



Advanced Driver Assistance Systems and Available Data

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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.

Member groups

AAA Carolinas
Acceptance Insurance
Acuity Insurance
Alfa Insurance
Allstate Insurance Group
American Agricultural Insurance Company
American Family Insurance
American National
Ameriprise Auto & Home
Amica Mutual Insurance Company
Auto Club Enterprises
Auto Club Group
Auto-Owners Insurance
Celina Insurance Group
Central States Health & Life Co. of Omaha and Affiliates
CHUBB
Colorado Farm Bureau Insurance Company
Commonwealth Casualty Company
Concord Group Insurance
COUNTRY Financial
CSAA Insurance Group
Desjardins Insurance
Donegal Insurance Group
DTRIC Insurance
ECM Insurance Group
Elephant Insurance Company
EMC Insurance Group
Encova Insurance
Erie Insurance Group
Esurance
Farm Bureau Financial Services
Farm Bureau Insurance Company of Michigan
Farm Bureau Insurance of Tennessee
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, Inc.
The 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
La Capitale General Insurance
Liberty Mutual Insurance
Louisiana Farm Bureau Insurance Company
The Main Street America Group
MAPFRE Insurance Group
Mercury Insurance Group
MetLife
Metromile Insurance
Mississippi Farm Bureau Casualty Insurance Company
MMG Insurance
Munich Reinsurance America, Inc.
Mutual Benefit Group®
Mutual of Enumclaw Insurance Company
Nationwide
NJM Insurance Group
Nodak Insurance Company
The Norfolk & Dedham Group®
North Carolina Farm Bureau Mutual Insurance Company
North Star Mutual Insurance Company
Northern Neck Insurance Company
NYCM Insurance
Ohio Mutual Insurance Group
Oregon Mutual Insurance Company
Pekin Insurance
PEMCO Mutual Insurance Company
Plymouth Rock Assurance

Progressive Insurance
PURE Insurance
Qualitas Insurance Company
Redpoint County Mutual Insurance Company
The Responsive Auto Insurance Company
Rider Insurance
Rockingham Insurance
Root Insurance Co
RSA Canada
Safe Auto Insurance Company
Safeco Insurance®
Samsung Fire & Marine Insurance Company
Say Insurance
SECURA Insurance
Selective Insurance Company of America
Sentry Insurance
Shelter Insurance®
Sompo International
South Carolina Farm Bureau Mutual Insurance Company®
Southern Farm Bureau Casualty Insurance Company
State Auto Insurance Companies
State Farm Insurance Companies
Stillwater Insurance Group
Swiss Reinsurance Company Ltd
Texas Farm Bureau Insurance
The Travelers Companies, Inc.
USAA
Virginia Farm Bureau Mutual Insurance
West Bend Mutual Insurance Company
Western National Insurance Group
Westfield

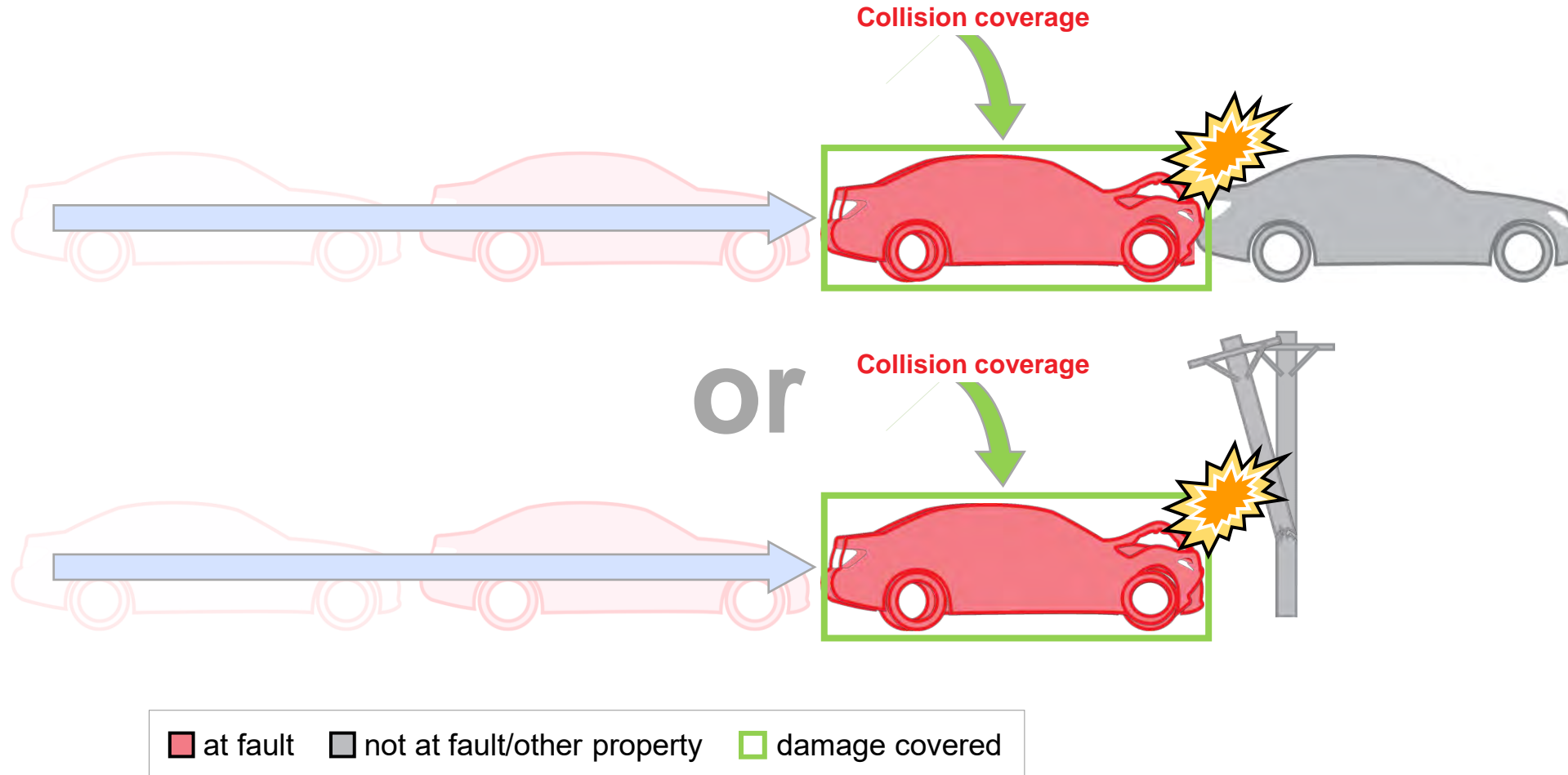
Funding associations

American Property Casualty Insurance Association
National Association of Mutual Insurance Companies

U.S. Auto Insurance 101

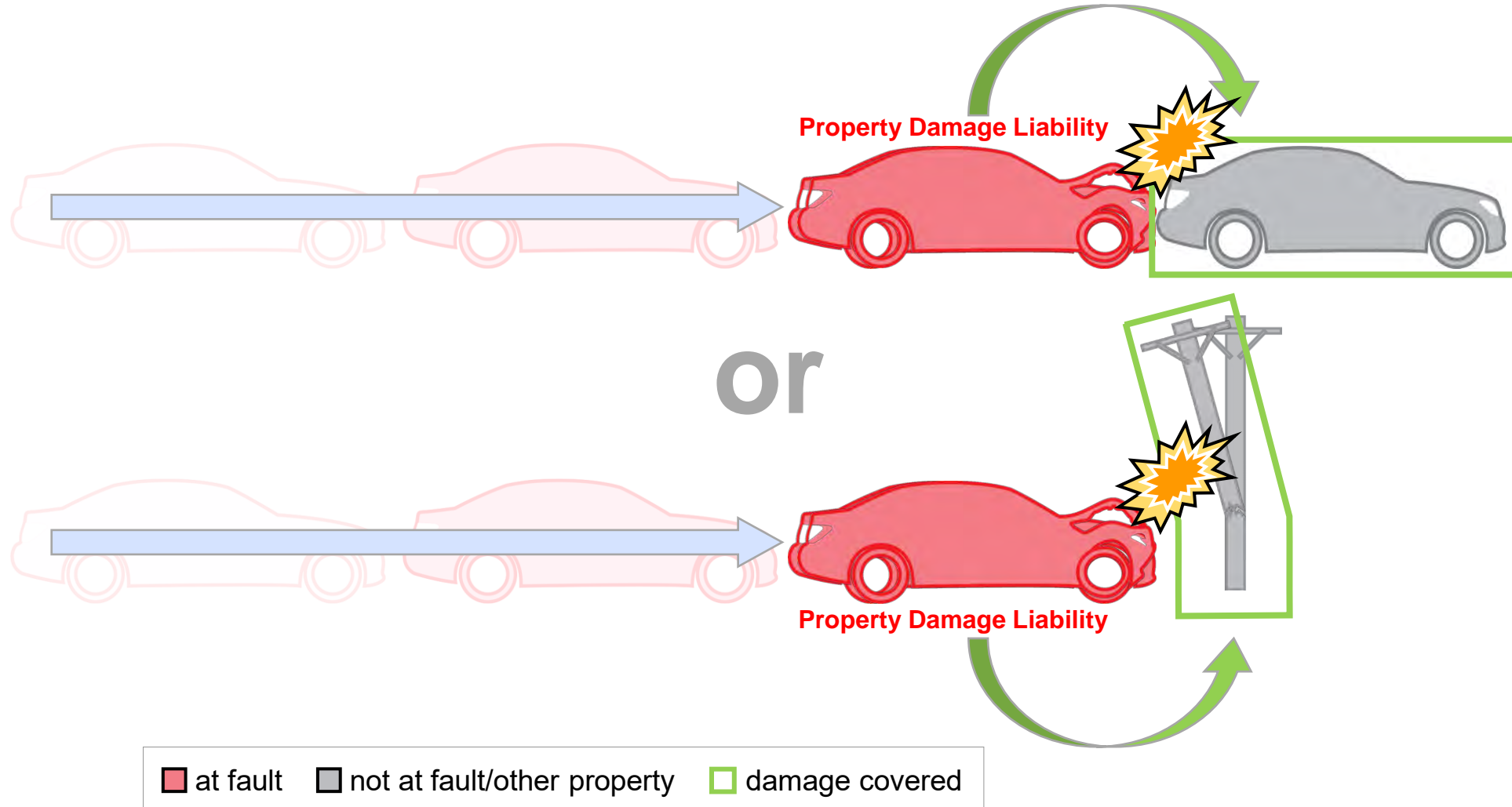
Collision coverage

Covers damage to your vehicle if you are at fault



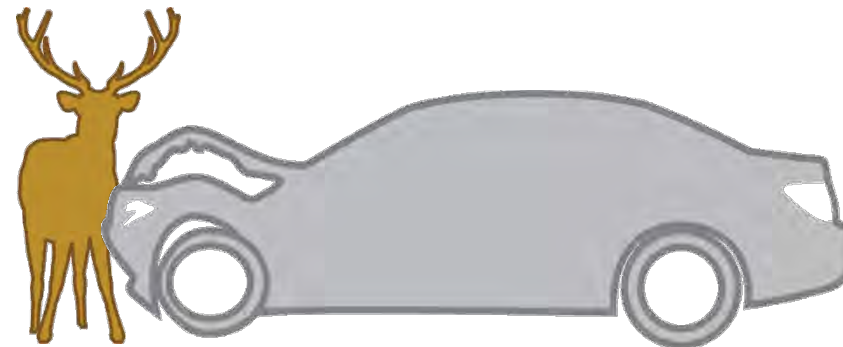
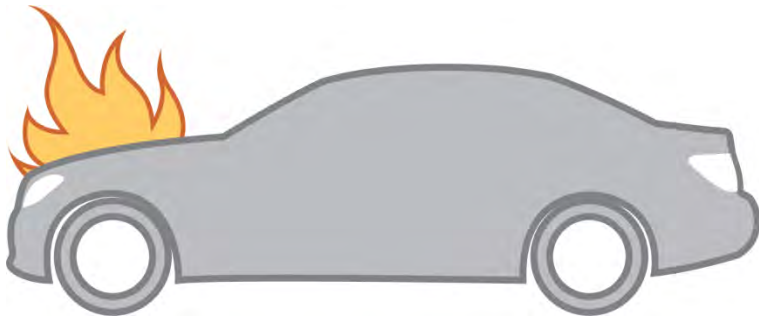
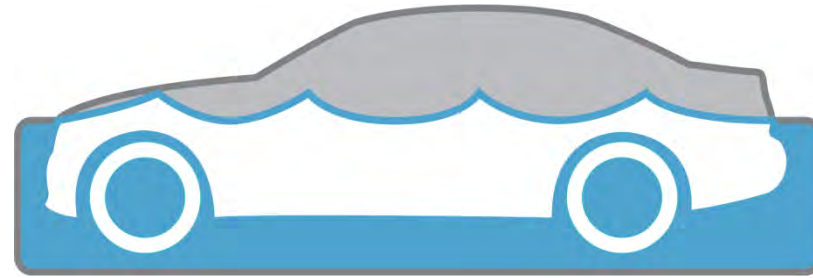
Property damage liability coverage

