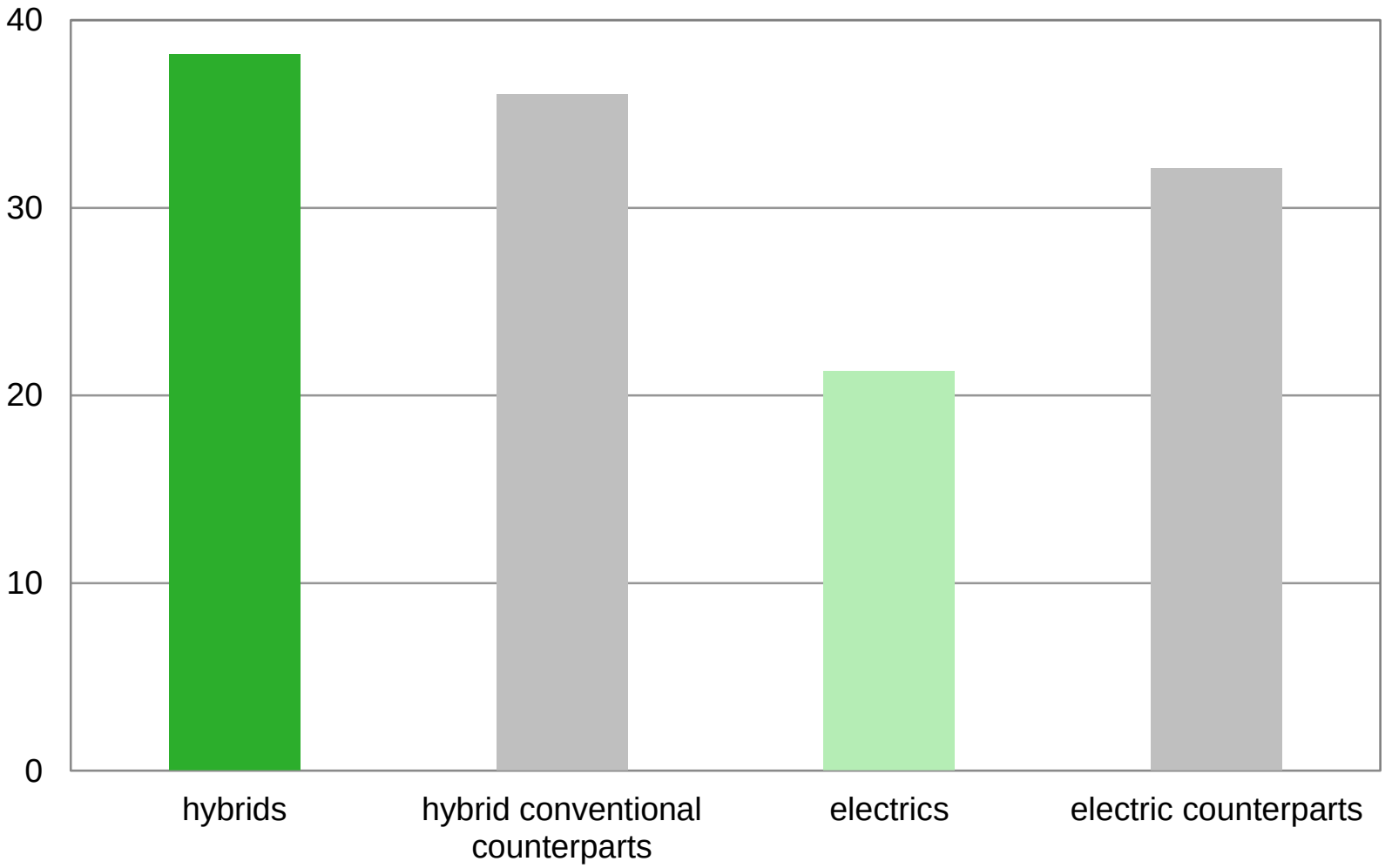
2017 Porsche Cayenne hybrid 4WD
Base price: $79,750
Curb weight: 5,181 lbs.

2017 Kia Soul station wagon

2017 Kia Soul station wagon
Base price: $18,400
Curb weight: 2,884 lbs.

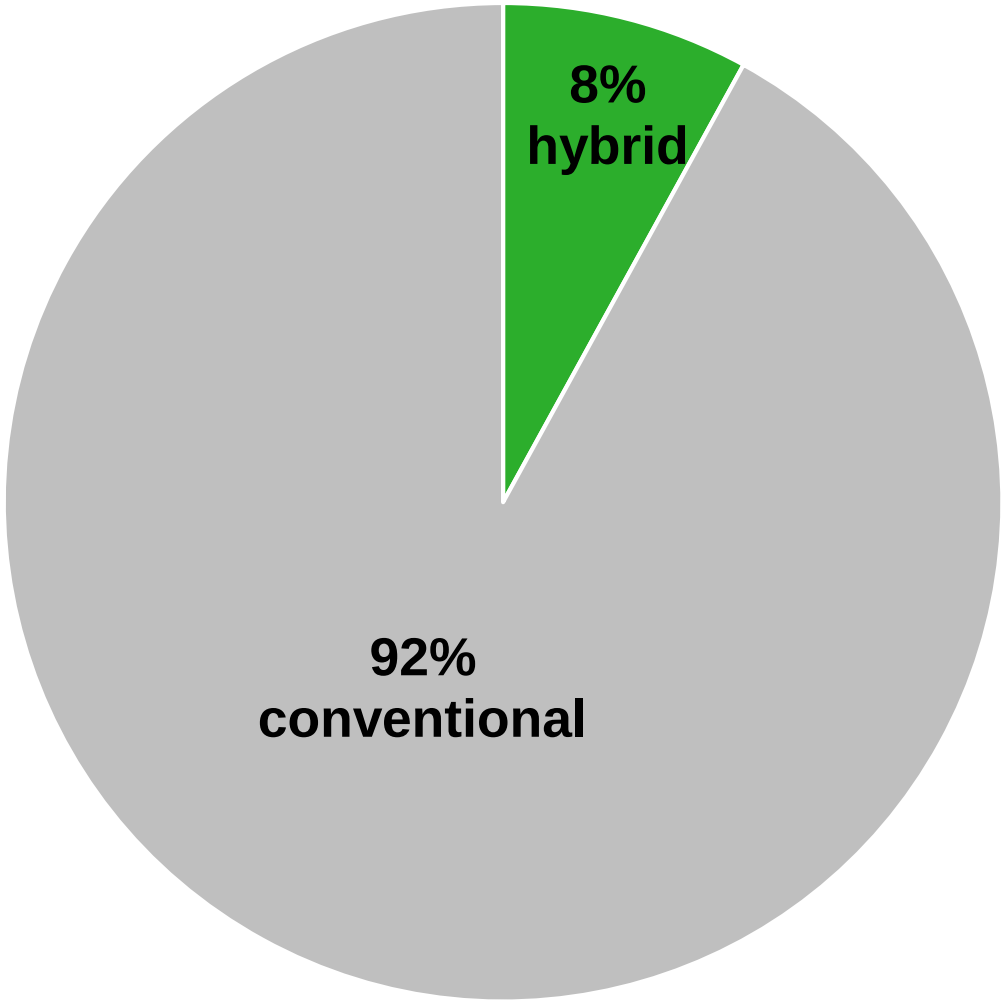
2017 Kia Soul electric station wagon
Base price: $33,145
Curb weight: 3,289 lbs.

