



INSURANCE INSTITUTE  
FOR HIGHWAY SAFETY

HIGHWAY LOSS  
DATA INSTITUTE

# Trends in Highway Safety: From Crashworthiness to Crash Avoidance

[www.iihs.org](http://www.iihs.org)

Michigan Traffic Safety Summit  
Lansing, MI • March 26, 2014

David Zuby, Chief Research Officer

## **The Insurance Institute for Highway Safety,**

founded in 1959, 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.

## **The Highway Loss Data Institute,**

founded in 1972, shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

Both organizations are wholly supported by auto insurers.

# Where are we?

Location of IIHS/HLDI and Vehicle Research Center





# IIHS members write 85% of private passenger market

- Acceptance Insurance
- ACE Private Risk Services
- Affirmative Insurance
- Agency Insurance Company of Maryland
- Alfa Alliance Insurance Corporation
- Alfa Insurance
- Allstate Insurance Group
- American Family Mutual Insurance
- American National Property and Casualty Company
- Ameriprise Auto & Home
- Amica Mutual Insurance Company
- ARI Insurance Companies
- Auto Club Enterprises
- Auto Club Group
- Auto-Owners Insurance
- Aviva Insurance
- Bankers Insurance Group
- Bituminous Insurance Companies
- California Casualty Group
- California State Auto Group
- Capital Insurance Group
- Chubb & Son
- Colorado Farm Bureau Mutual Insurance Company
- Commonwealth Mutual Insurance Company of America
- Concord Group Insurance Companies
- COUNTRY Financial
- CSE Insurance Group
- Dallas National Insurance Company
- Direct General Corporation
- Driver's Insurance Group
- Erie Insurance Group
- Esurance
- Farm Bureau Financial Services
- Farm Bureau Insurance of Michigan
- Farm Bureau Mutual Insurance Company of Idaho
- Farmers Insurance Group of Companies
- Farmers Mutual Hail Insurance Company of Iowa
- Farmers Mutual of Nebraska
- Fireman's Fund Insurance Company
- Florida Farm Bureau Insurance Companies
- Frankenmuth Insurance
- Gainsco Insurance
- GEICO Group
- Georgia Farm Bureau Mutual Insurance Company
- Goodville Mutual Casualty Company
- Grange Insurance
- Hallmark Insurance Company
- Hanover Insurance Group
- The Hartford
- Haulers Insurance Company, Inc.
- Horace Mann Insurance Companies
- ICW Group
- Imperial Fire & Casualty Insurance Company
- Indiana Farmers Mutual Insurance Company
- Infinity Property & Casualty
- Kemper Preferred
- Kentucky Farm Bureau Insurance
- Liberty Mutual Insurance Company
- Louisiana Farm Bureau Mutual Insurance Company
- Maryland Automobile Insurance Fund
- Mercury Insurance Group
- MetLife Auto & Home
- Michigan Millers Mutual Insurance Company
- MiddleOak
- Mississippi Farm Bureau Casualty Insurance Company
- MMG Insurance
- 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 County Mutual Fire Insurance
- Old American Indemnity Company
- Oregon Mutual Insurance
- Pekin Insurance
- PEMCO Insurance
- Plymouth Rock Assurance
- Progressive Corporation
- QBE
- The Responsive Auto Insurance Company
- Rockingham Group
- Safe Auto Insurance
- Safeco Insurance
- Samsung Fire & Marine Insurance Company
- SECURA Insurance
- Sentry Insurance
- Shelter Insurance
- Sompo Japan Insurance Company of America
- South Carolina Farm Bureau Mutual Insurance Company
- Southern Farm Bureau Casualty Insurance Company
- State Auto Insurance Companies
- State Farm
- Tennessee Farmers Mutual Insurance Company
- Texas Farm Bureau Insurance Companies
- Tower Group Companies
- The Travelers Companies
- United Educators
- USAA
- Utica National Insurance Group
- Virginia Farm Bureau Mutual Insurance
- West Bend Mutual Insurance Company
- Western National
- Westfield Insurance
- Young America Insurance Company
- Zurich North America