Covers damage you cause to other people's vehicles and property

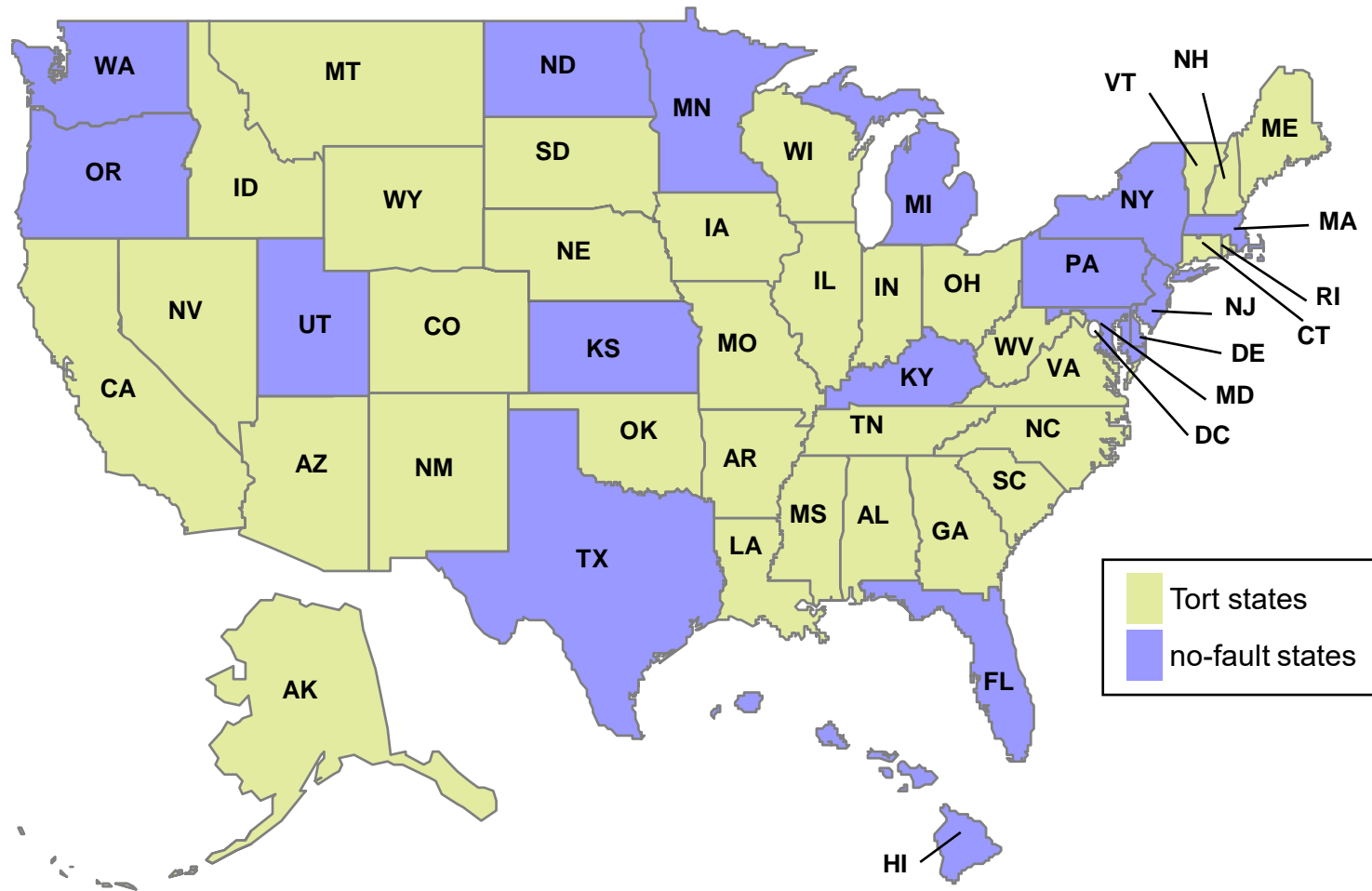


Comprehensive coverage

Covers theft and damage for reasons other than crashes

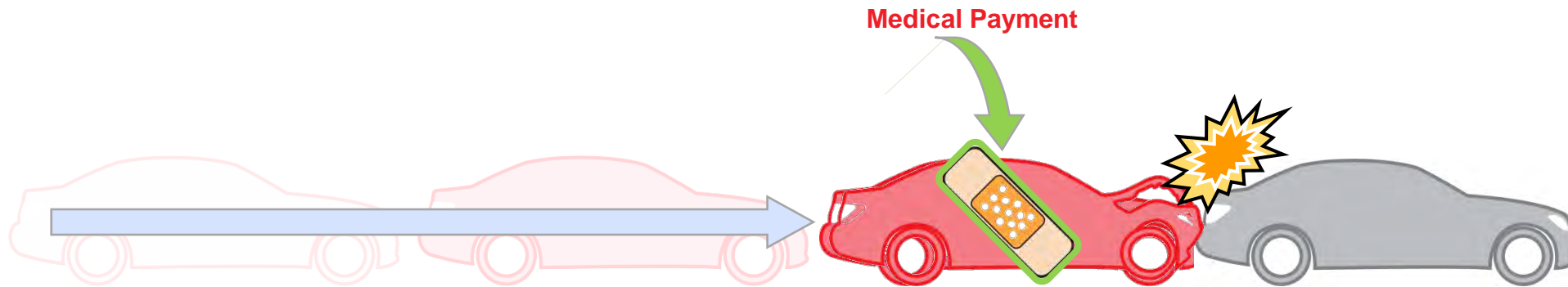


Tort and no-fault states



Medical payment coverage

Covers injuries to you and your passengers if you are at fault in states with traditional systems

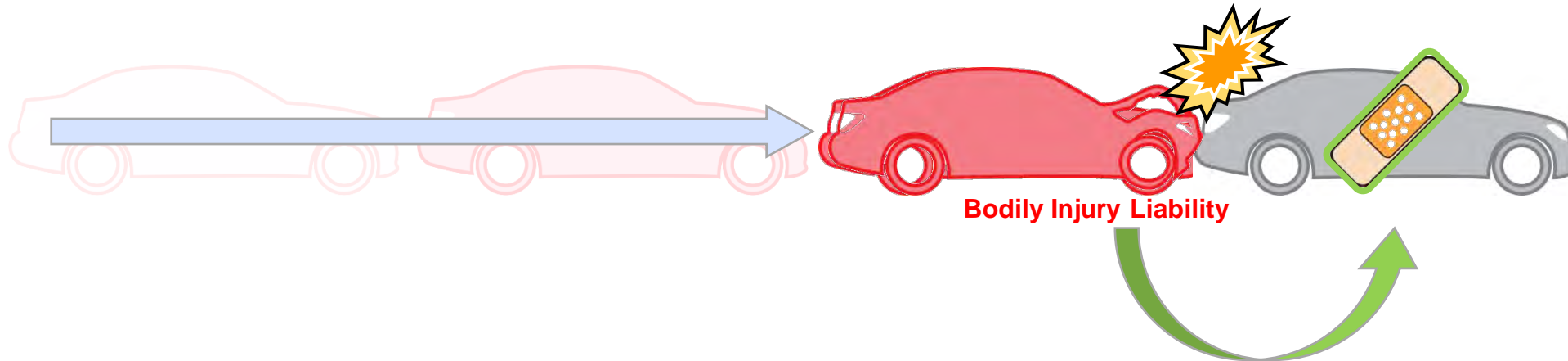


■ at-fault driver/passengers ■ not at-fault driver/passengers □ injuries covered

Bodily injury liability coverage

Covers injuries you cause to people in other vehicles in states with traditional systems

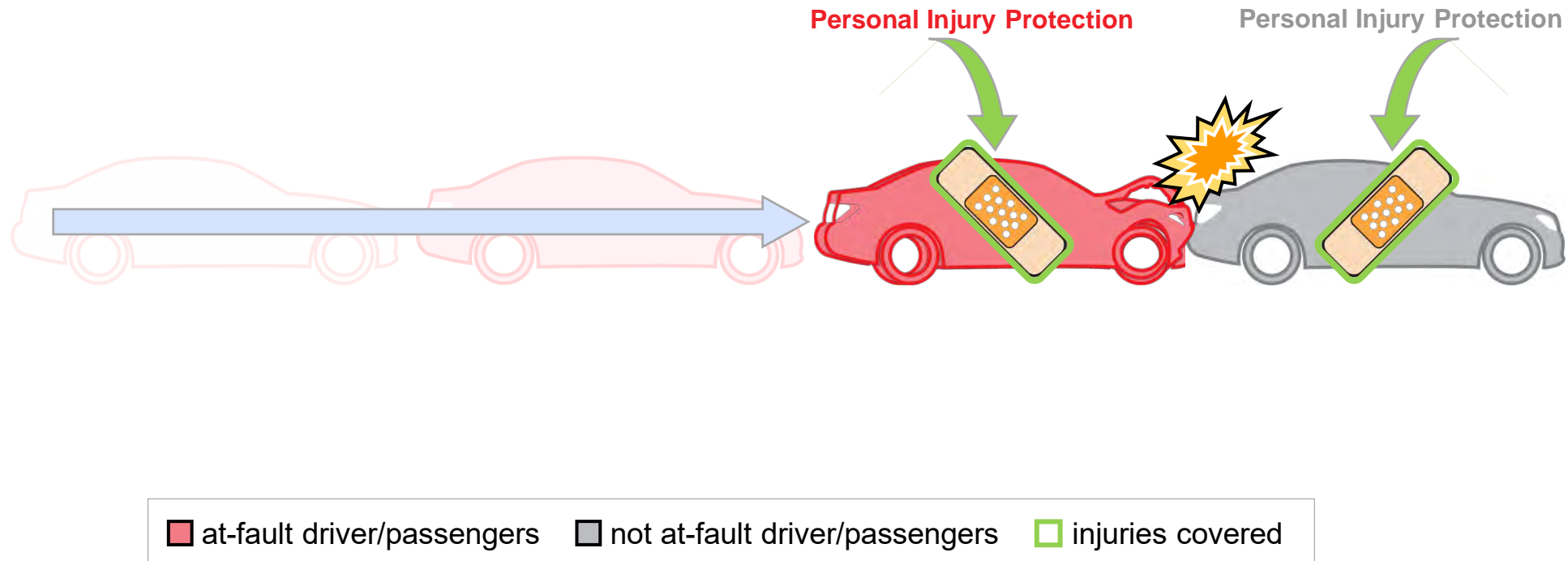
with traditional



■ at-fault driver/passengers ■ not at-fault driver/passengers ■ injuries covered

Personal injury protection coverage

Covers injuries up to a specified amount, regardless of who is at fault, in states with no-fault systems



Insurance measures

Exposure

- Expressed in insured vehicle years
- One insured vehicle year represents 1 vehicle insured for 1 year or 2 vehicles insured for 6 months

Claim frequency

- Calculated by dividing claims by exposure
- Expressed as the number of claims per selected number of insured vehicle years (exposure)

Claim severity

- Represents the average cost per claim
- Calculated by dividing dollars paid for all claims by the claim count