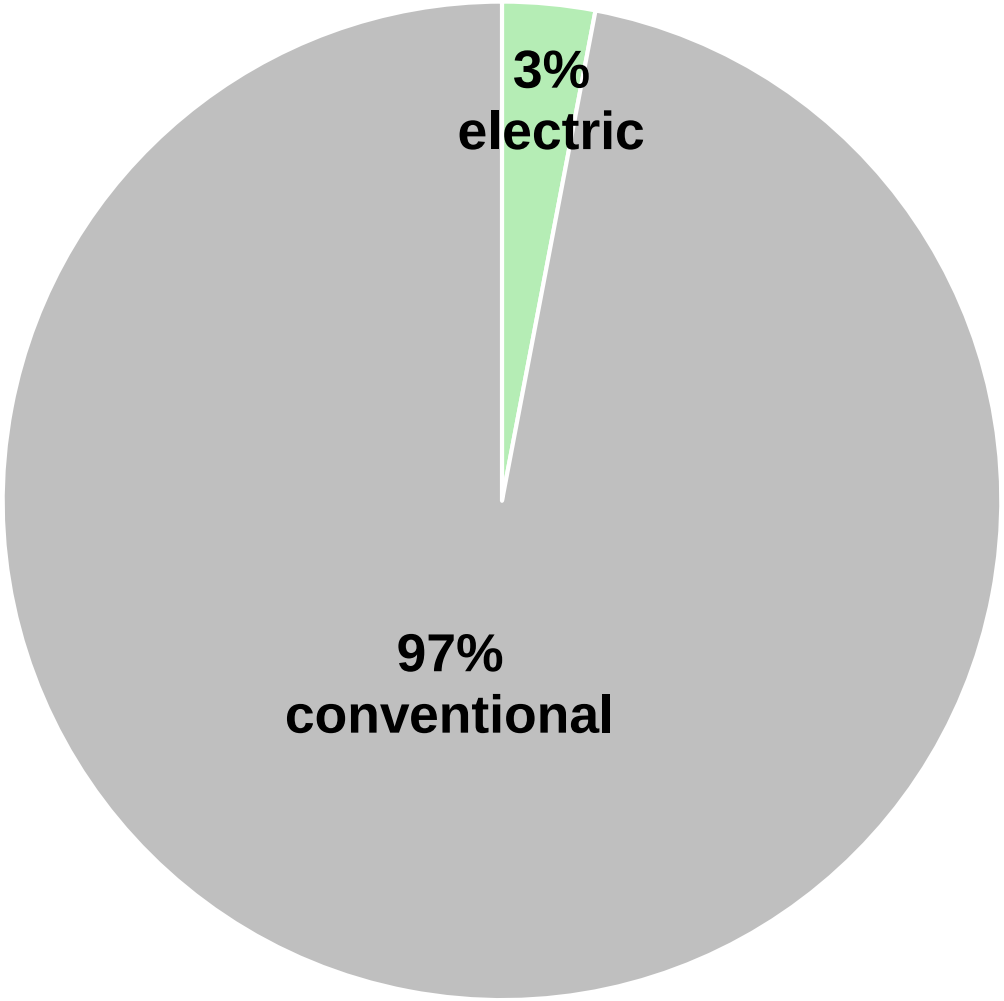
Average miles per day



Hybrid and electric vehicles and their conventional counterparts

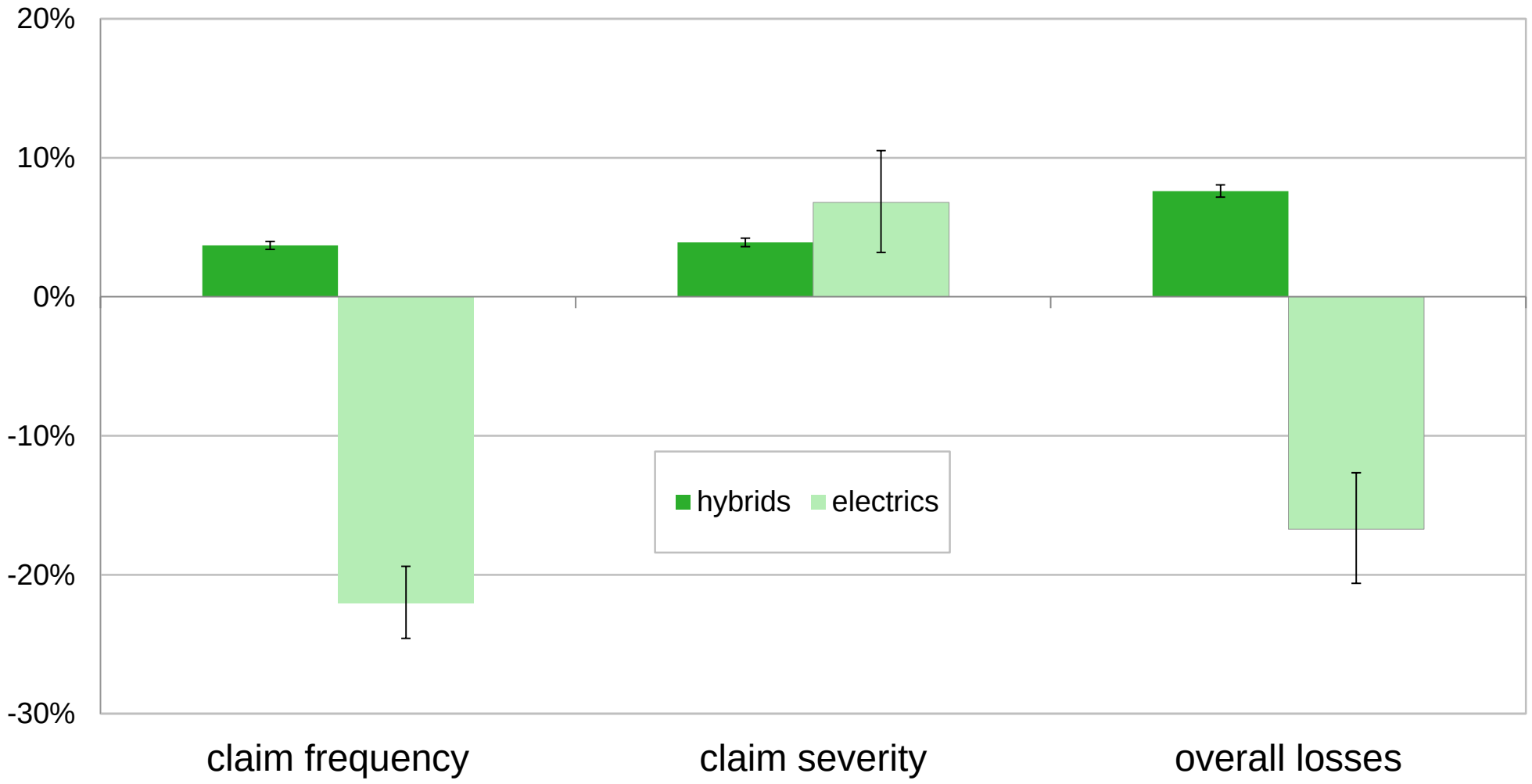
Percent of study exposure





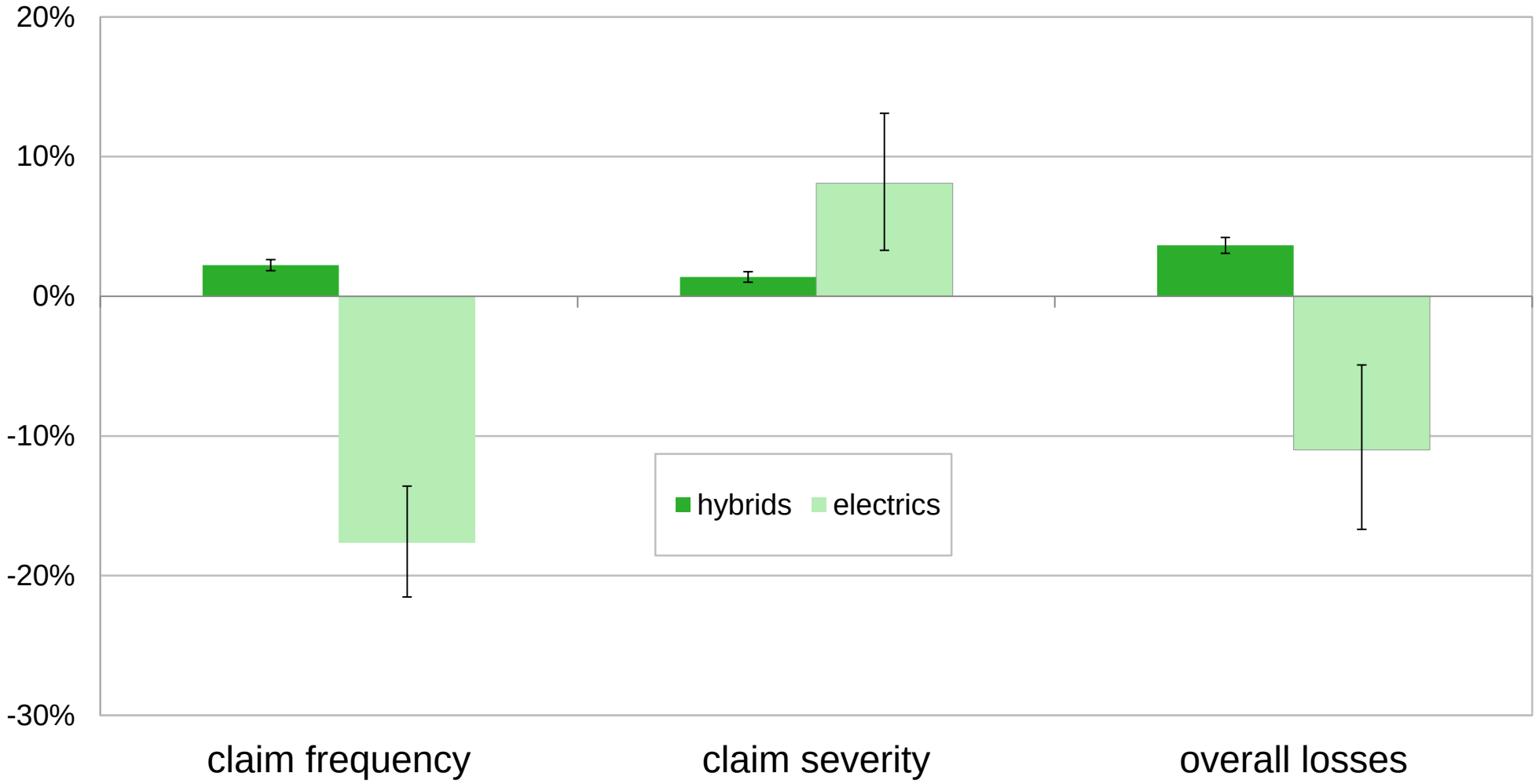
Estimated collision losses

Hybrid and electric vs. conventional



Estimated PDL losses

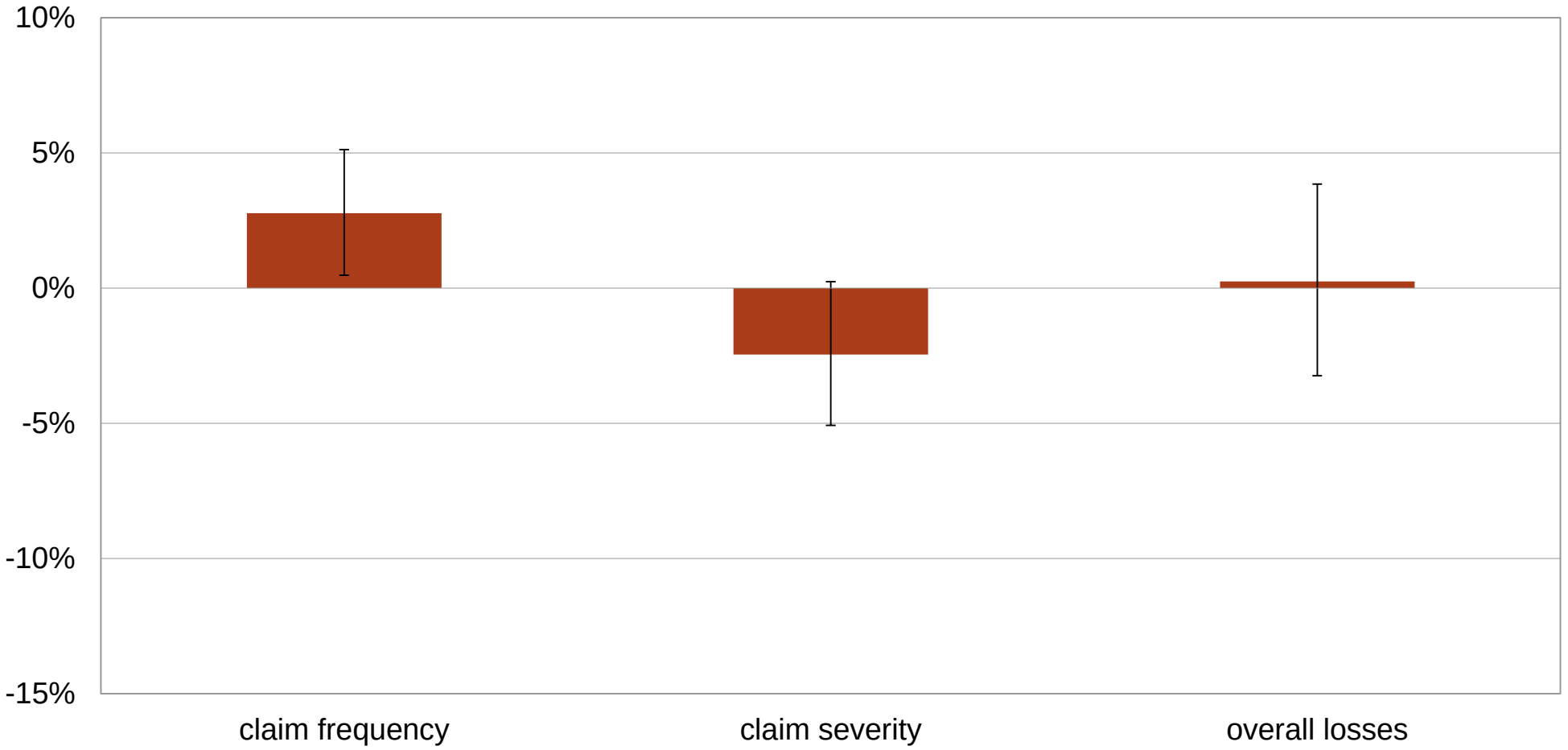
Hybrid and electric vs. conventional



Ford F-150 collision losses

Ford F-150 estimated change in collision insurance losses

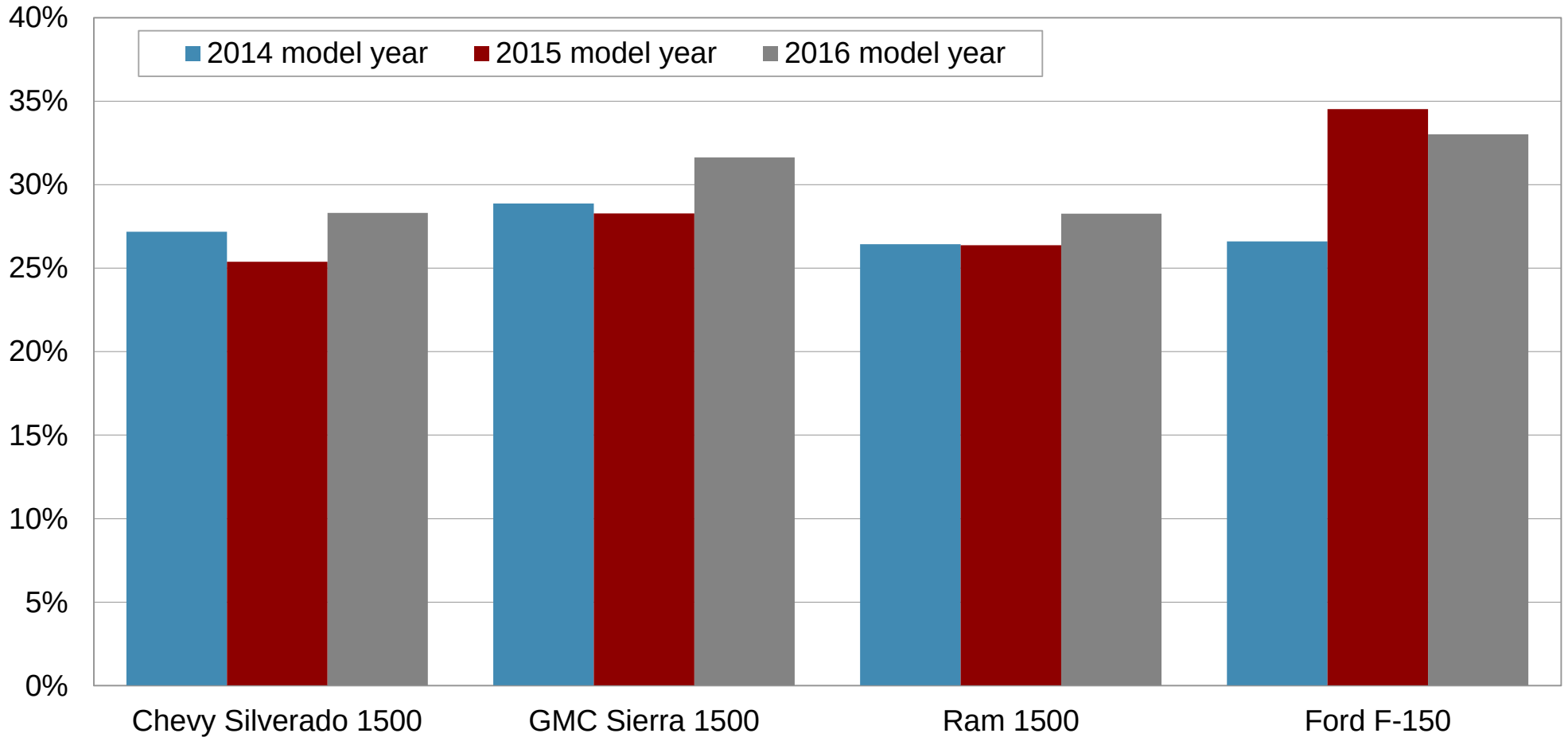
2015 model year compared to 2014 model year



NOTE: Raptor model excluded

Percentage of claims with delayed payment information

Ford F-150 compared to comparably-sized pickups



Ford F-150 part pricing comparison

Source: Audatex software and Mitchell

part	2014 model year			2015-16 model year			2015-16 vs. 2014
	Apr-15	Mar-16	Apr-17	Apr-15	Mar-16	Apr-17	Apr-17
hood	$880	$1,201	$1,201	$880	$823	$489	-52%
fender	$268	$272	$307	$268	$264	$205	-33%
front bumper	$929	$929	$930	$528	$528	$548	-41%
headlight	$270	$270	$271	$248	$251	$179	-34%
rear bumper	$584	$584	$592	$794	$794	$816	38%
exhaust pipe	$689	$689	$612	$522	$522	$488	-20%
bedside	$654	$654*	$760	$967	$864	$852	12%
taillight	$123	$115	$115	$144	$108	$79	-31%
total	$4,397	$4,534	$4,608	$4,351	$4,154	$3,656	-21%

* Price unavailable so prior year's price used

Effect of Takata airbag recall on total losses

Study design

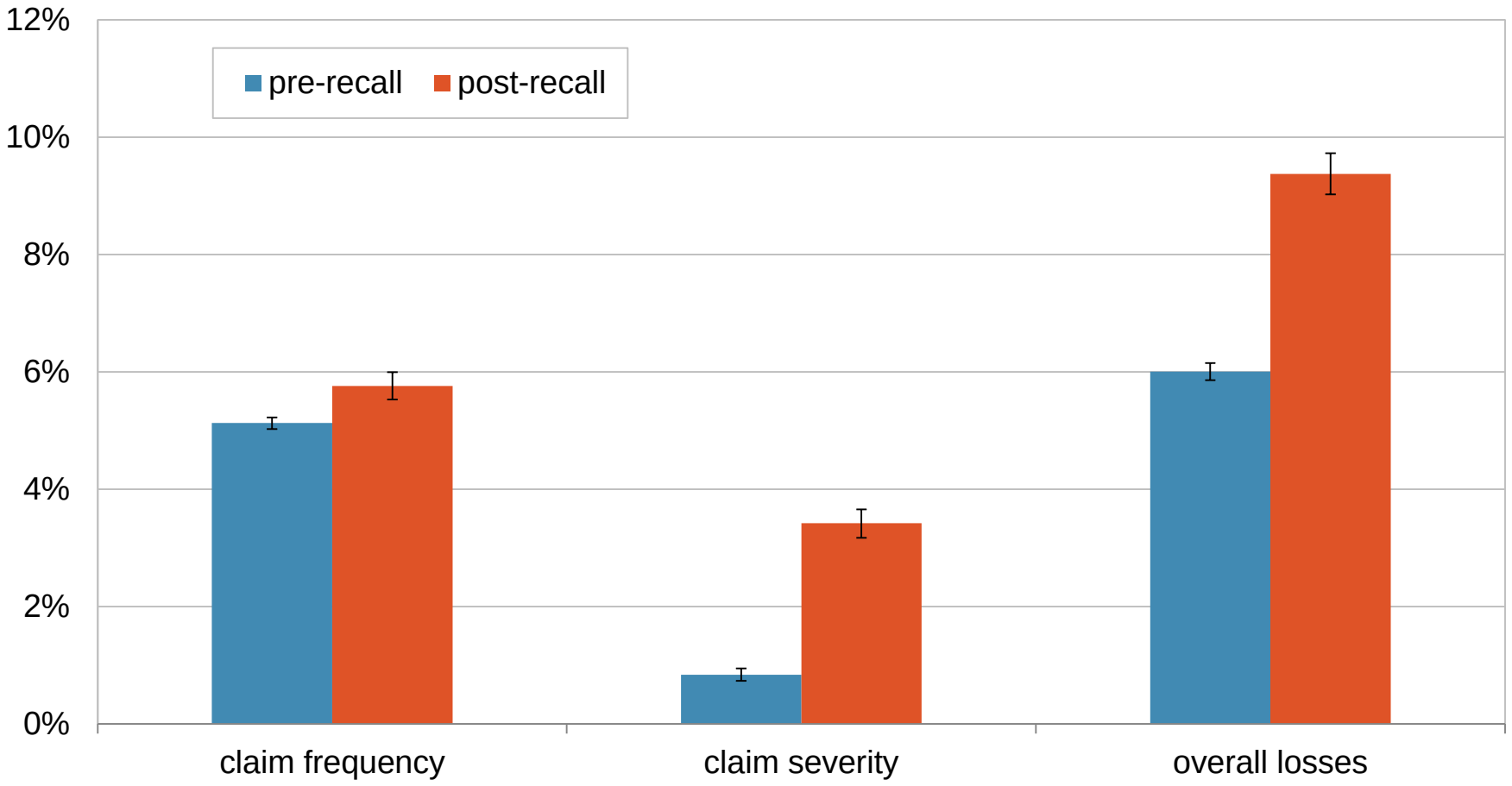