# Insurance Institute for Highway Safety

Organization as of February 2014

## **Total employees (105)**

- Arlington, Virginia – headquarters (66 employees)
  - Research & Communications (48)
  - Highway Loss Data Institute (18)
- Ruckersville, Virginia – Vehicle Research Center (39 employees)

# 2014 IIHS and HLDI budget

In millions

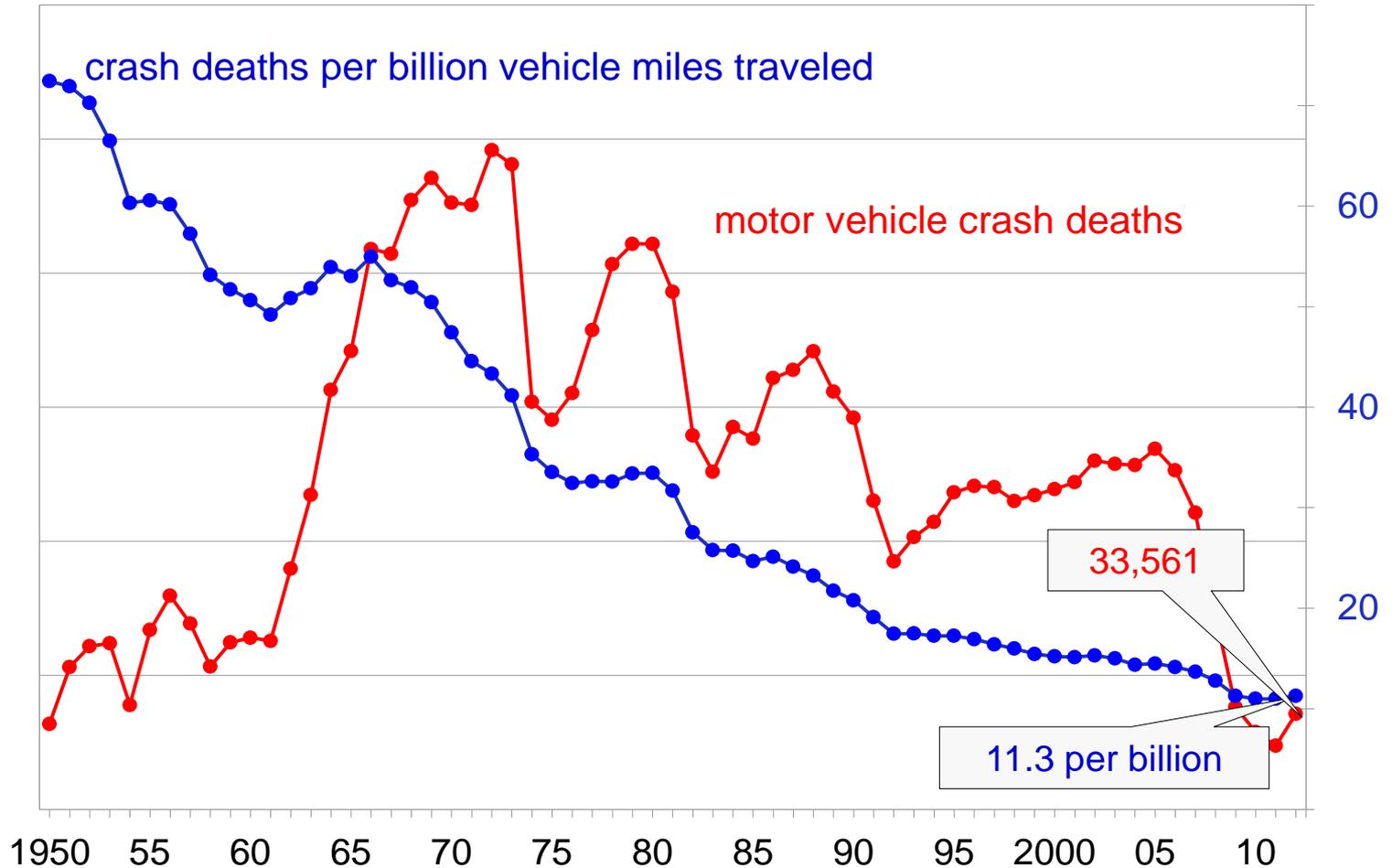
IIHS	\$18.1
HLDI	\$ 3.6
total	\$21.7

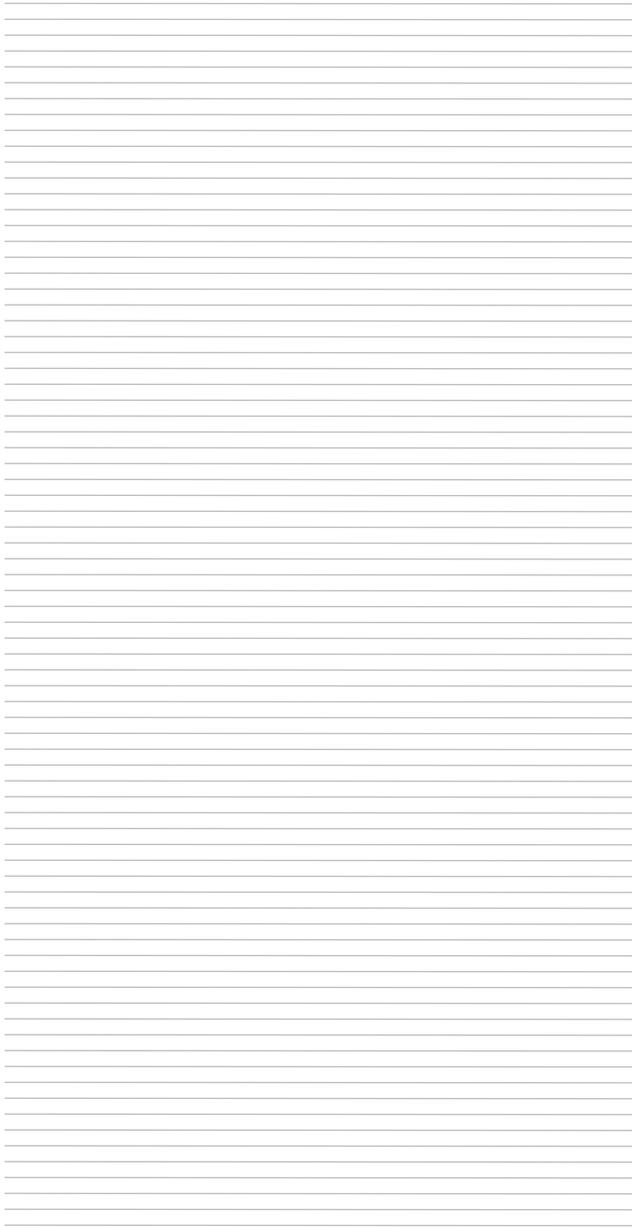
# Haddon matrix

Recognizing opportunities to make a difference

changes in...	crash phase			
	before	during	after	losses
people	<ul style="list-style-type: none"> <li>•licensing (GDL, elderly)</li> <li>•impaired driving laws</li> <li>•camera enforcement</li> </ul>	<ul style="list-style-type: none"> <li>•restraints (use)</li> <li>•helmets</li> <li>•speed cameras</li> </ul>	<ul style="list-style-type: none"> <li>•alcohol</li> </ul>	<ul style="list-style-type: none"> <li>•injuries</li> <li>•deaths</li> <li>•economic</li> </ul>
vehicles	<ul style="list-style-type: none"> <li>•driver assistance</li> <li>•daytime running lights</li> <li>•electronic control</li> </ul>	<ul style="list-style-type: none"> <li>•restraints (effect)</li> <li>•vehicle structure</li> <li>•Bumpers</li> </ul>	<ul style="list-style-type: none"> <li>•crash notification</li> <li>•fuel systems</li> </ul>	<ul style="list-style-type: none"> <li>•damage</li> <li>•repairability</li> </ul>
environment	<ul style="list-style-type: none"> <li>•intersection design</li> <li>•trouble-spot treatment</li> <li>•rumble strips</li> </ul>	<ul style="list-style-type: none"> <li>•roundabouts</li> <li>•breakaway poles</li> <li>•crash cushions</li> </ul>	<ul style="list-style-type: none"> <li>•emergency medicine</li> </ul>	<ul style="list-style-type: none"> <li>•economic</li> <li>•fuel economy</li> </ul>