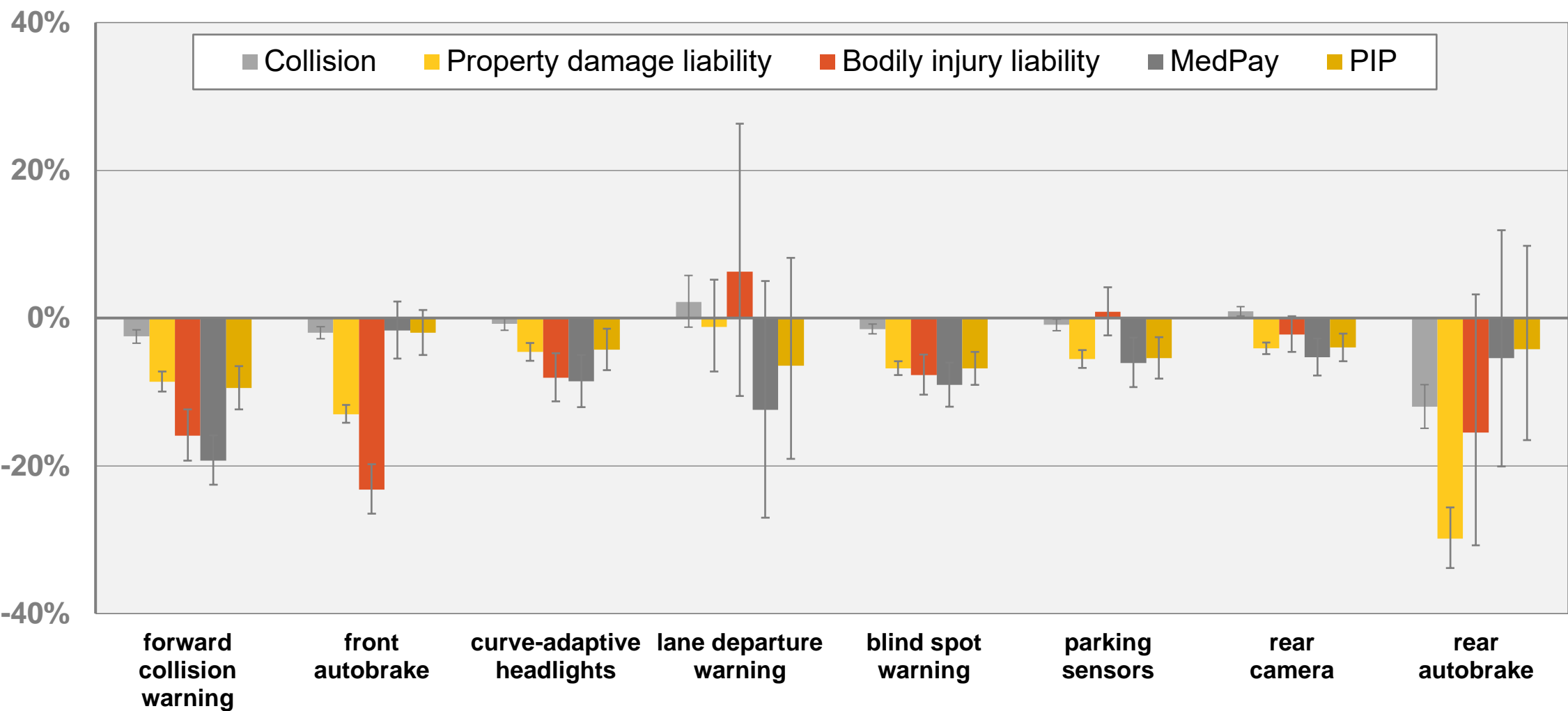
Overall losses

- Represents the average cost per insured vehicle (year)
- Calculated by dividing total dollars paid for claims by exposure

Evaluations of Advanced Driver Assistance Systems (ADAS) using insurance data

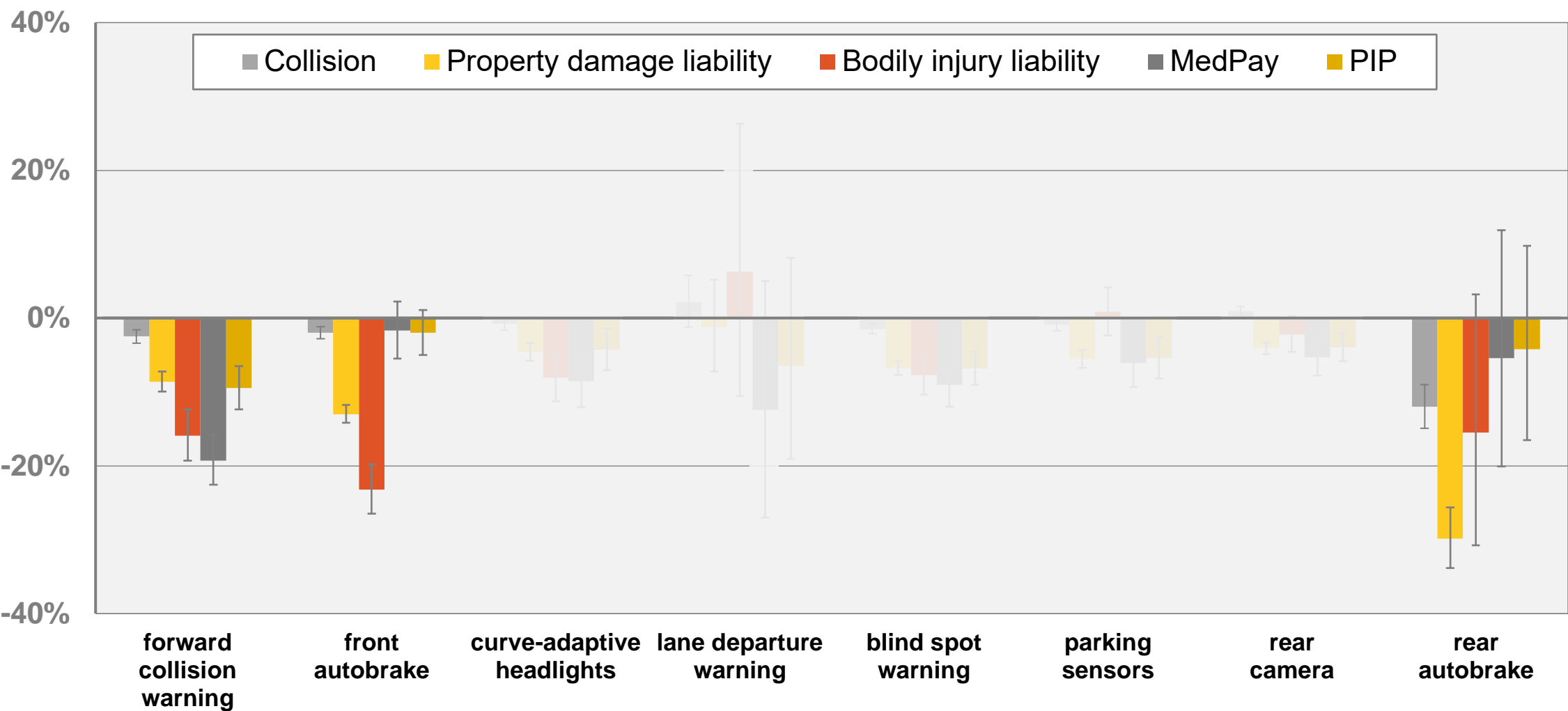
Effect of crash avoidance systems on claim frequency

Results pooled across automakers



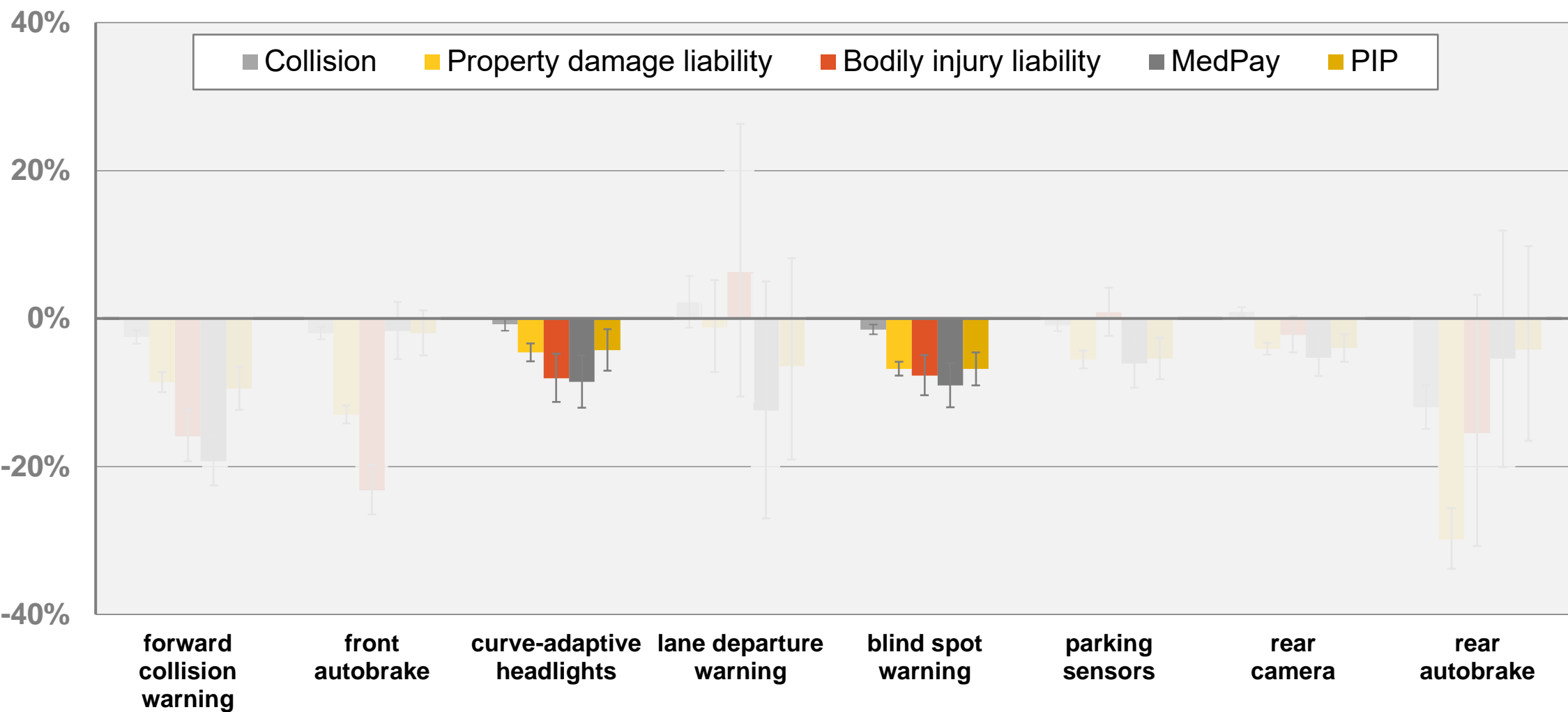
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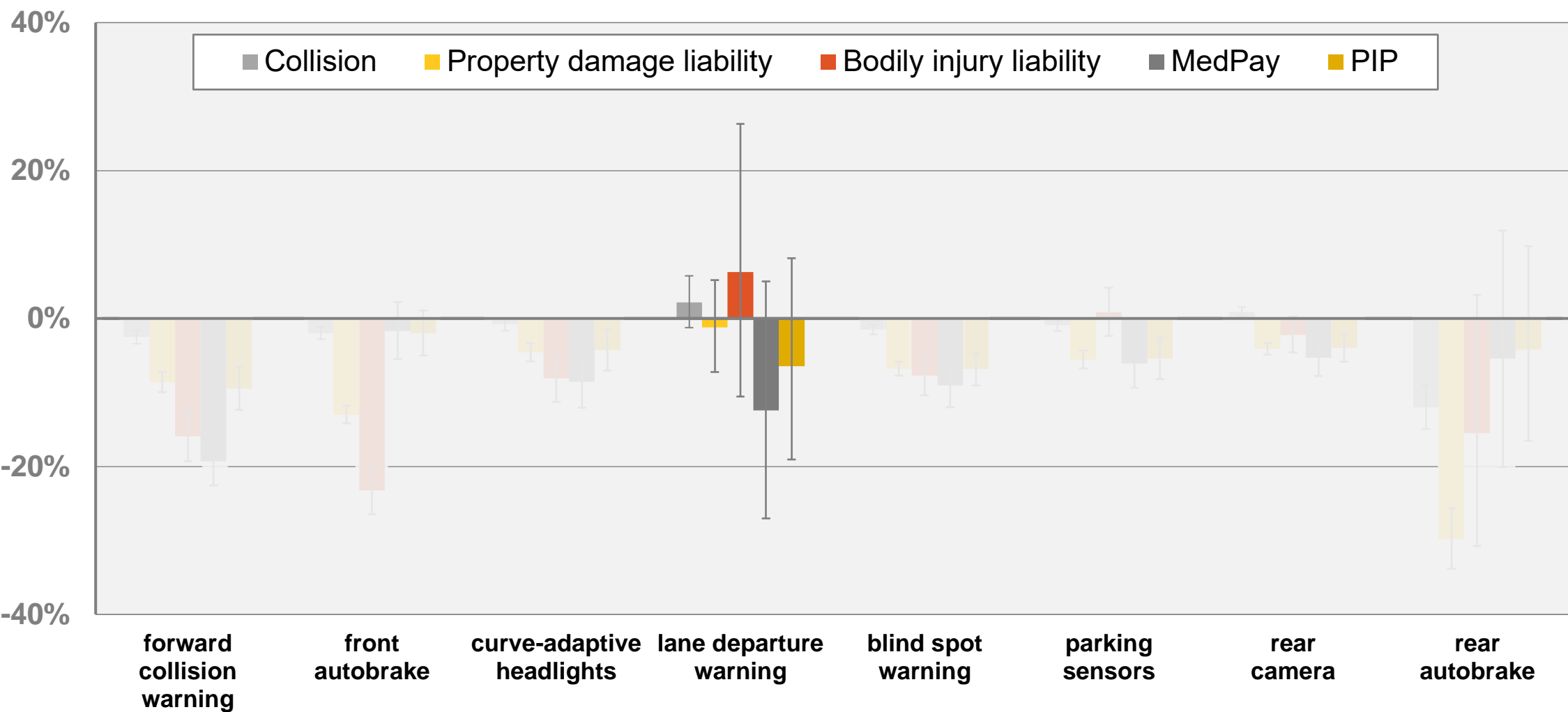
Effect of crash avoidance systems on claim frequency