- Collision exposure and claims for vehicles affected by a Takata airbag recall were separated into pre- and post-recall periods based on recall date
- For vehicles affected by multiple Takata airbag recalls, the date of the first related recall was used
- Focused on vehicles recalled between 2013 and 2015
- Vehicles recalled in 2016 were excluded due to insufficient post-recall data
- Vehicles of same model year, size and class currently not affected by a Takata airbag recall constitute the control population

Takata airbag recall regression analysis

collision exposure (years)	565,994,659
model years	2000-11
covariates	calendar year, vehicle age, state, vehicle density, rated driver age group, gender, marital status, deductible, risk, vehicle size and class, vehicle age x vehicle size and class, recall status

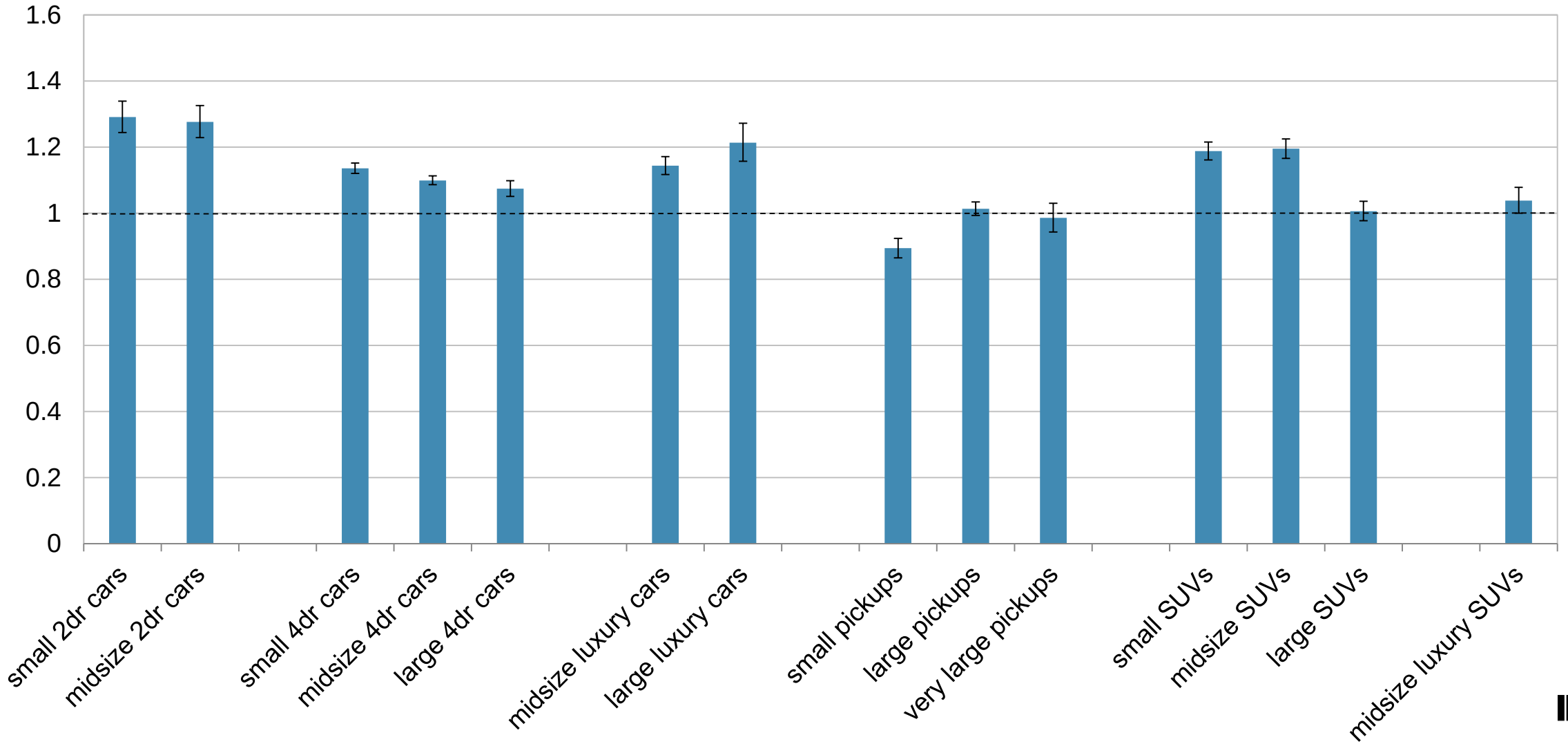
Change in collision insurance losses

Takata recalled vehicles vs. nonrecalled vehicles



Odds ratio of collision claims declared total loss

Takata recalled vehicles post recall vs. pre recall



Overall impact of Takata recall

- Assume that
  - Estimated average 2.6 percent increase in severity true for all recalled vehicles
  - Every collision claim for recalled vehicles – after being recalled – is affected
  - “But for” Takata airbag recalls, subsequent airbag shortages and drop in value of affected vehicles, payment amounts for claims of recalled would have been on average 2.6 percent less
- Under these assumptions, over $150 million in insurer costs due to higher collision severity are associated with Takata recall