# IIHS and HLDI research has contributed significantly to the decline of motor vehicle crash injuries during the past 50+ years

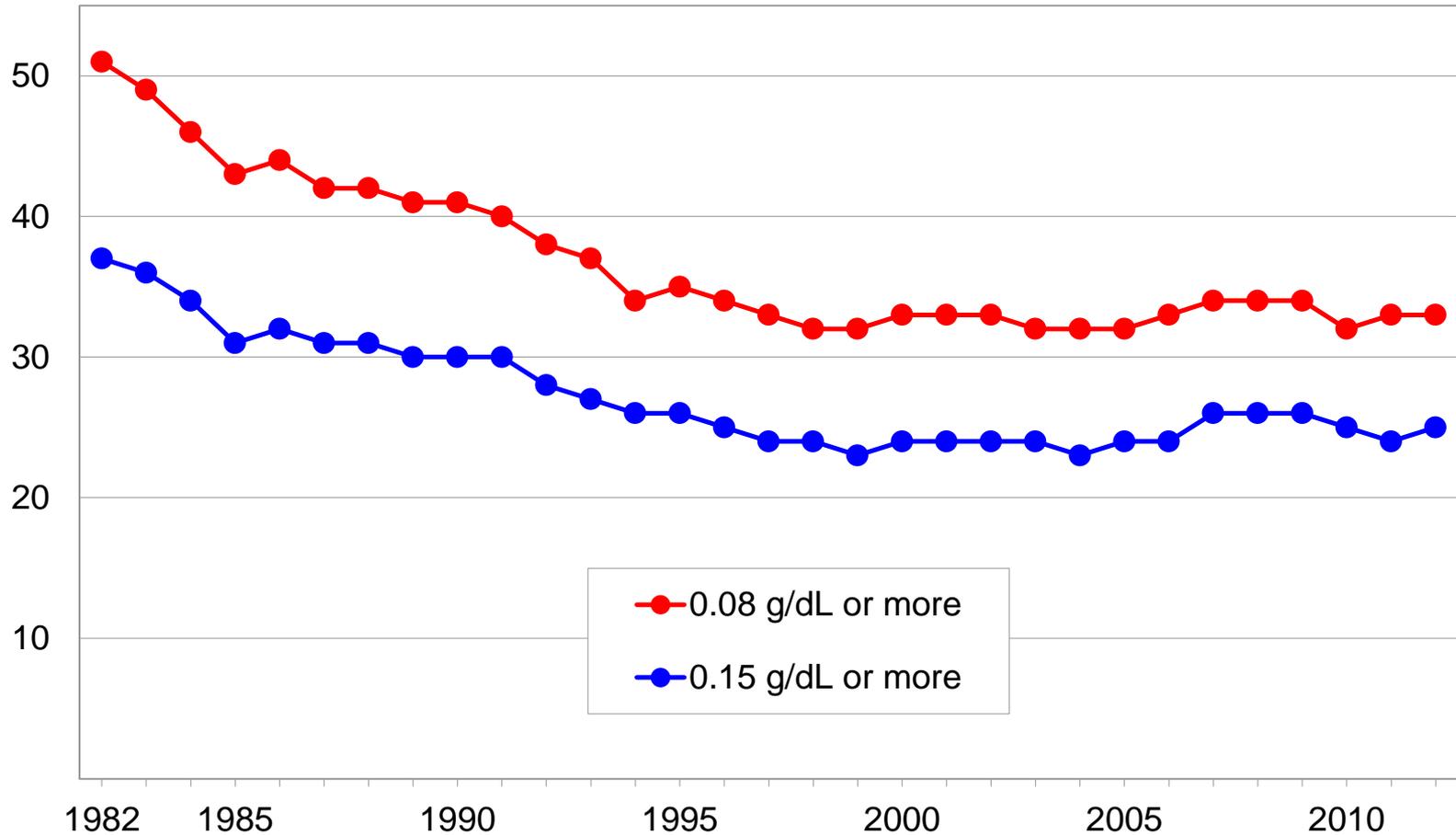




# Making drivers safer – Alcohol ignition interlocks

# Percent of fatally injured passenger vehicle drivers with BACs at or above specified levels

1982-2012