Results pooled across automakers



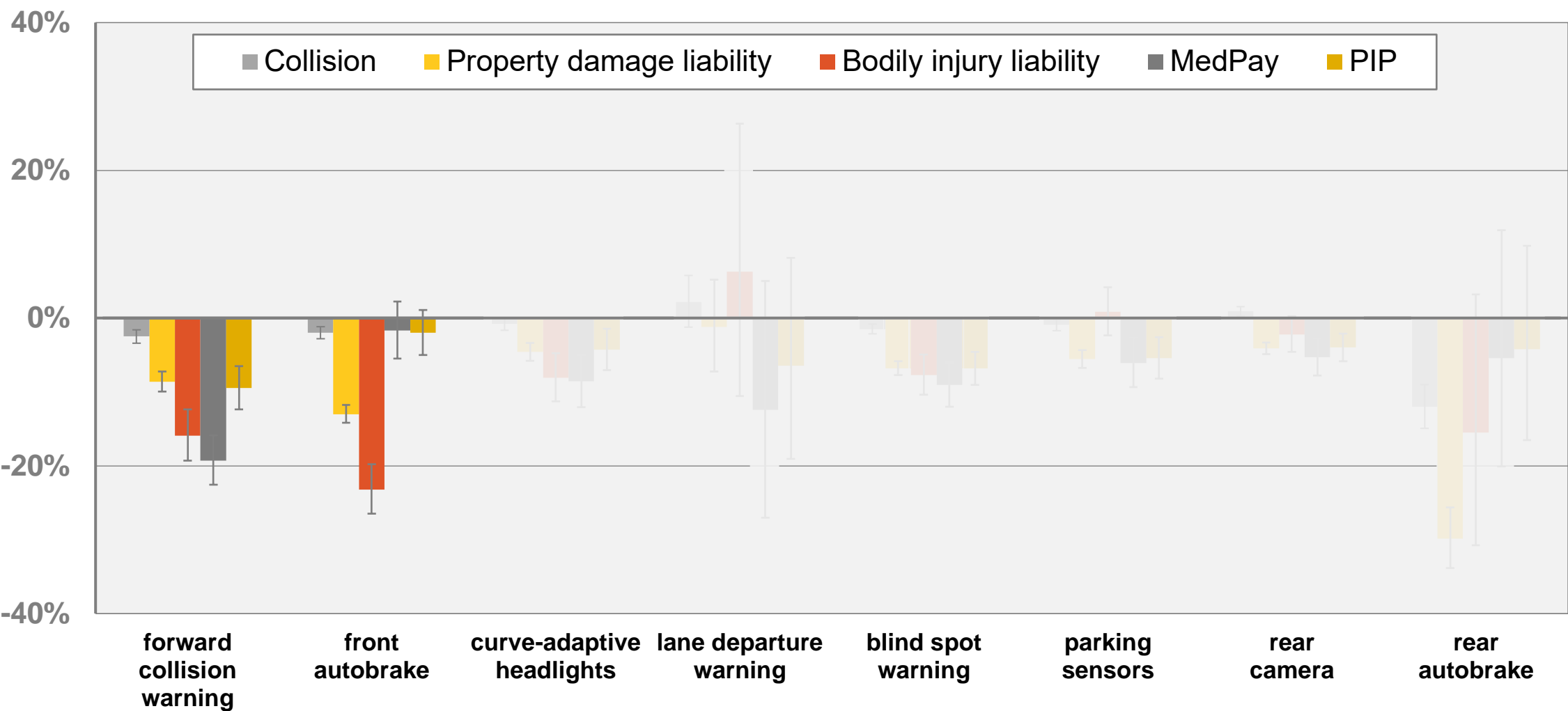
Effect of crash avoidance systems on claim frequency

Results pooled across automakers



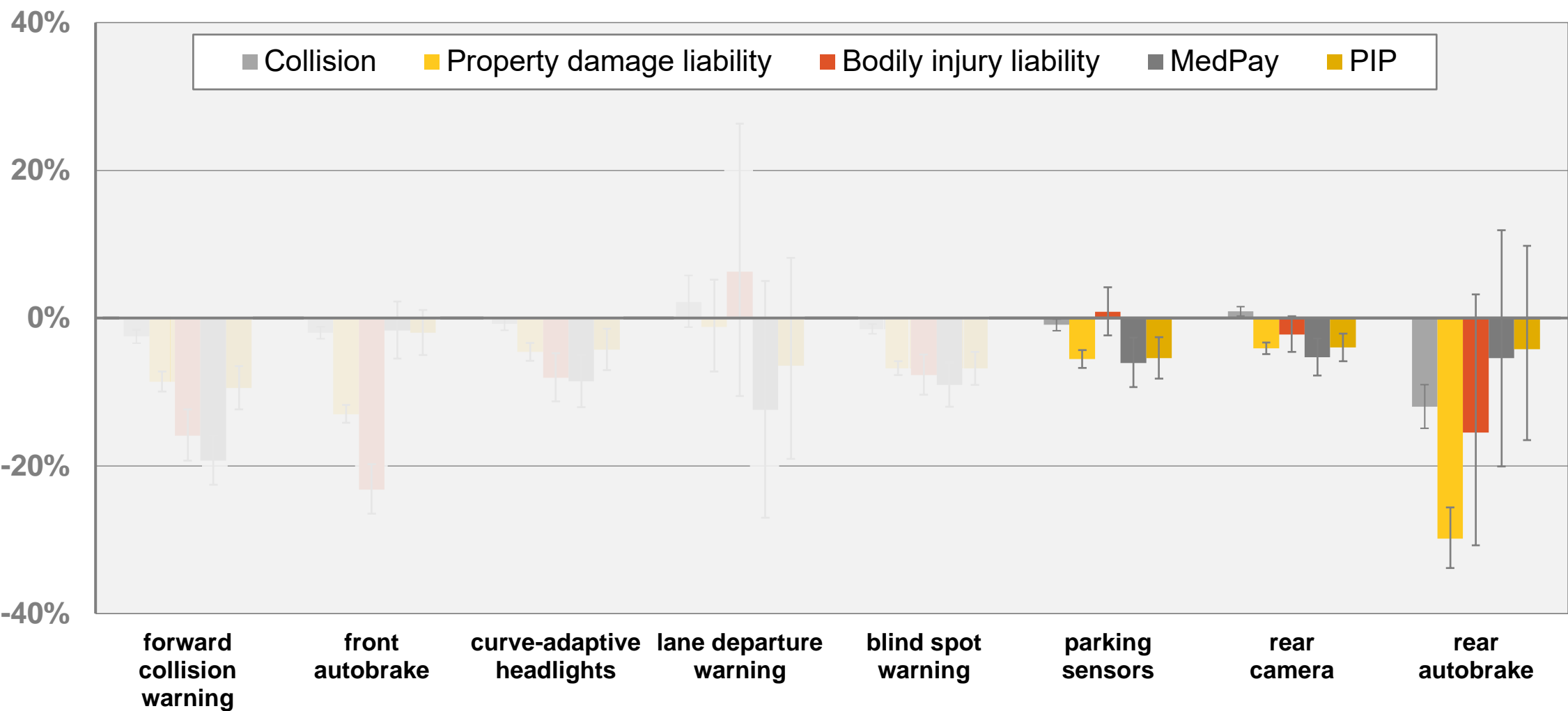
Effect of crash avoidance systems on claim frequency

Results pooled across automakers



Effect of crash avoidance systems on claim frequency

Results pooled across automakers



Evaluations of ADAS using police reported crash data

HLDI and police-reported crash data

Insurance data

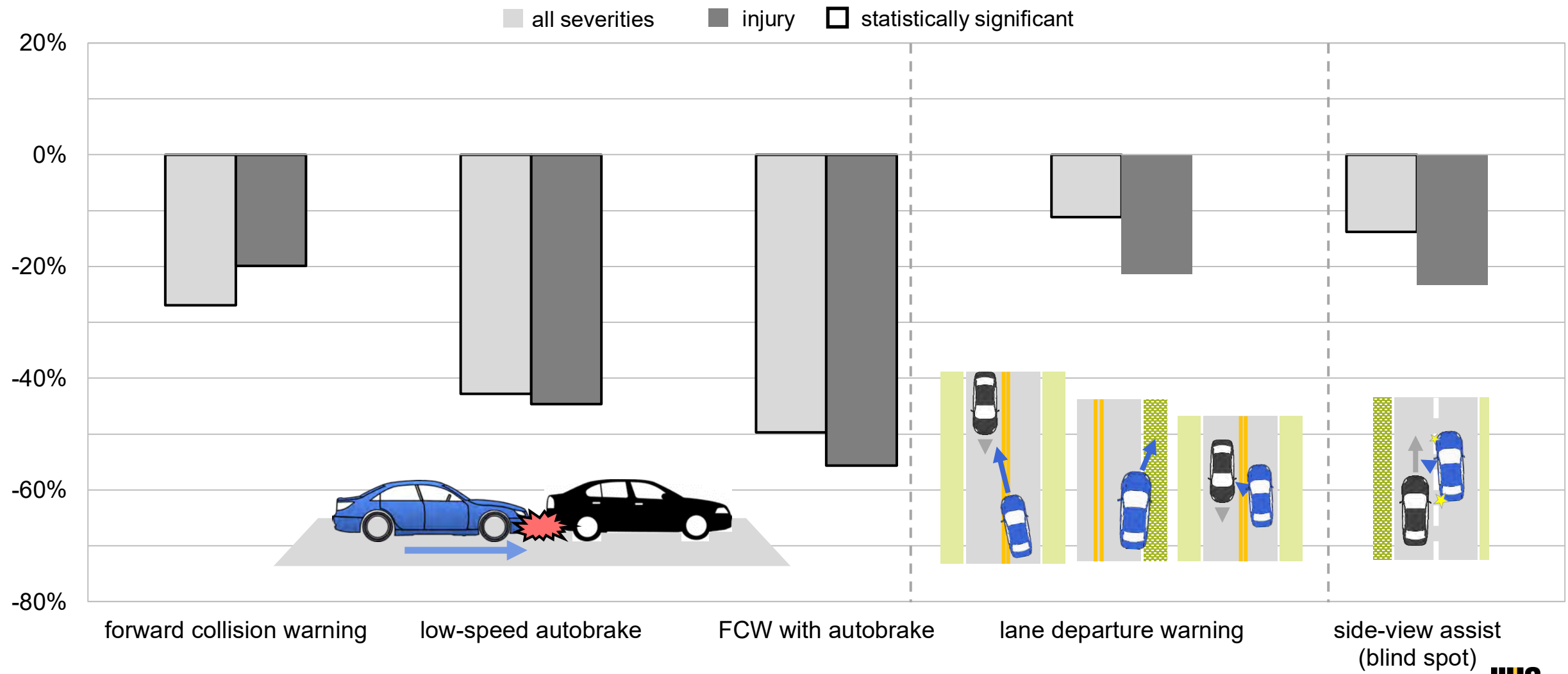
- ▶ Large amount of timely data
- ▶ Limited information on crash circumstances

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



Vehicle Identification Numbers (VINs)

What is a VIN?