Takata airbag recalls

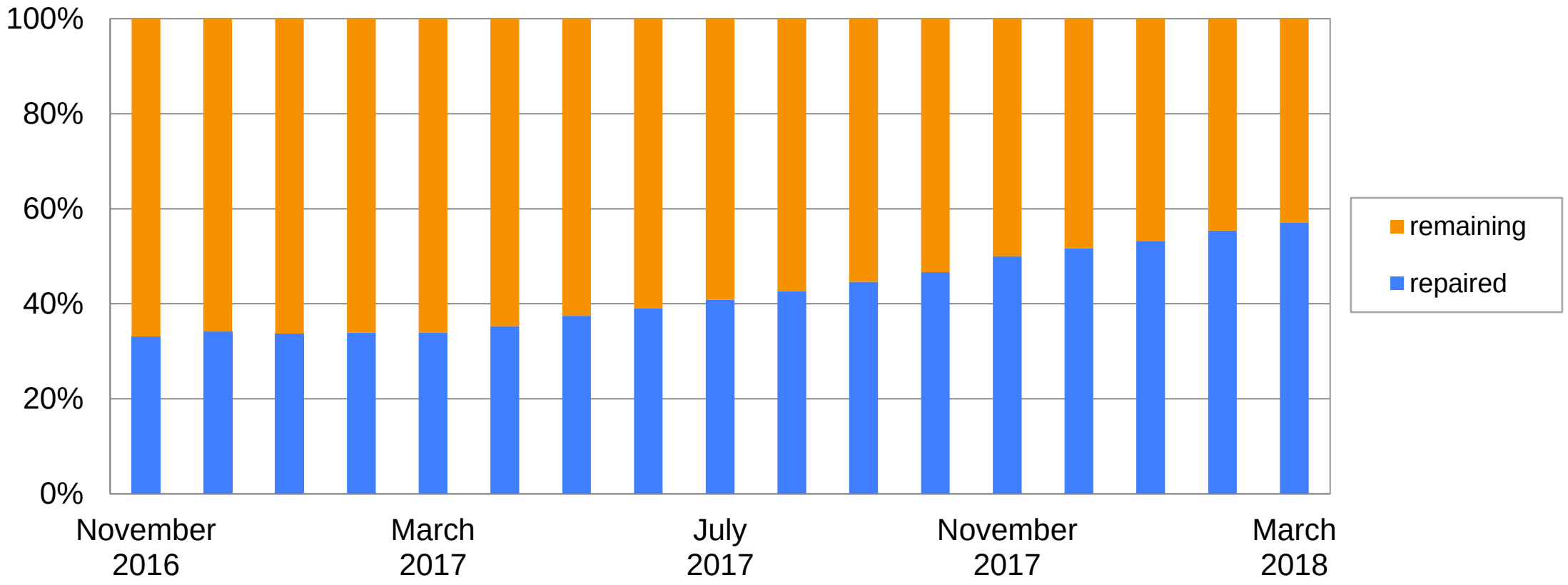
Recent events

- February 2018: Ford expands recall of the 2006 Ranger and advises owners to stop driving them immediately.
- January 2018: Takata announces recall of another 3.3 million front airbag inflators.
  - Audi, BMW, Fiat Chrysler, Ford, General Motors, Honda, Jaguar, Land Rover, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Subaru, Tesla and Toyota
- October 2017: Mitsubishi recalls 2004–06 Lancer models a second time. The initial 2015 recall replaced them with the same Takata part since no inflators were available without ammonium nitrate.
- August 2017: Ford recalls 650 brand-new vehicles that have defective airbags. These faulty inflators were made by ARC Automotive, which NHTSA has been investigating since July 2015. NHTSA estimates that up to 8 million inflators may be defective in Chrysler, GM, Kia and Hyundai models in the U.S.
- July 19, 2017: Driver of 2002 Honda Accord died as result of defective Takata airbag. At least 22 people worldwide have died from a faulty Takata airbag.
- In 2017 alone, there were over 1.2 million collision claims for vehicle series affected by a Takata airbag recall in the HLDI database.

Takata airbag recalls

Percentage of airbags repaired (NHTSA)

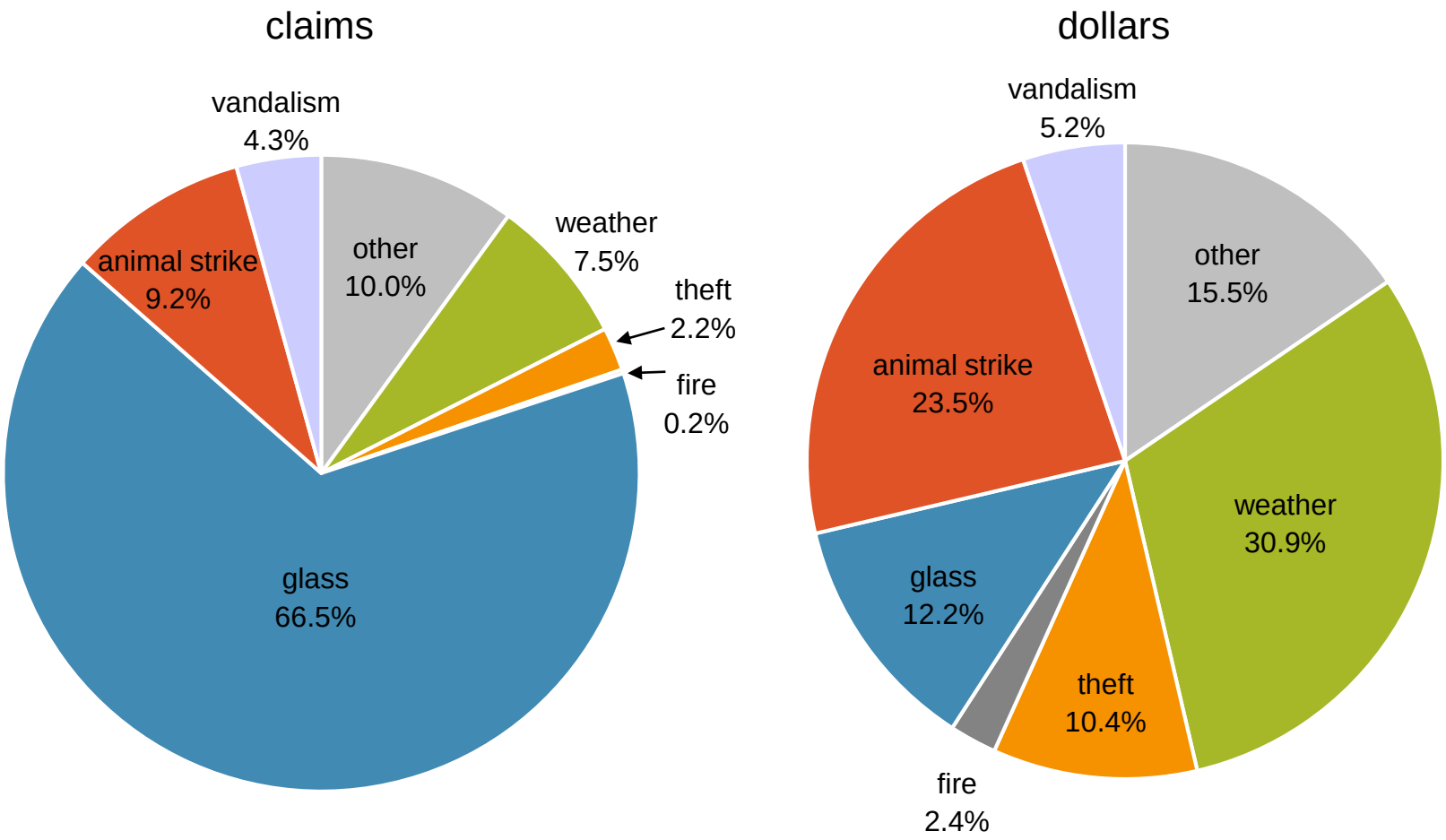
NHTSA estimates approximately 37 million vehicles and
50 million defective Takata airbags are under recall