# Alcohol ignition interlocks

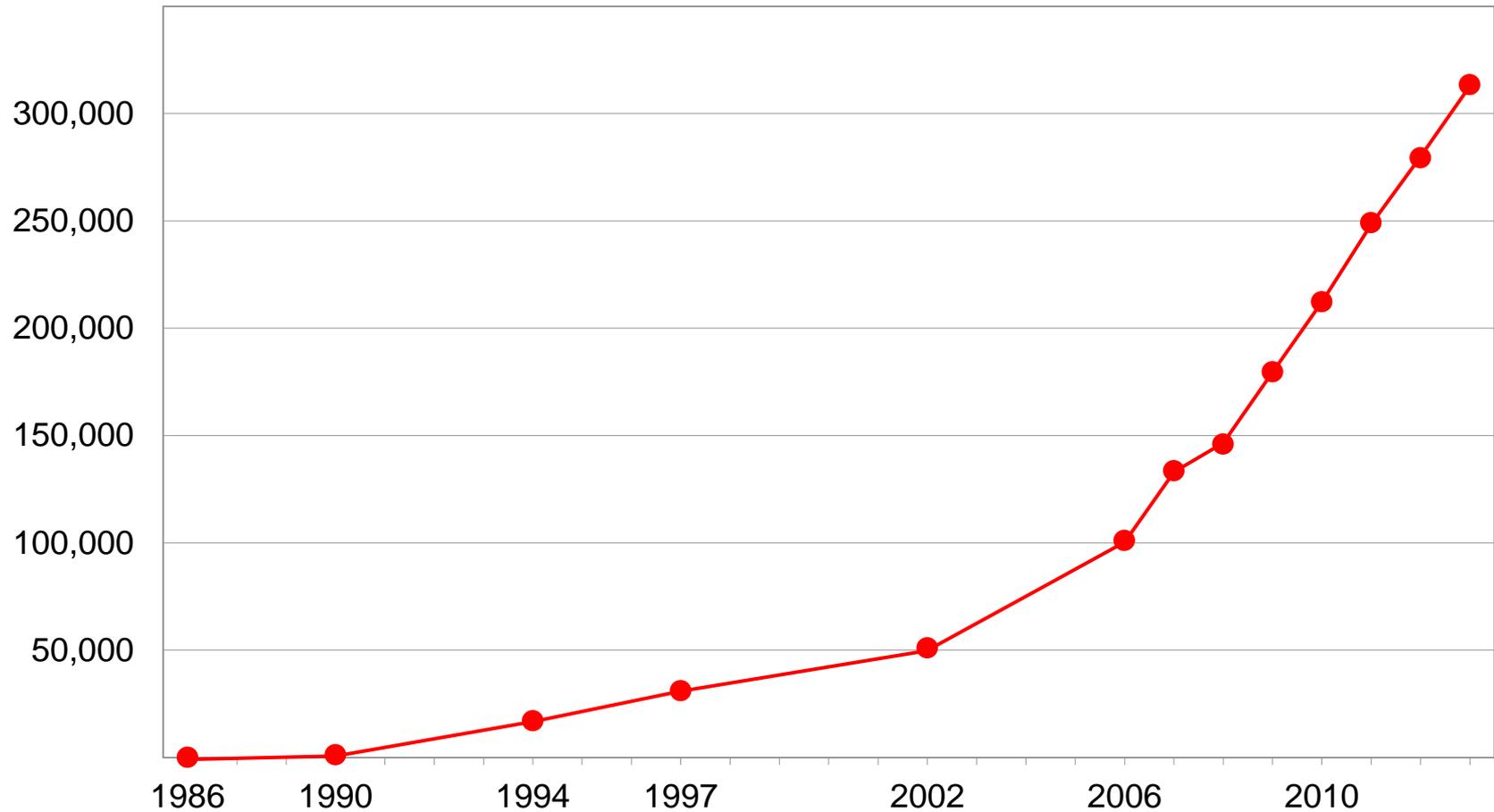
- Driver blows into a tube to test breath for alcohol
- Vehicle won't start if certain amount of alcohol detected
- Periodic retests while vehicle is in motion
- BAC  $\leq 0.025$  percent is typical threshold for DUI offenders