- ▶ VINs are 17-digit alpha numeric strings that uniquely identify “vehicles”
- ▶ The contents of VINs are prescribed by FMVSS 565
- ▶ The contents of VINs vary by vehicle type
- ▶ VINs were required to be on all vehicles starting with model year 1981
- ▶ VINs were required as a tool to fight theft
- ▶ VINs are required to be on vehicles in several locations
 - Some locations are prescribed by FMVSS 565
 - Some locations are kept secret for anti-theft purposes

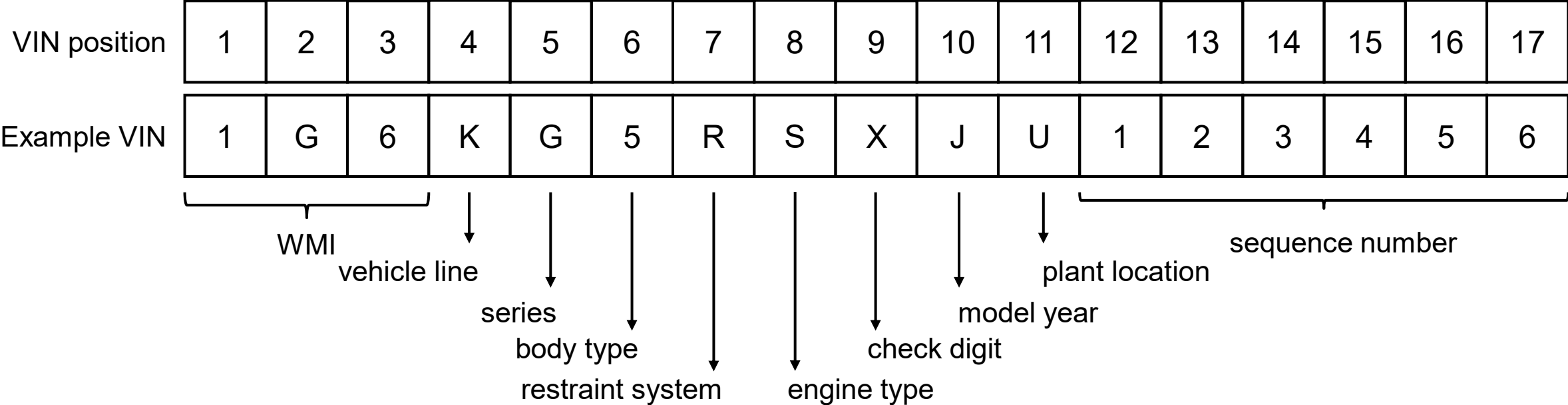
What is a VIN?

- ▶ VINs are affixed to vehicles in several ways
 - Stickers or plates
 - Stamped or engraved into major components
- ▶ All VINs regardless of vehicle type contain:
 - Model Year
 - Manufacturer
 - Model
- ▶ The only information about vehicle content that must be embedded in the VINs of automobiles are the engine, airbags and active seatbelts

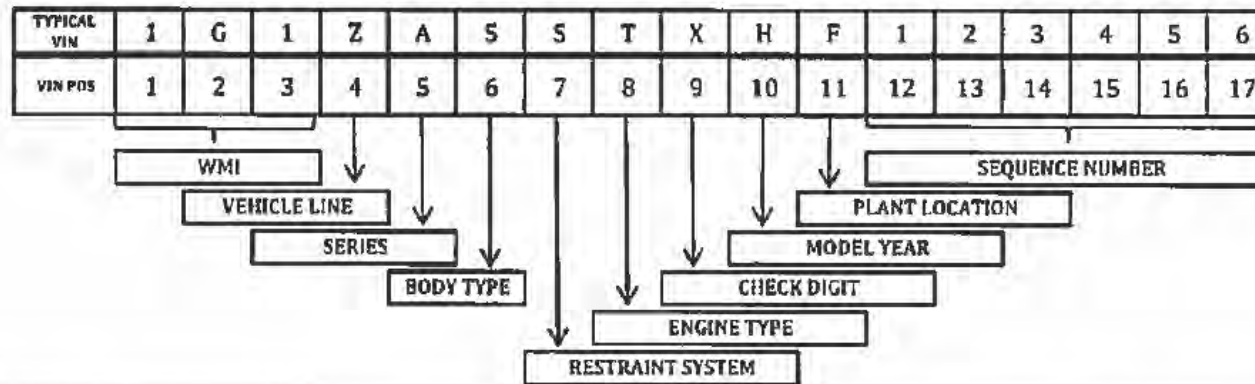
What is a VIN?

- ▶ The VIN contains two main sections
 - Encoded information (Positions 1 through 11)
 - Sequence number (Positions 12 through 17)
- ▶ There are two types of VIN level information
 - Encoded information
 - Associated information

VIN contents for passenger cars



Chevrolet Malibu



1-3: WORLD MAKE/MANUFACTURER IDENTIFIER (WMI)

- 1: Region of Build**
 - 1:** United States
- 2: Manufacturer**
 - G:** General Motors
- 3: Vehicle Brand/Type**
 - 1:** Chevrolet Passenger Car

8: ENGINE TYPE

- T:** LFV - ENGINE GAS, 4 CYL, L4, 1.5L, DI, DOHC, VVT, TURBO, GEN 1 GMNA
- U:** LKN - ENGINE GAS, 4 CYL, 1.8L, SIDI, DOHC, VVT, HYBRID, FAM 1 GEN 4, GME
- X:** LTG - ENGINE GAS, 4 CYL, 2.0L, SIDI, L4, ALUM DOHC, VVT, DCVCP TURBO, E0-E100, ALUM

4-5: VEHICLE LINE/SERIES

Book Z

- Z A:** Chevrolet Malibu, L (1VL)
- Z B:** Chevrolet Malibu, LS (1LS)
- Z C:** Chevrolet Malibu, LS (1FL)
- Z D:** Chevrolet Malibu, LT (2FL)
- Z E:** Chevrolet Malibu, LT (1LT)
- Z F:** Chevrolet Malibu, LT (2LT)
- Z G:** Chevrolet Malibu, Premier (1LZ)
- Z H:** Chevrolet Malibu, Premier (2LZ)
- Z I:** Chevrolet Malibu, Hybrid
- Z 9:** Chevrolet Malibu, (Non-US, Non-Canada)

9: CHECK DIGIT

0-9, X - Calculated by POMS

10: MODEL YEAR

H: 2017

11: PLANT LOCATION

When VIN position 1 is "1" (United States):

F: Fairfax

12-17: SEQUENCE NUMBER

Positions 12 through 17 represent the number sequentially assigned by the manufacturer in the production process.

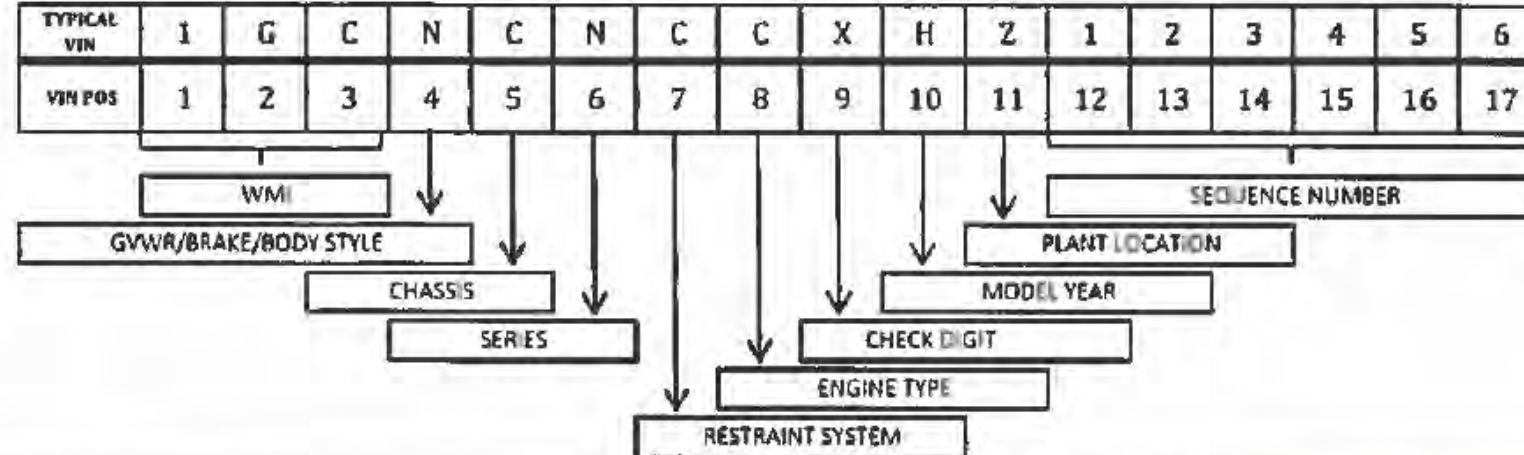
6: BODY STYLE

S: 69 - Sedan, 4 - Door, 4 Window, Notchback

7: RESTRAINT SYSTEM

S: AYP - Active Manual Belts, Airbags - Driver & Passenger Front (1st row), Front Seat Side (1st row) & Rear Seat Side (2nd row), Roof Side (all seating rows), Driver & Passenger knee (1st row)

Chevrolet Silverado



1-3: WORLD MAKE/MANUFACTURER IDENTIFIER (WMI)			
1: Region of Build		Valid Combinations	
1: United States		1GB	3GB
3: Mexico		1GC	3GC
2: Manufacturer			
G: General Motors			
3: Vehicle Brand/Type			
B: Chevrolet Incomplete Truck			
C: Chevrolet Truck			

4: GVWR/BRAKE SYSTEM/BODY STYLE				
GVW (Lbs)/ Brake System		Body Style		
		03	43	53
Class E: 6,001-7,000	Hyd.	N	P	R
Class F: 7,001-8,000	Hyd.		U	V
Class H: 9,001-10,000	Hyd.	0	1	2
Class 3: 10,001-14,000	Hyd.	3	4	5

5-6: CHASSIS/SERIES (CONTINUED)			
Book 6			
K	0:	4x4, 3500 Chevrolet Silverado, LTZ	
K	1:	4x4, 3500 Chevrolet Silverado, High Country	
K	9:	4x4, Chevrolet Silverado, (Non-US, Non-Canada)	

7: RESTRAINT SYSTEM	
C:	AK5 - Active Manual Belts, Airbag-Driver & Passenger-Front (1st row)
E:	AY0 - Active Manual Belts, Airbags-Driver & Passenger-Front (1st row). Front Seat Side (1st row), Roof Side (all seating rows)

8: ENGINE TYPE	
B:	LC8 - ENGINE LPG/CNG, 8 CYL, V8, 6.0L, SFI, GEN 1, GMNA
C:	L83 - ENGINE GAS, 8 CYL, 5.3L, SIDI VVT, AFM, E85 MAX, ALUM, GM
G:	L96 - ENGINE GAS, 8 CYL, 6.0L, SFI, E85 MAX, IRON, GM
H:	LV3 - ENGINE GAS, 6 CYL, 4.3L, GEN 5, SIDI, V6, VVT, OIIV, E85 MAX