Glass losses

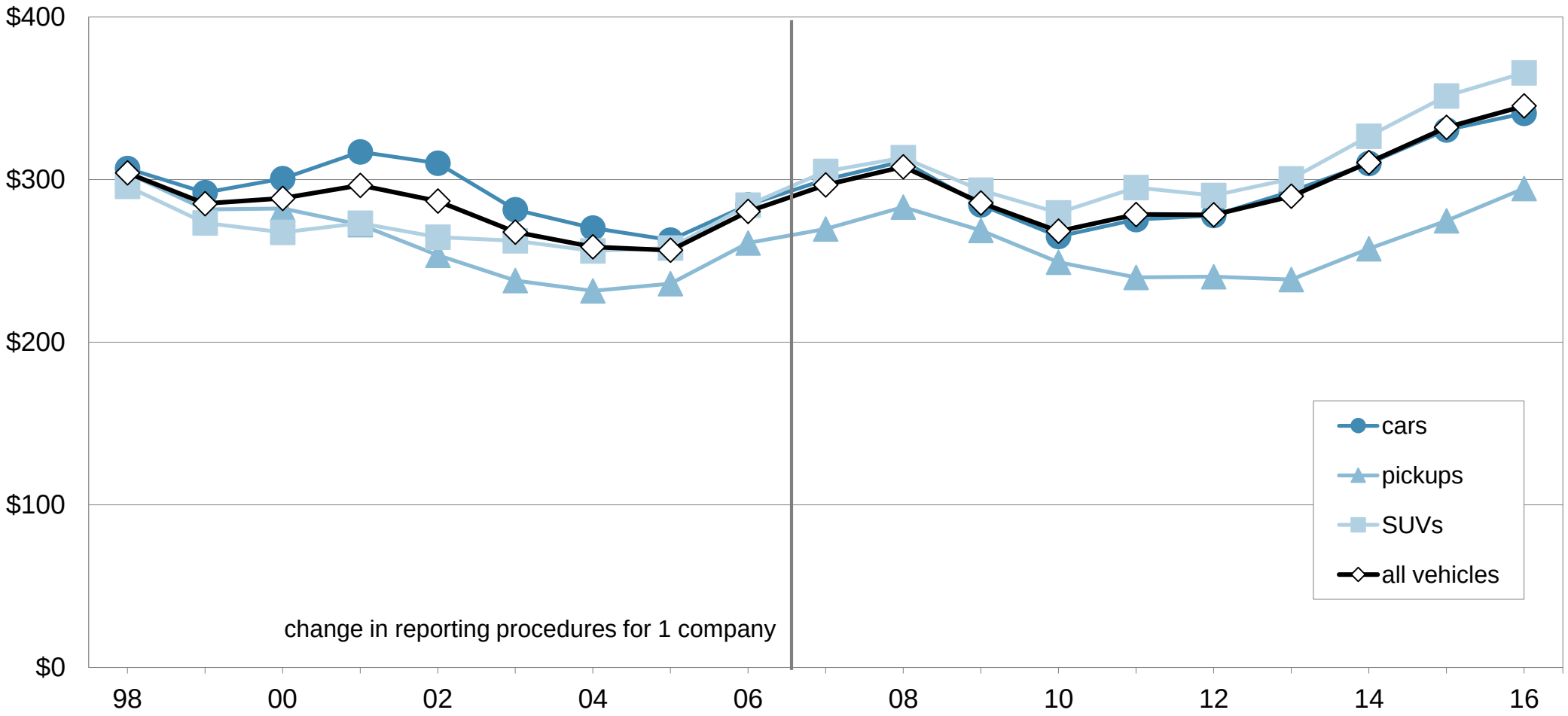
Comprehensive claims and dollars

By loss type, 2015–17 models



Glass claim severities

By calendar year and vehicle type, 4 most current model years



Subaru glass losses associated with ADAS and moonroofs

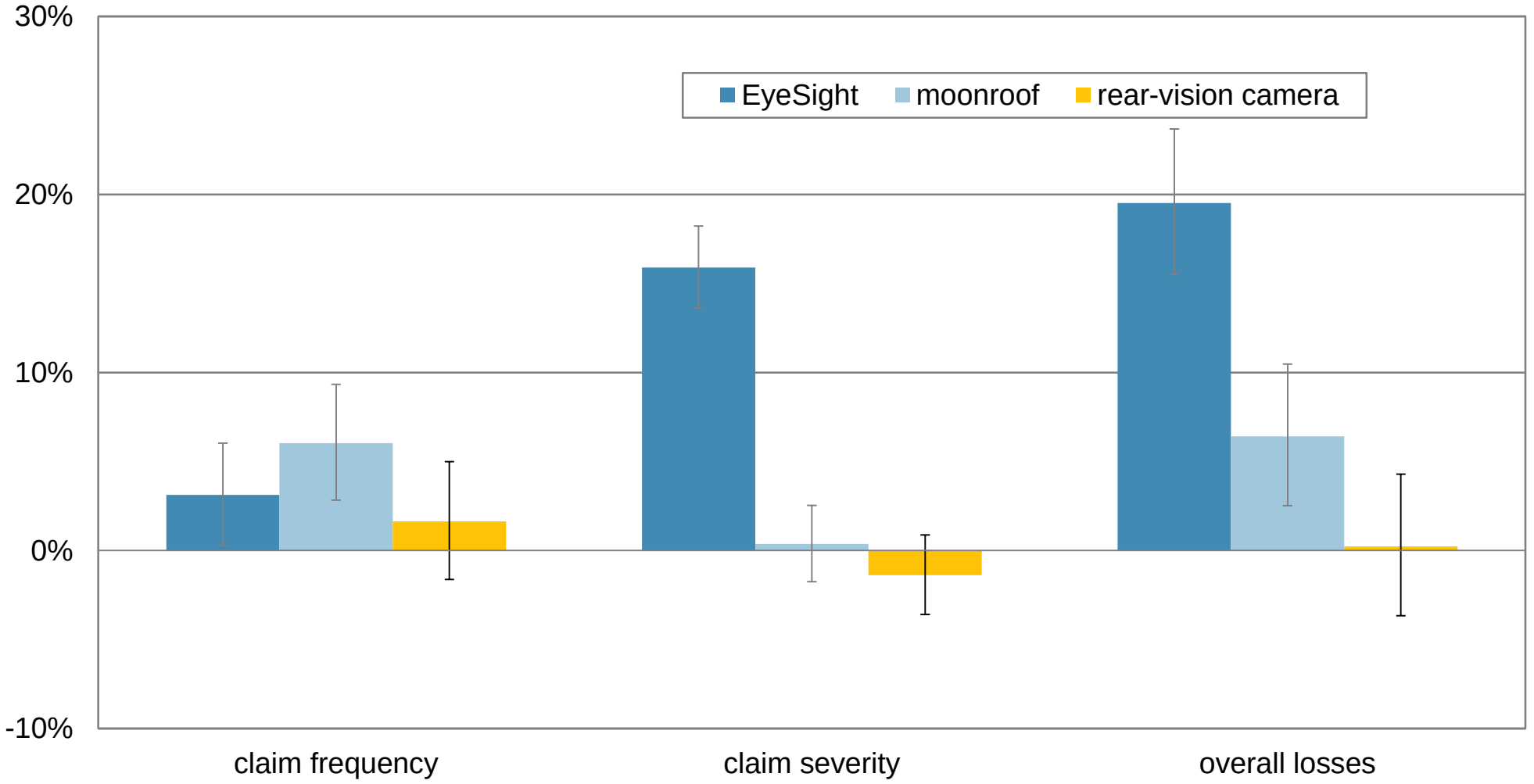
Subaru glass losses

Methods

coverage type	comprehensive - glass
exposure (years)	1,049,918
model year and vehicles	2013–17 Subaru Legacy and Outback
calendar years	2012–18
covariates	calendar year, vehicle age, state, vehicle density, rated driver age group, gender, marital status, deductible, risk, EyeSight, moonroof, rear-vision camera

Subaru glass losses – EyeSight, moonroof, rear-vision camera

2013–14 Subaru Legacy and Outback



Glass losses associated with Panoramic roofs

Panoramic roofs

Pooled

panoramic roof standard exposure (years)	81,751
panoramic roof optional exposure (years)	71,371
panoramic roof not available exposure (years)	380,653
model year(s) & vehicle	2014-15 Kia Sorento 2016 Kia Sportage
calendar years	2013-17
covariates	calendar year, model year, make, series, state, vehicle density, rated driver age group, gender, marital status, deductible, risk
method	vehicle series that have models with and without a panoramic roof standard and optional vs. not available

Panoramic roofs

2014 Kia Sorento

2016 Kia Sportage

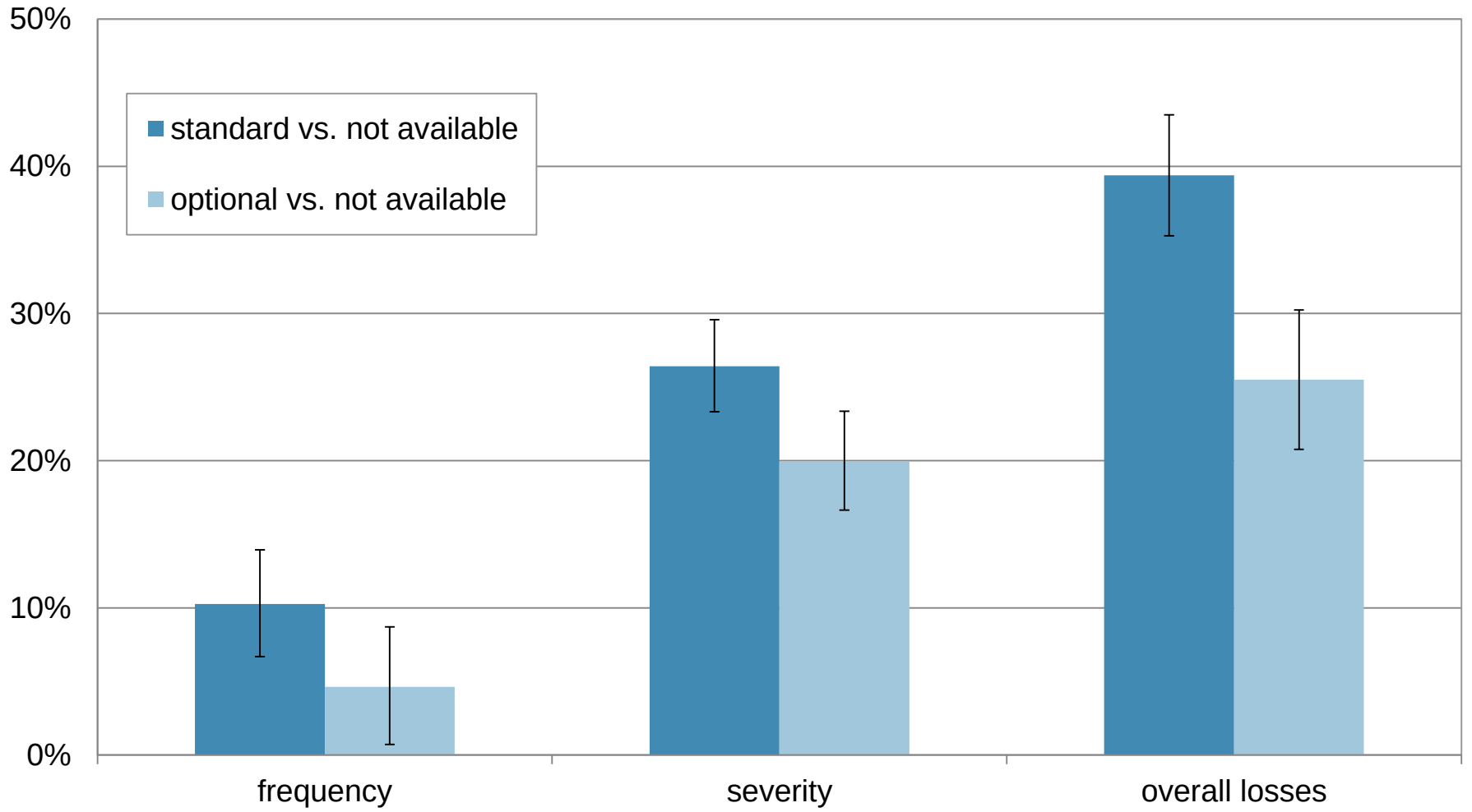
Panoramic roofs

2014 Kia Sorento

2016 Kia Sportage

Panoramic roofs

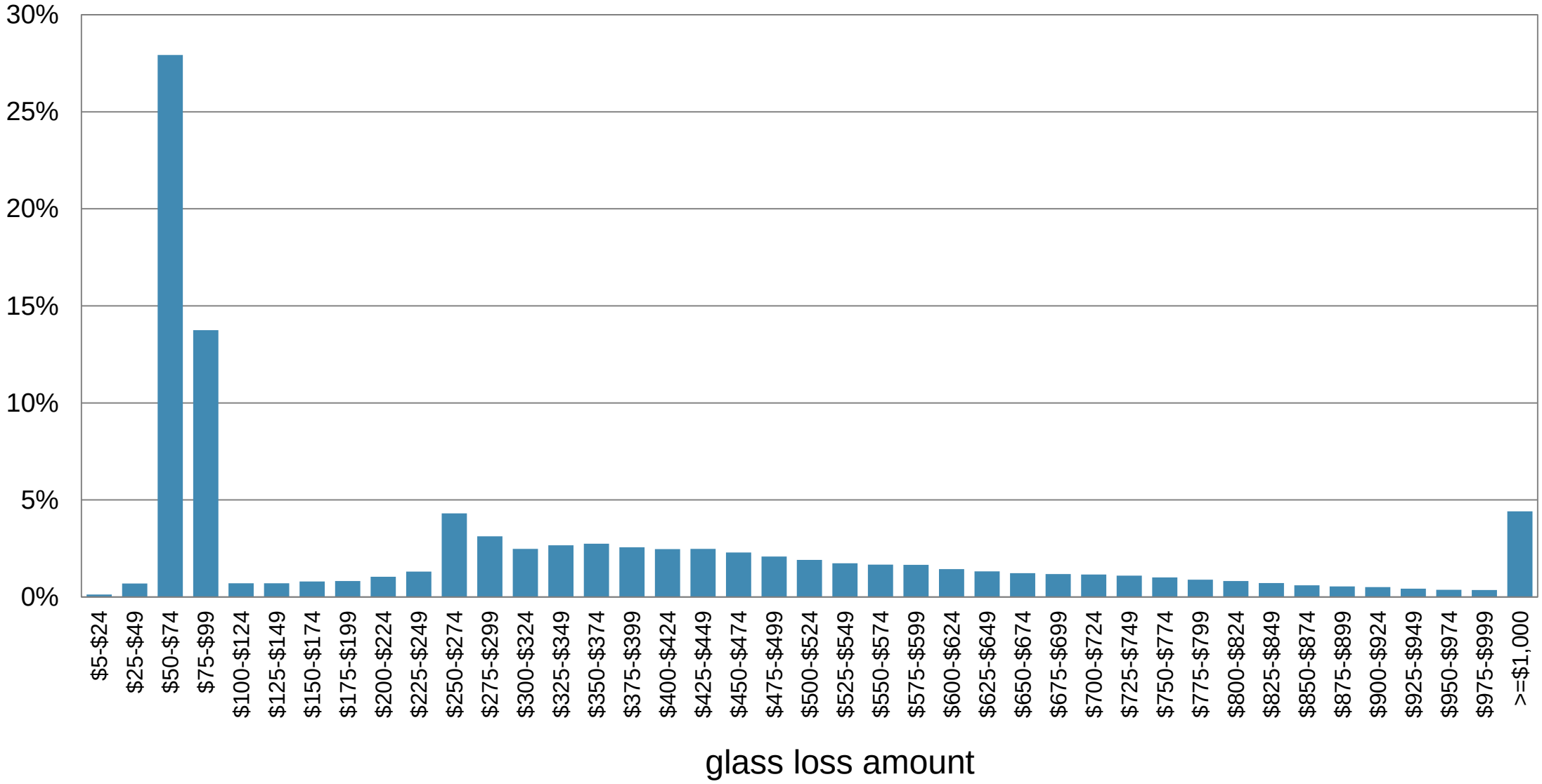
Percent change in glass insurance losses by availability