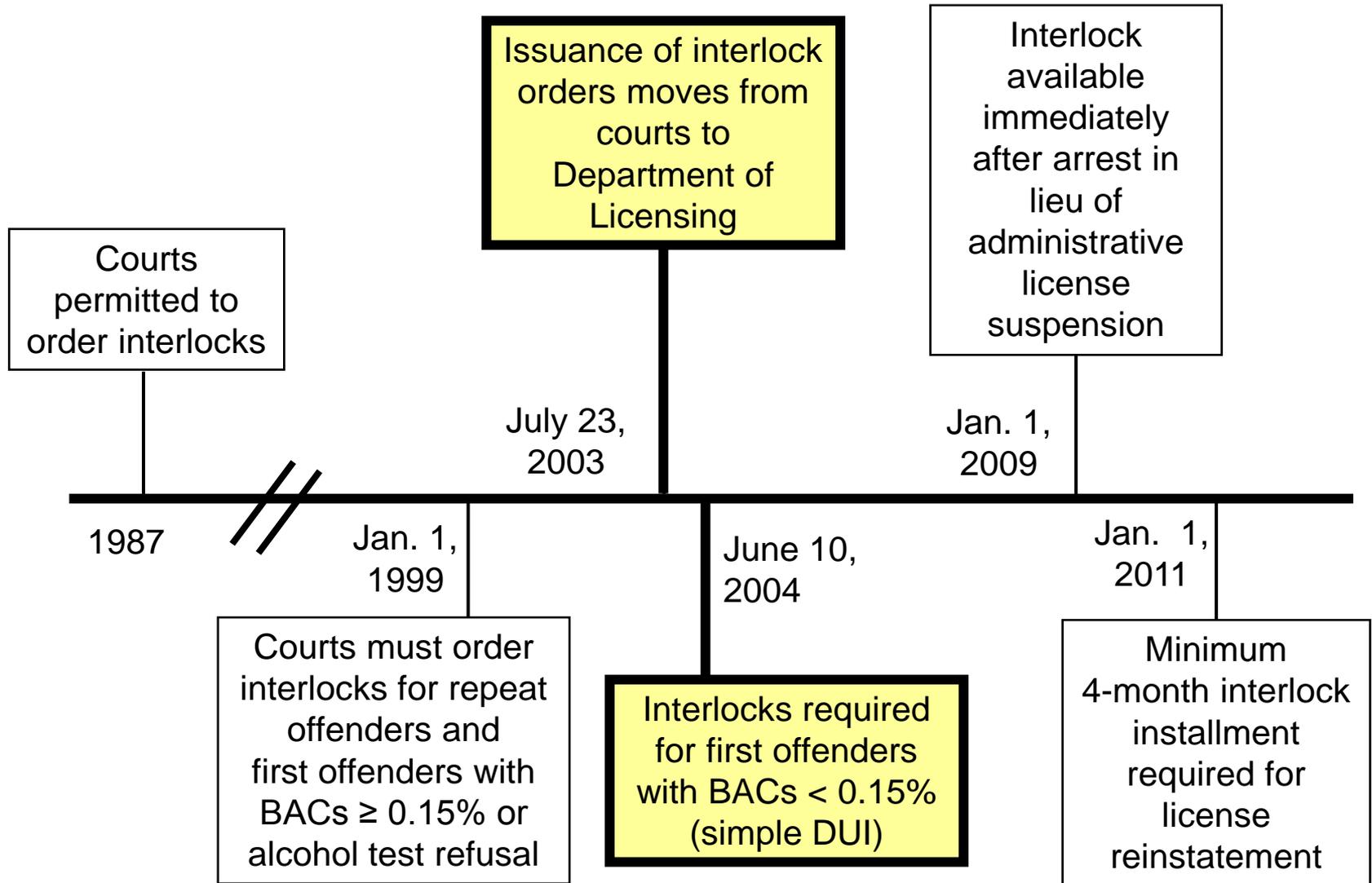


# Installed interlocks in United States

1986-2013