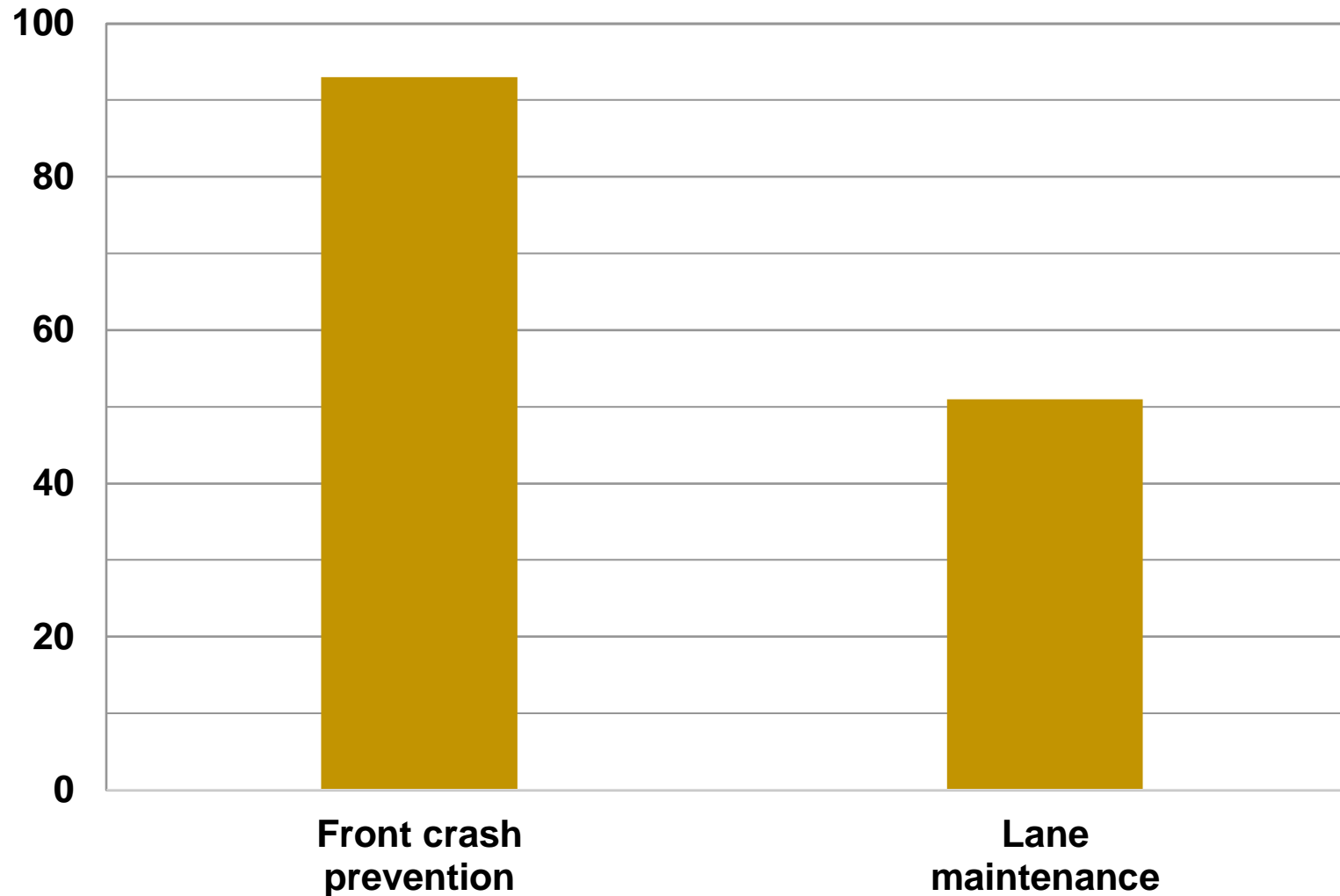
What is needed?

- ▶ An extension of the VIN standard that includes information about advanced driver assistance systems and vehicle automation
 - Static
- ▶ A VIN associated database that includes information about advanced driver assistance systems and vehicle automation along with information about software updates
 - Dynamic

Evaluations of system status

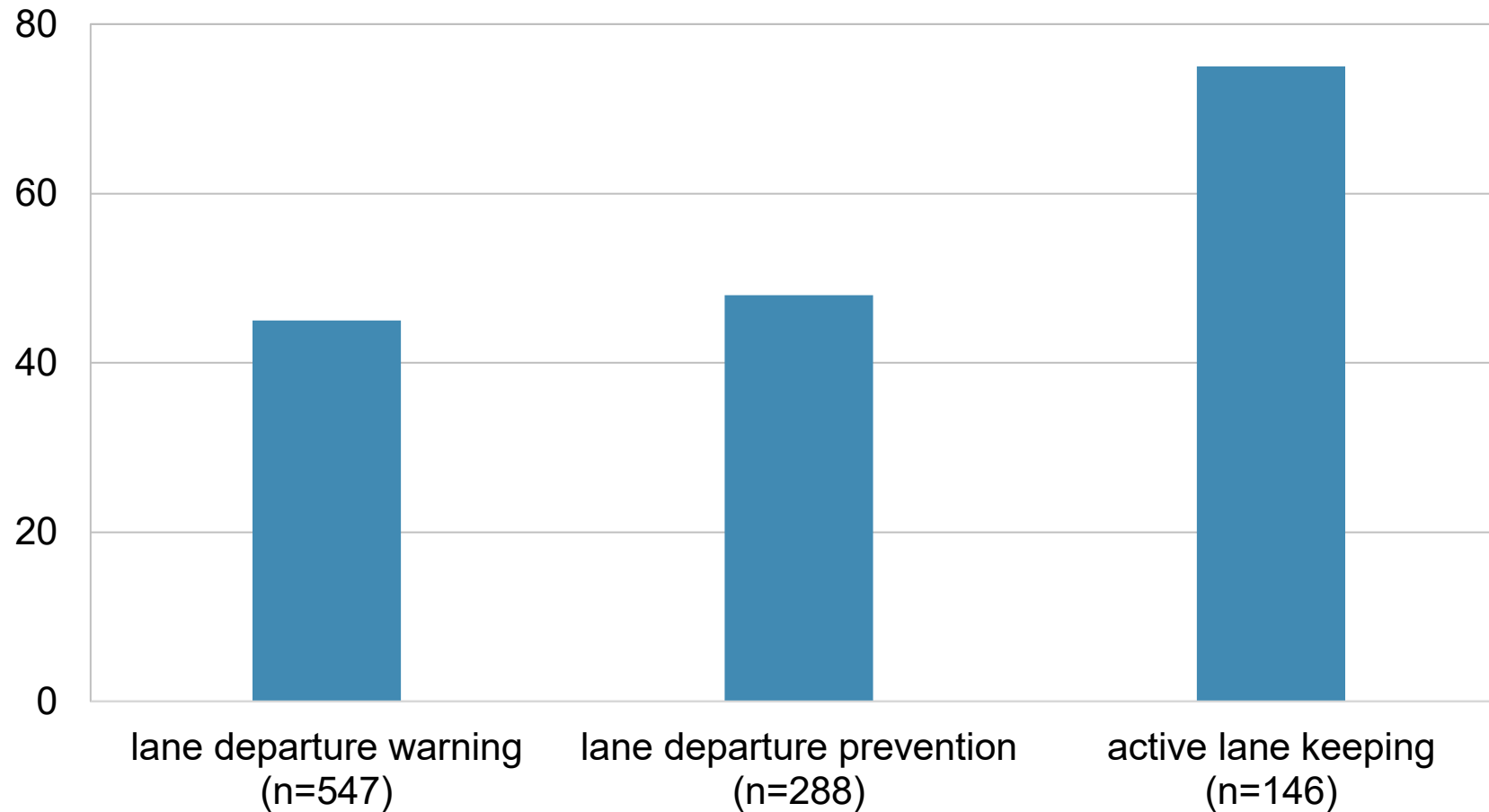
Status of crash prevention systems

Percent with system on



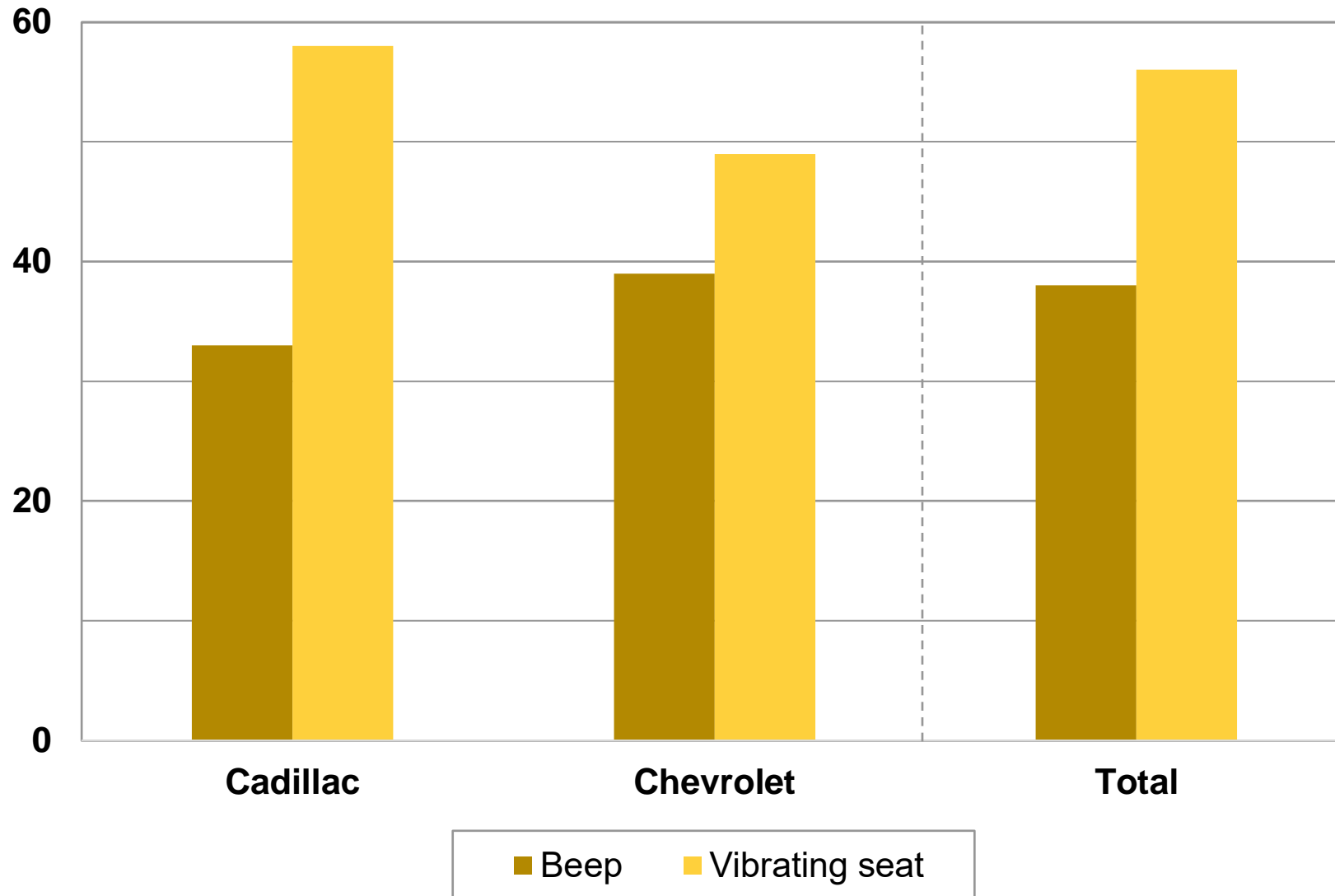
On-off status by maximum observable lane-maintenance intervention level

Percent with system on



GM lane departure warning on-off status by warning modality

Percent with system on



Event Data Recorders (EDRs)

What is an EDR?

- ▶ Requirements for Event Data Recorders (EDRs) are defined in FMVSS 563.
- ▶ An Event Data Recorder (EDR) is a function or device installed in a motor vehicle to record technical vehicle and occupant information for a brief period of time (seconds, not minutes) before, during and after a crash for the purpose of monitoring and assessing vehicle safety system performance
- ▶ Vehicles manufactured on or after September 1, 2010 voluntarily fitted with an EDR are subject to the requirements

What is an EDR?

- ▶ If a manufacturer voluntarily fits an EDR to a vehicle then that EDR is subject to 49 CFR Part 563.
- ▶ 49 CFR Part 563 includes 15 mandatory data elements and how those data must be logged.
- ▶ 49 CFR Part 563 includes a list voluntarily data elements and how those data must be logged.
- ▶ Manufacturers may choose to include data elements beyond the mandatory and voluntary data elements.