Glass losses: repair vs. replace

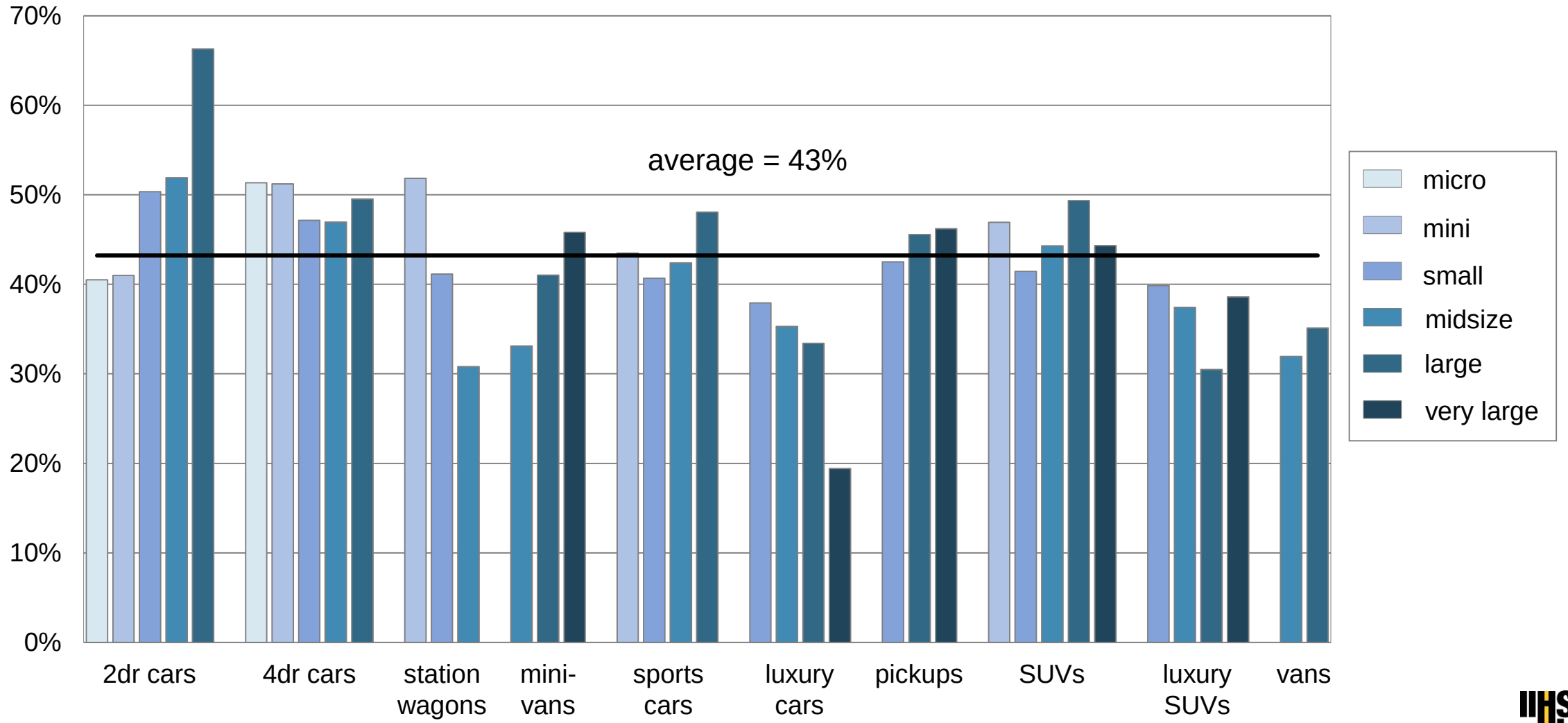
Glass claim size distribution

2015–17 models



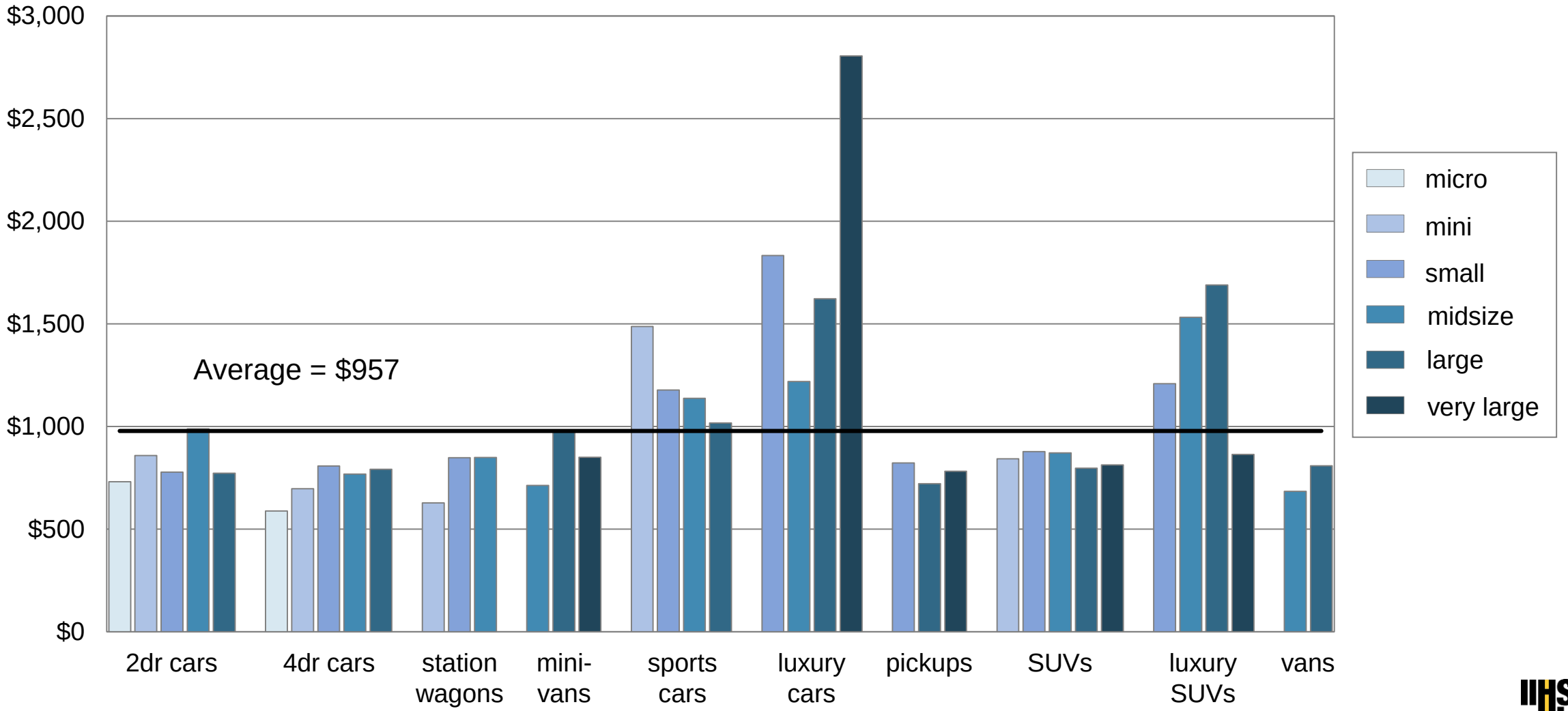
Percentage of glass claims under $125

By vehicle type and size and class, 2015–17 models



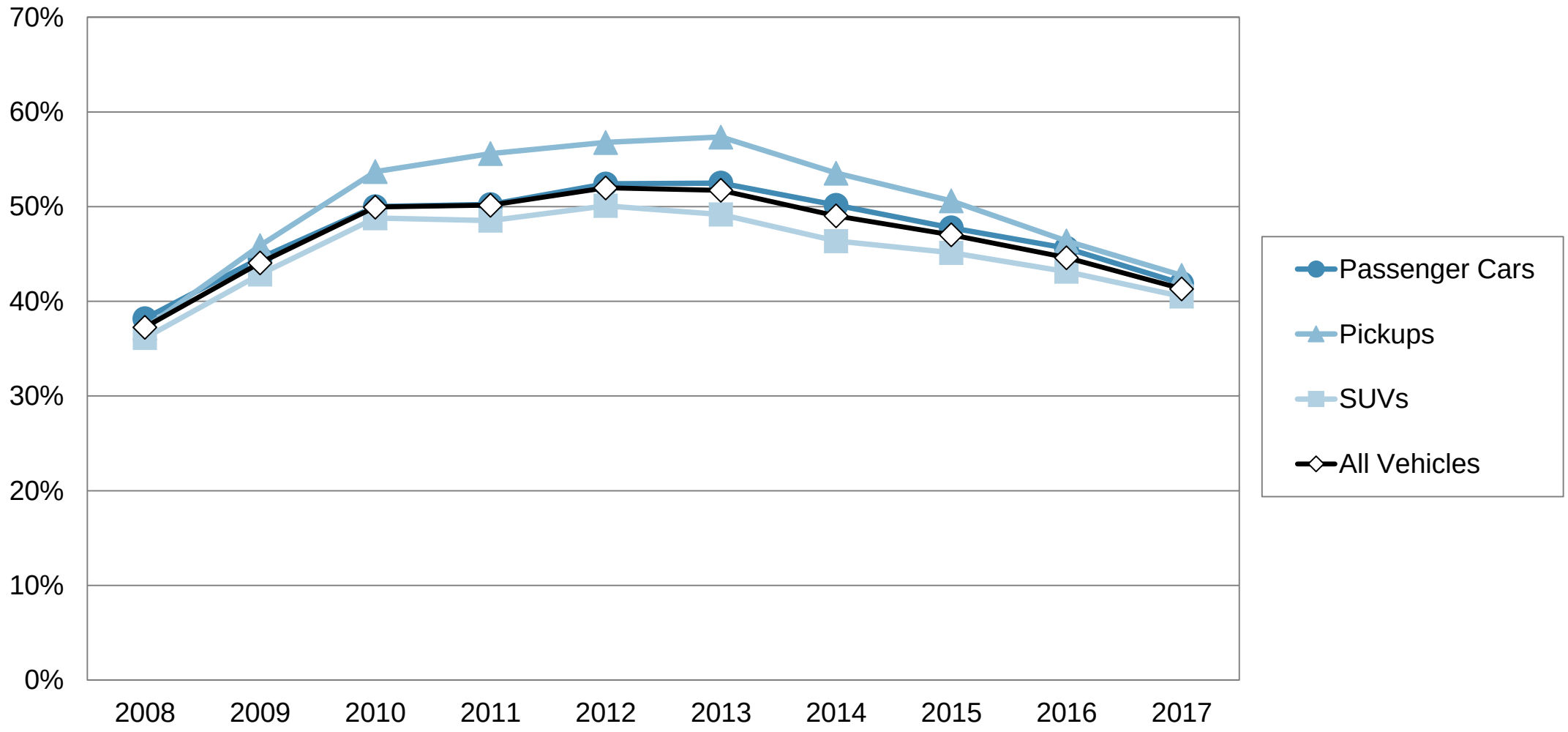
95th percentile of glass claims

By vehicle type and size and class, 2015-17 models

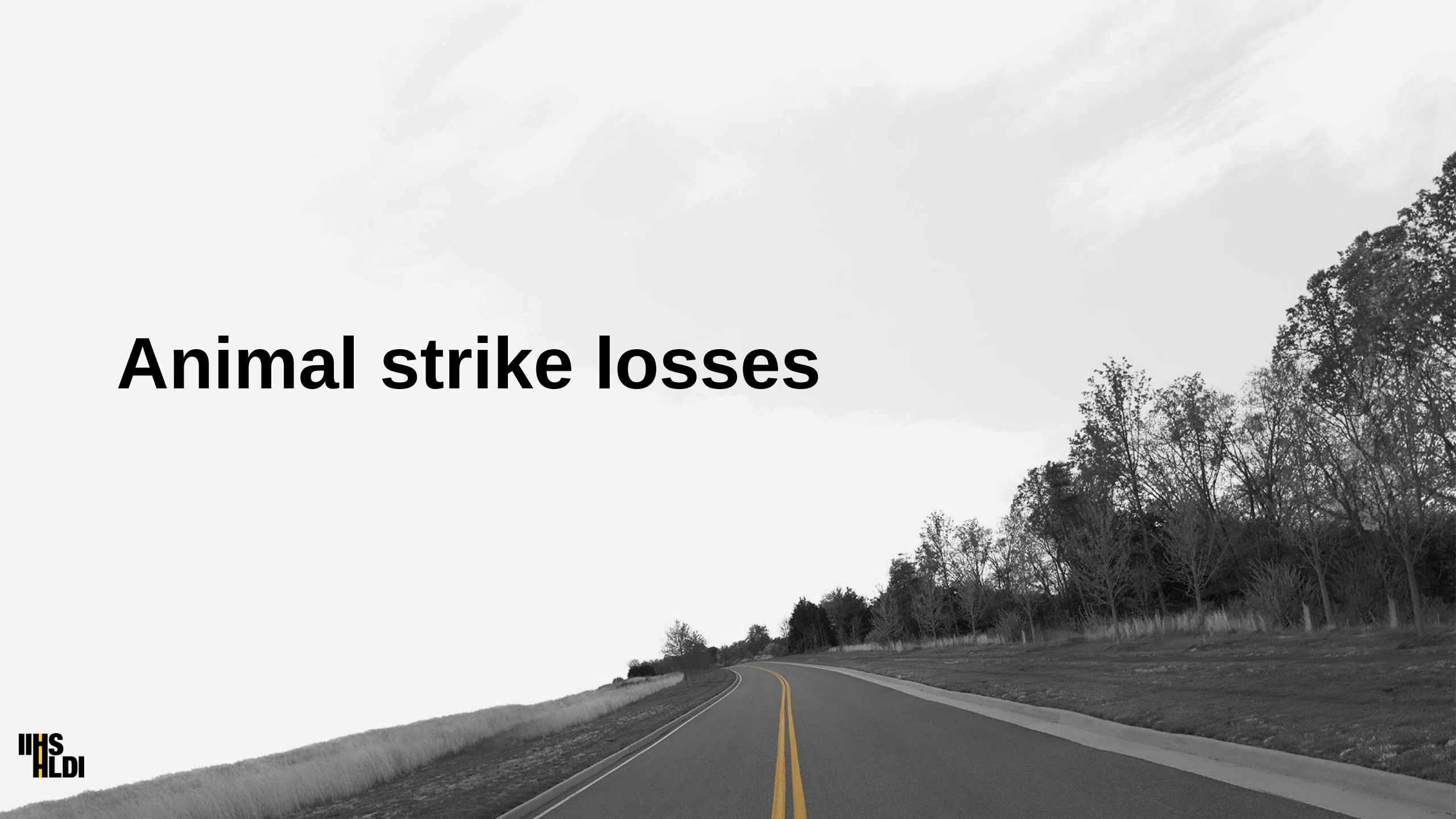


Percentage of glass claims under $125 by calendar year

Based on vehicles up to 3 years old

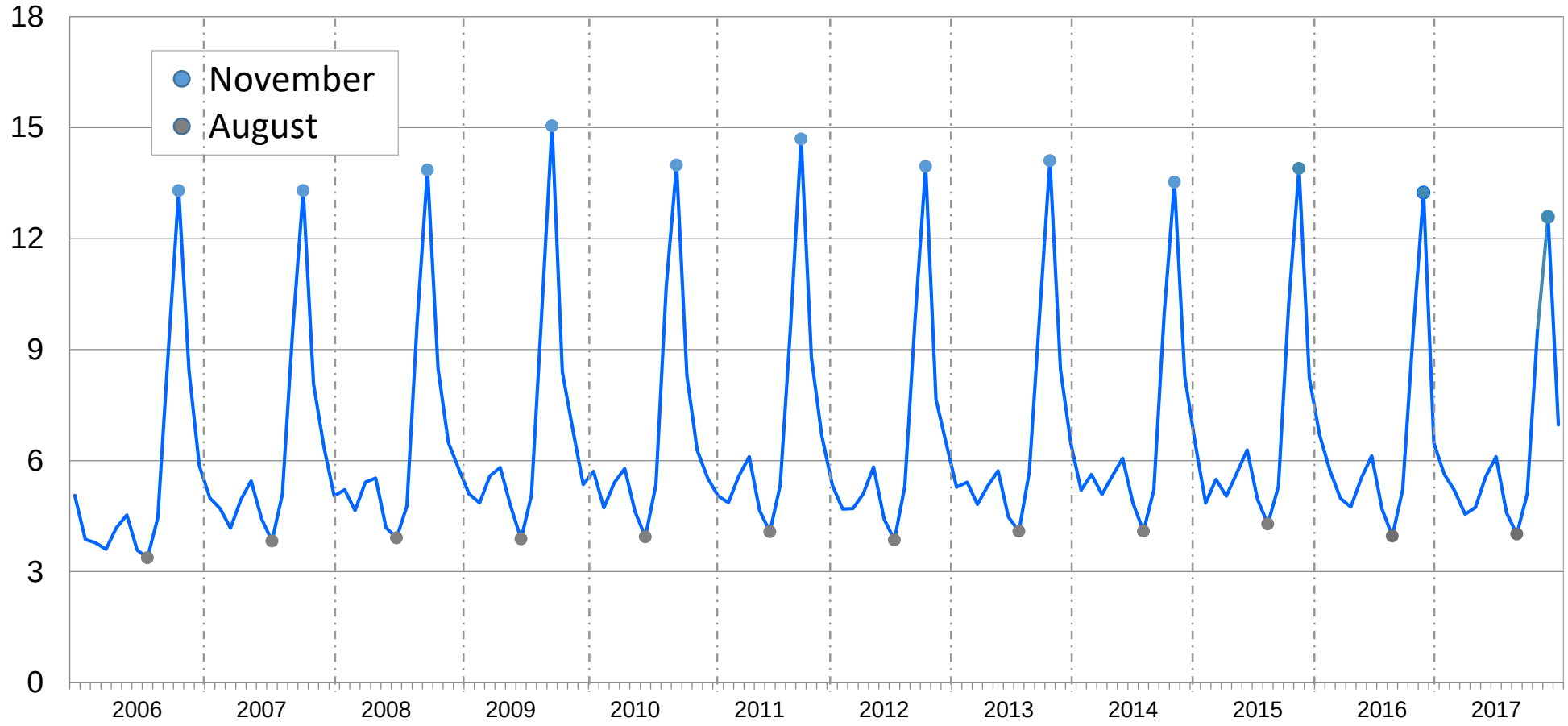


Animal strike losses



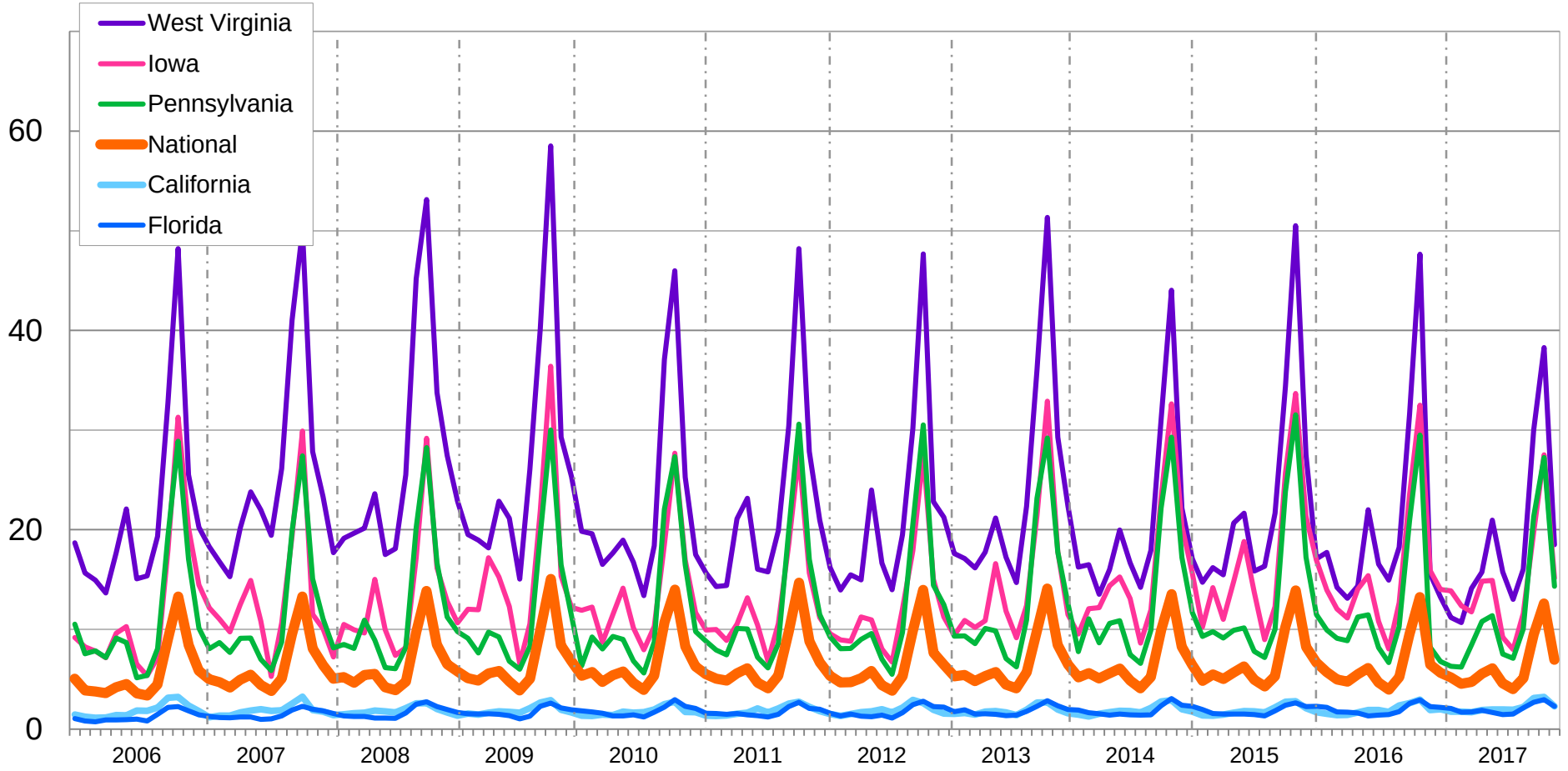
National comprehensive claim frequencies for animal strikes