What is an EDR?

- ▶ Examples of mandatory data elements
 - Change in forward crash speed
 - Speed the vehicle was traveling
 - Was the accelerator pedal pressed?
- ▶ Examples of voluntary data elements
 - Sideways acceleration or force
 - Forward/rearward acceleration or force
 - Vertical acceleration

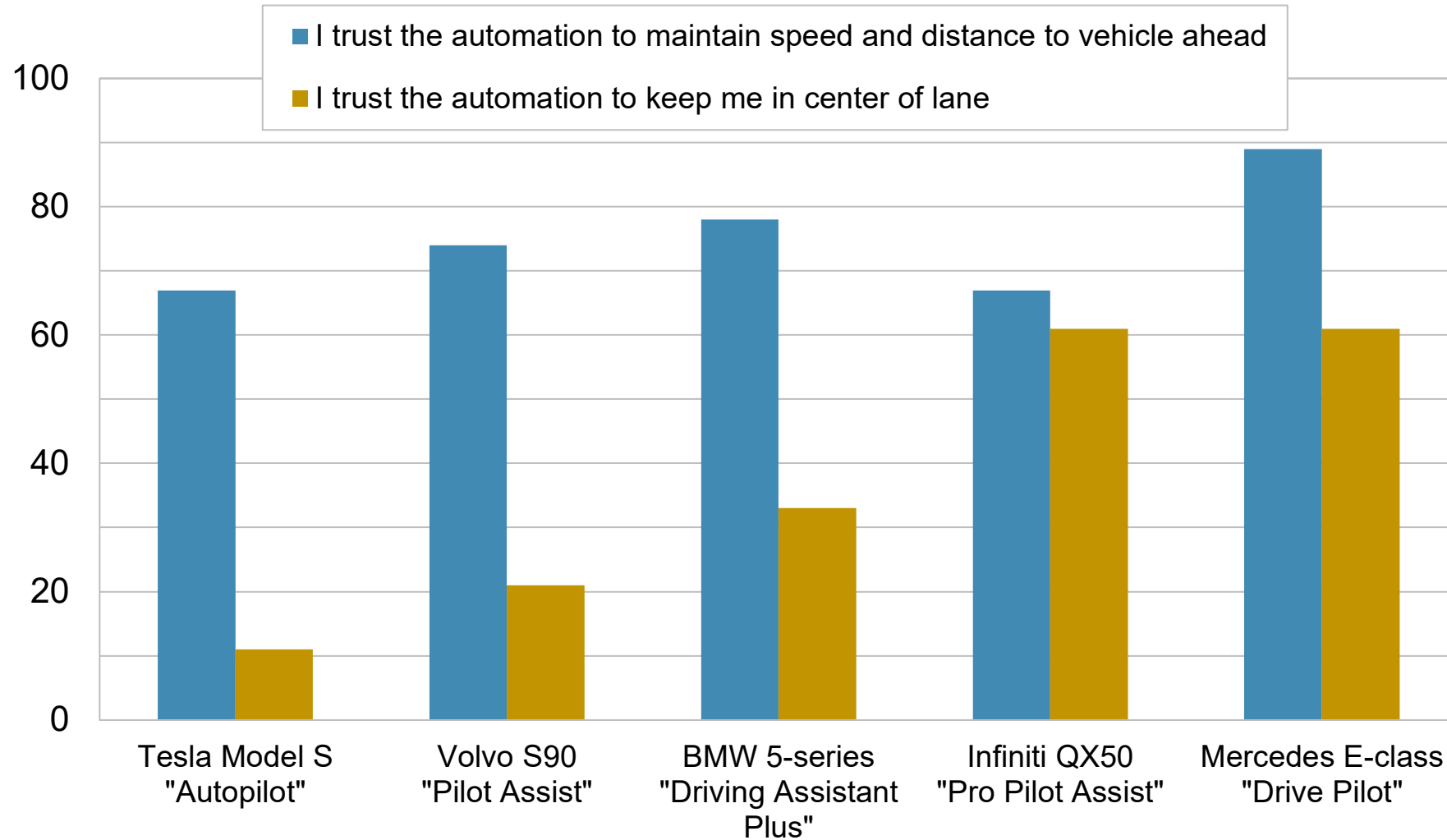
What is an EDR?

- ▶ Examples of mandatory data elements related to vehicle features
 - Did the ABS work?
 - Was the electronic stability control on or off, and if on, did it operate?
 - What steering operations occurred in the 5 seconds preceding the crash?
 - Was the right front passenger safety belt buckled 1 second prior to the crash?
 - If there was an on/off switch for the right front passenger air bag, how was it set?
On/off/automatic?

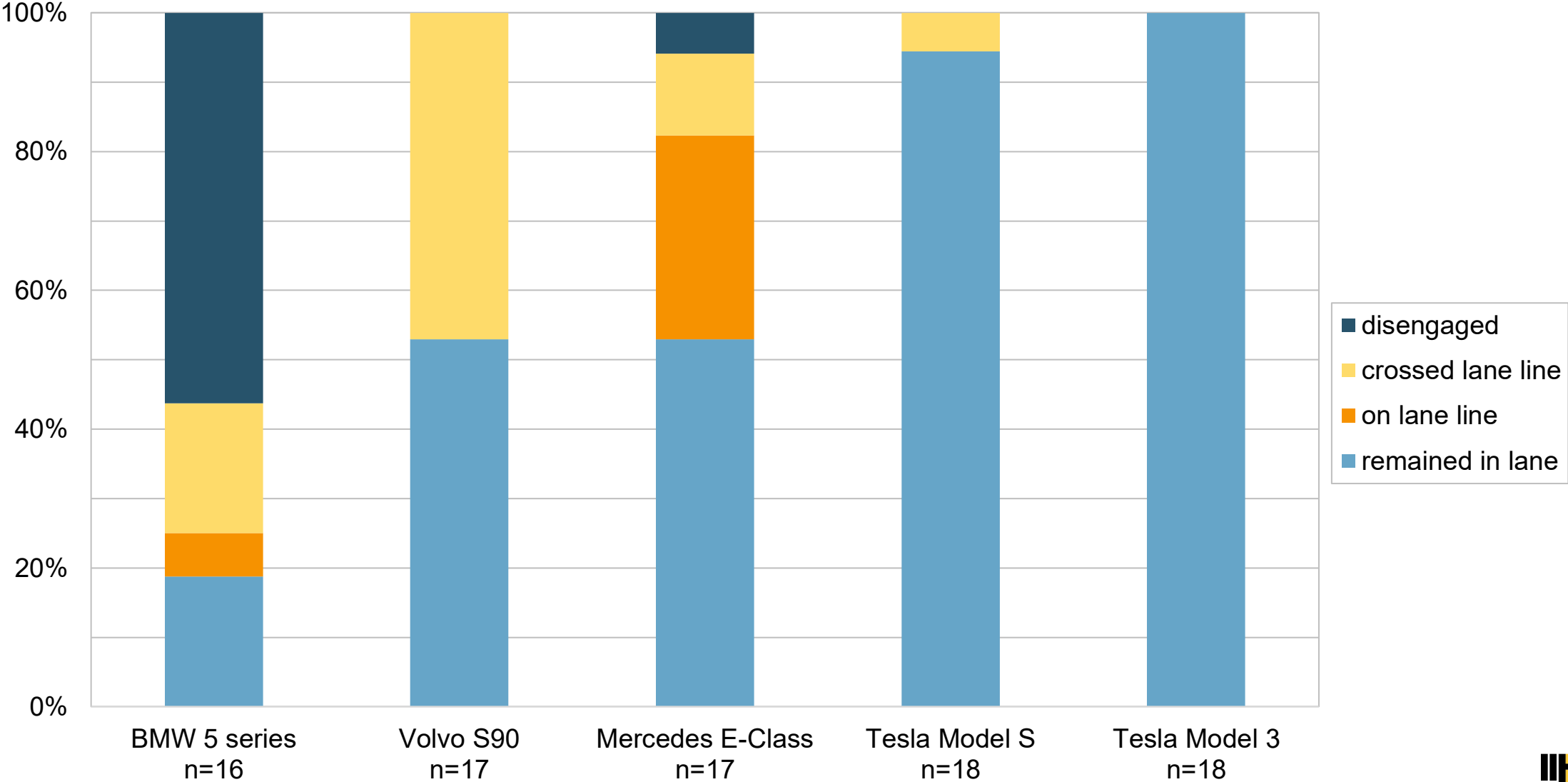
Experiences with driving automation

Adaptive cruise control trusted more than active lane keeping

Percentage of drivers who agreed or strongly agreed



Lane keeping in curves



On-Board Diagnostics

What is an OBD?

- ▶ On-Board Diagnostics (OBD) is additional software that monitors the emissions systems along with some engine components.
- ▶ The purpose of the OBD is to detect malfunctions or deteriorations that can affect emissions and illuminate the "Check Engine" or "Service Engine Soon" lights
- ▶ The federal regulations related to OBD are primarily found in CFR Part 86
- ▶ OBD requirements were implemented with the 1994 model year. However, waivers were granted during model years 1994 and 1995. Model year 1996 was the first year that waivers were not available.

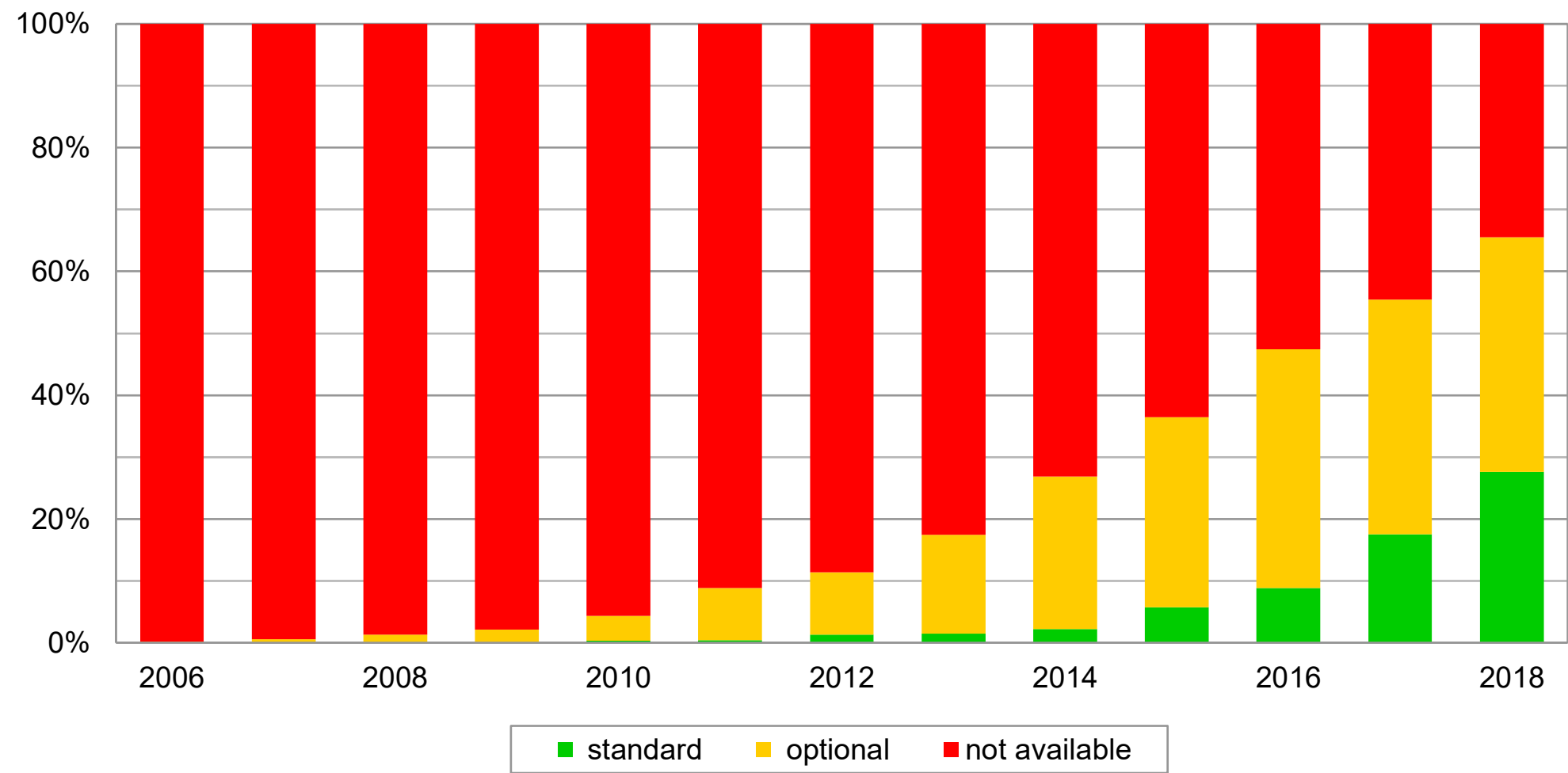
What is an OBD?