January 2006–December 2017



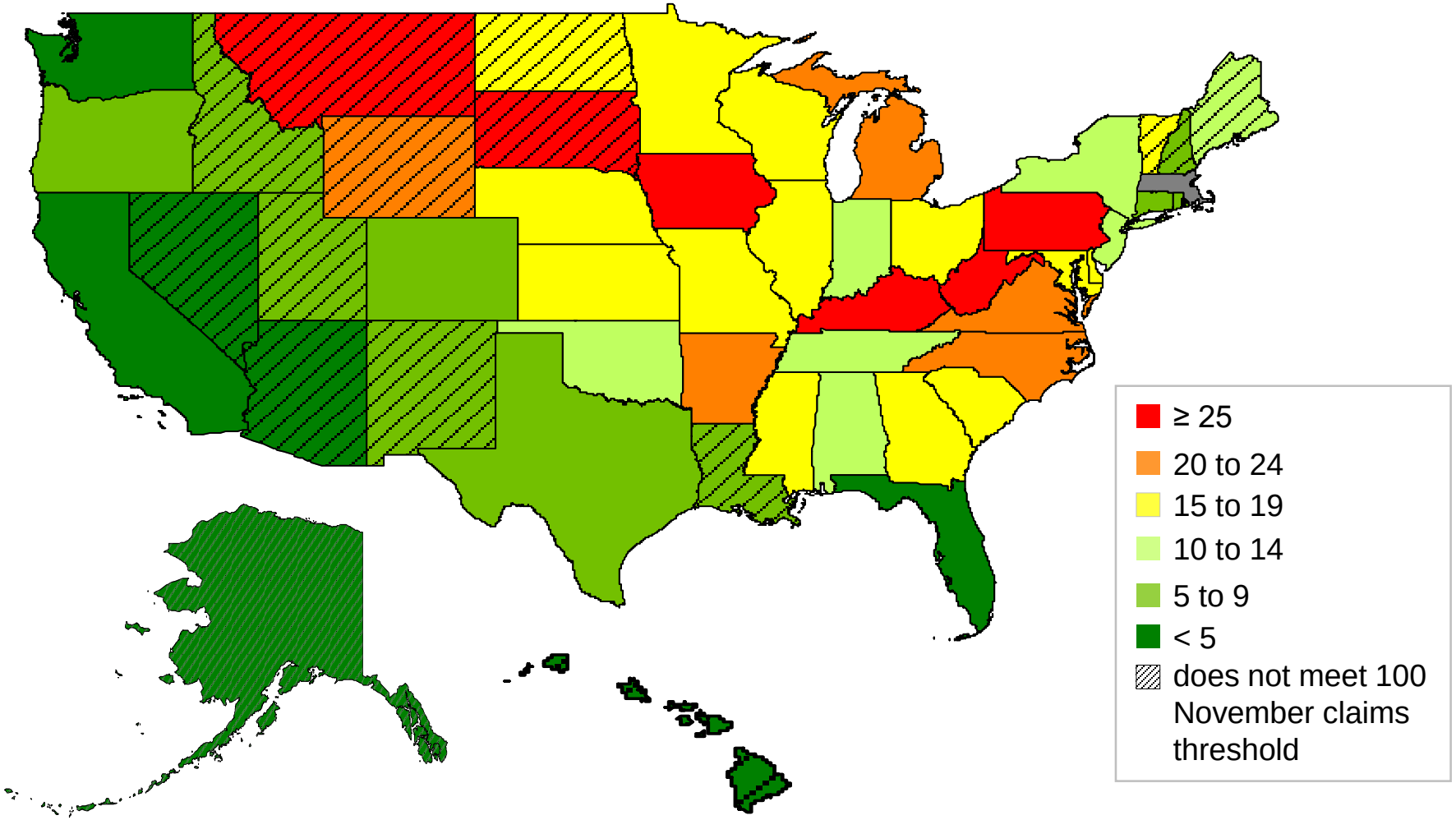
Comprehensive claim frequencies for animal strikes in selected states

Compared with national average, January 2006–December 2017



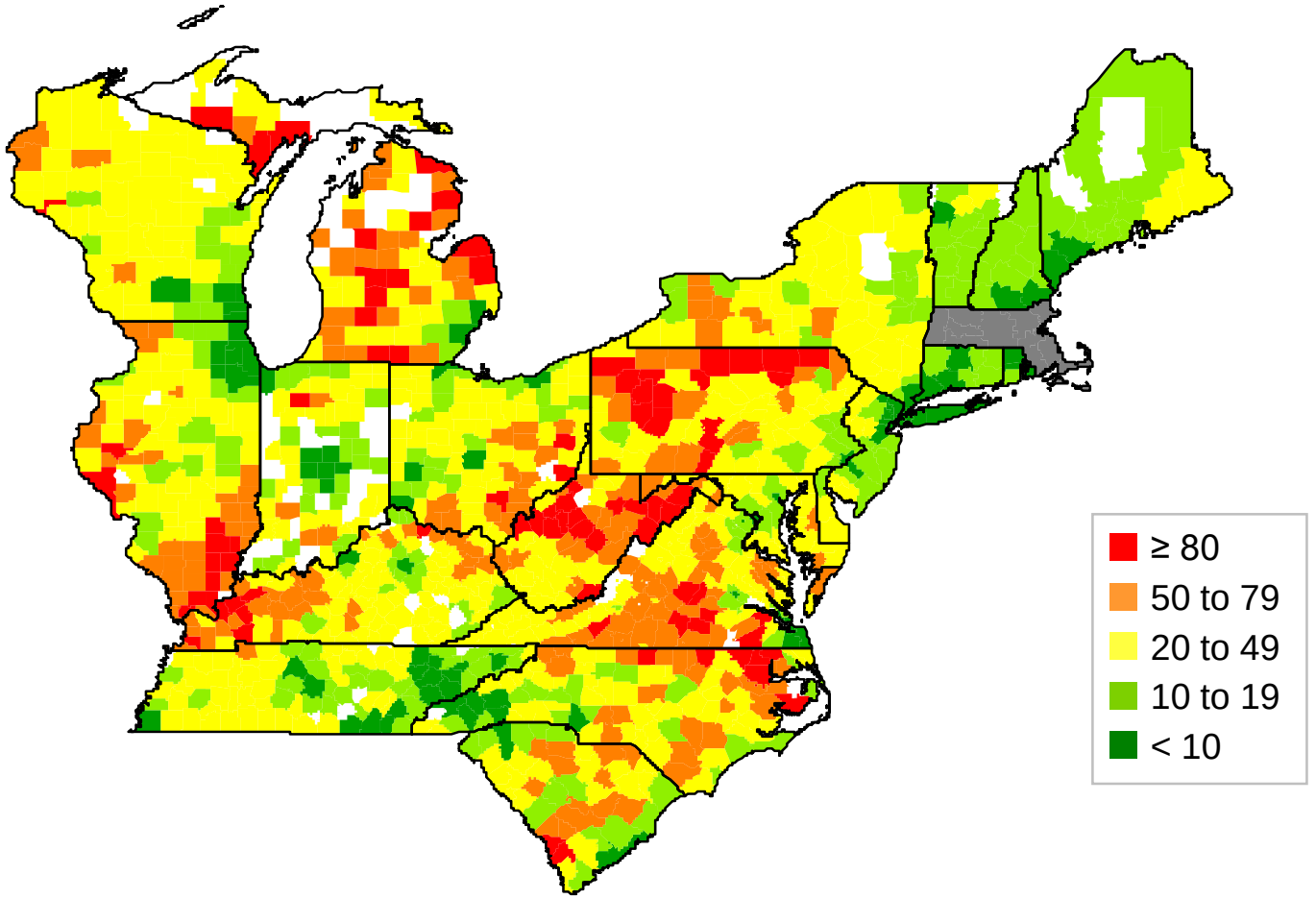
November animal-strike claims

Per 1,000 insured vehicle years



November animal-strike frequency

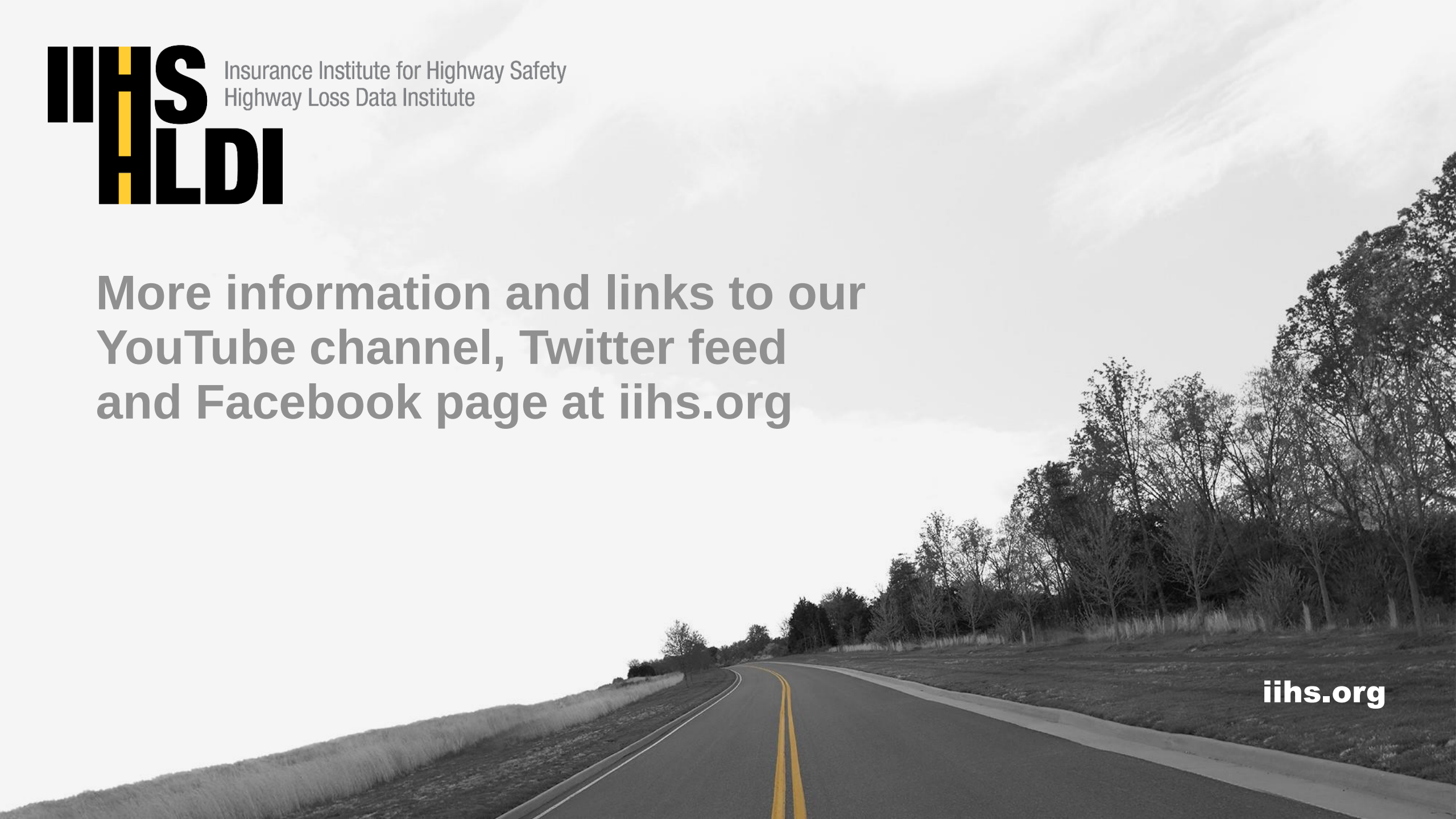
Per 1,000 insured vehicle years




Y94 radio talk show
Fargo, ND

Insurance Institute for Highway Safety
Highway Loss Data Institute

More information and links to our YouTube channel, Twitter feed and Facebook page at iihs.org



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