- ▶ OBD information is often used for Pay-As-You-Drive insurance
- ▶ ODB ports commonly provide vehicle speed and RPMs

Phase in of collision avoidance systems

New vehicle series with autonomous emergency braking

By model year



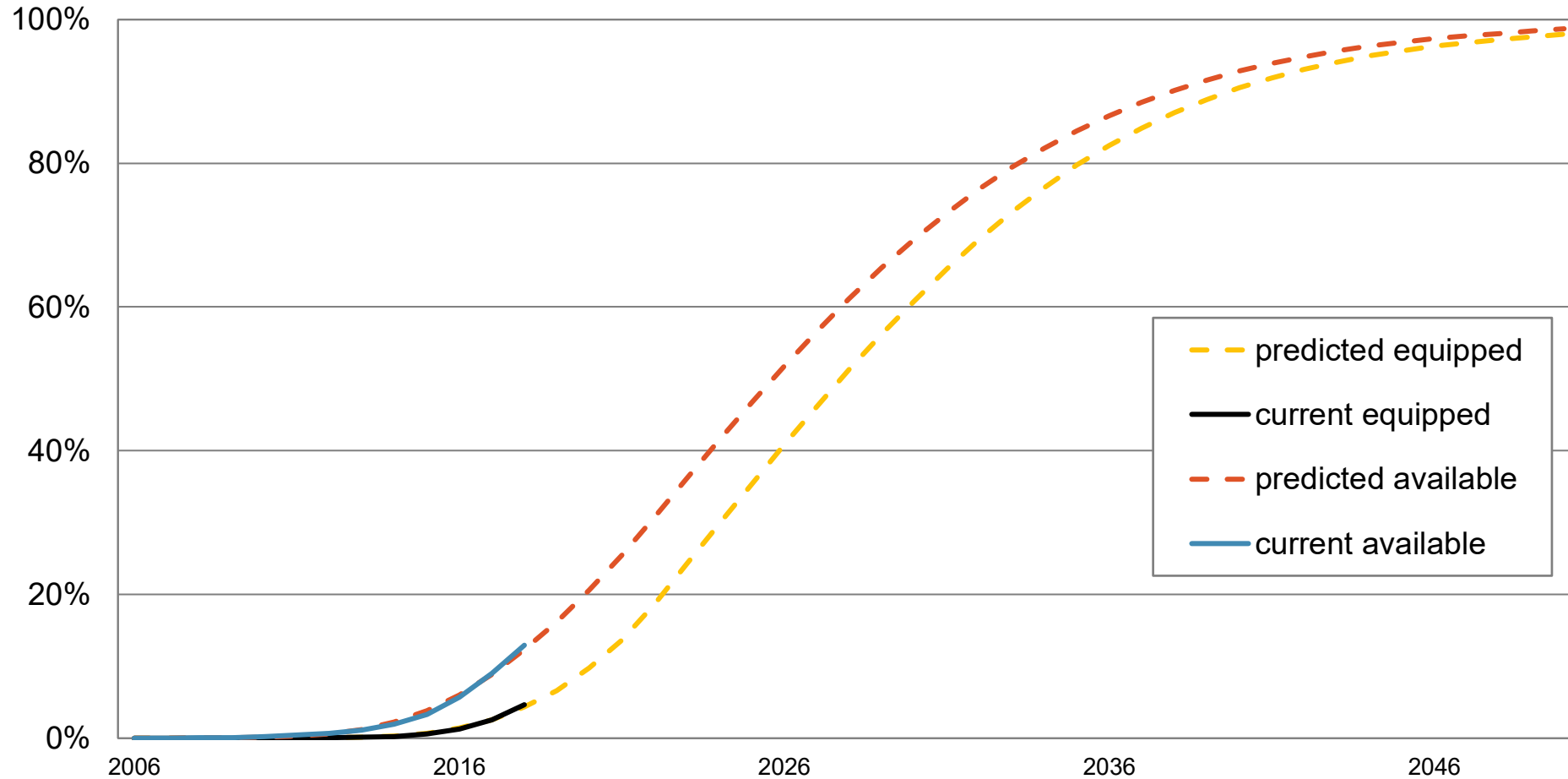
Registered vehicles with autonomous emergency braking

By calendar year



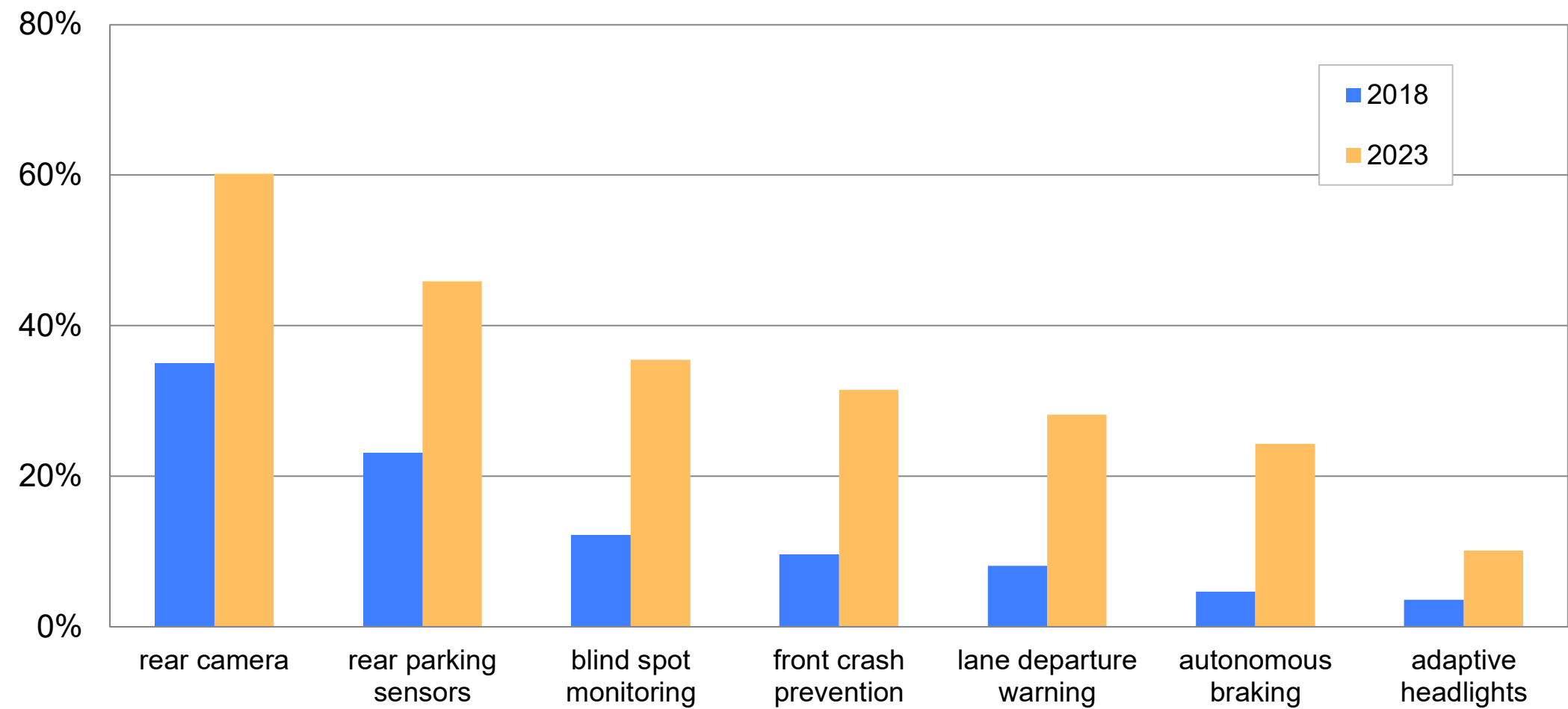
Predicted percentage of registered vehicles with autonomous emergency braking

By calendar year

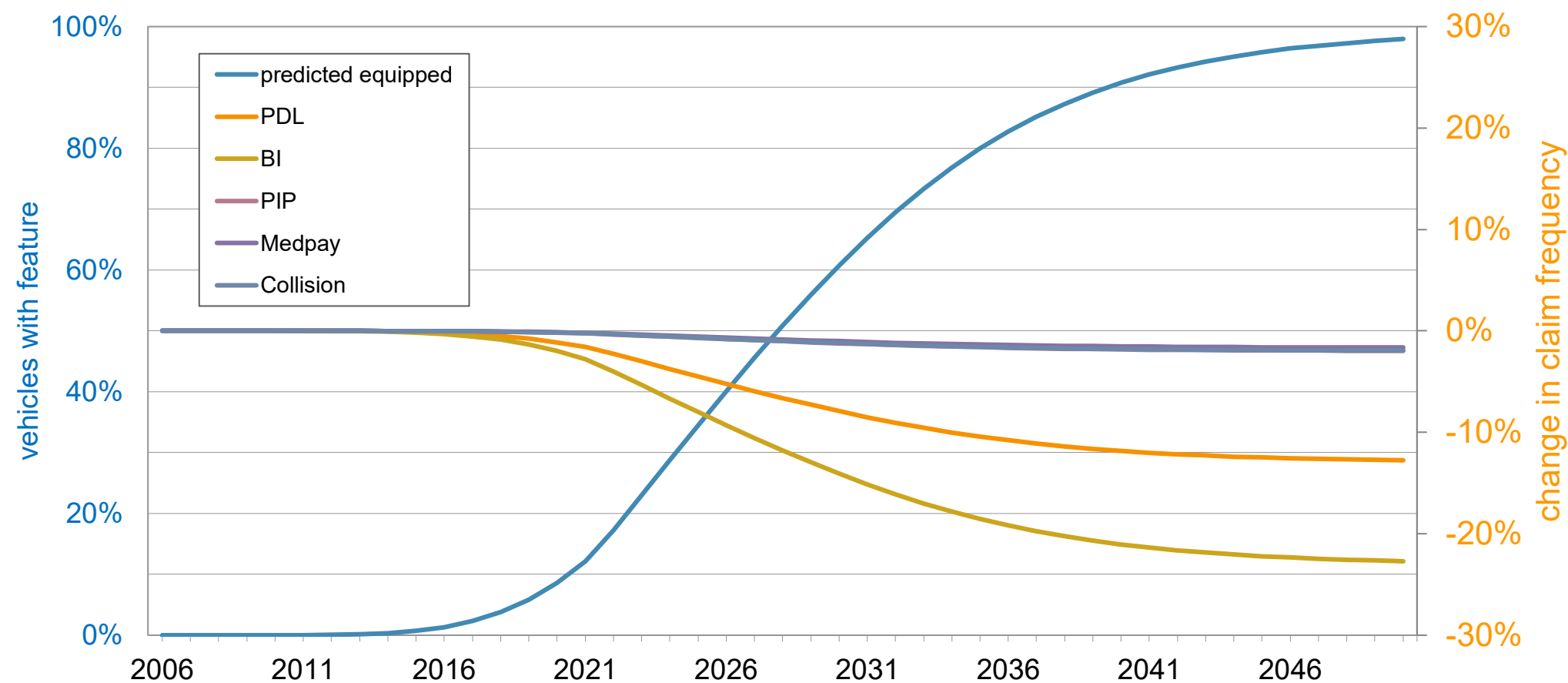


Estimated registered vehicles by feature

Calendar years 2018 and 2023



Estimated change in claim frequency due to increased fitment of front autobrake systems





Insurance Institute for Highway Safety
Highway Loss Data Institute

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