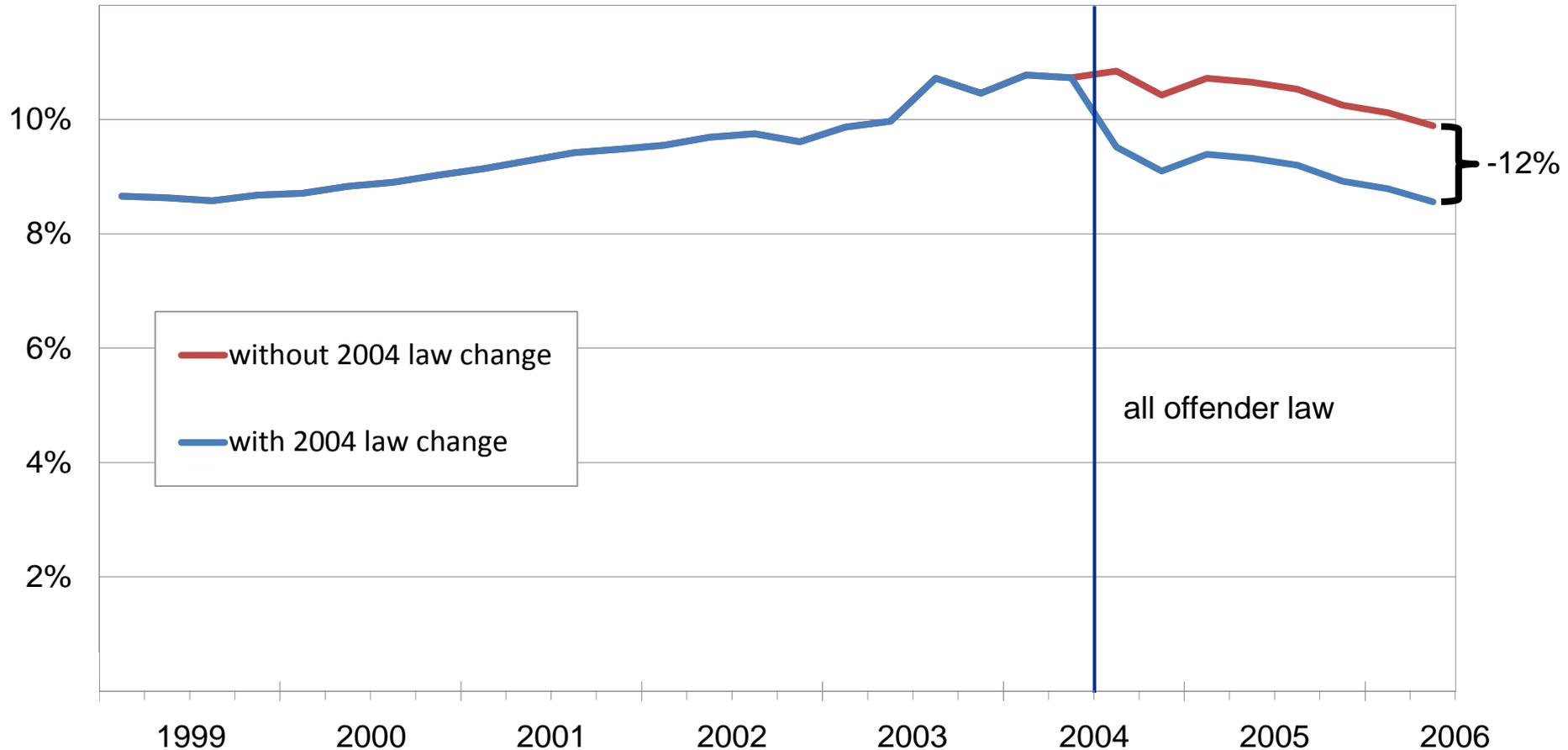


# Timeline of Washington state interlock laws



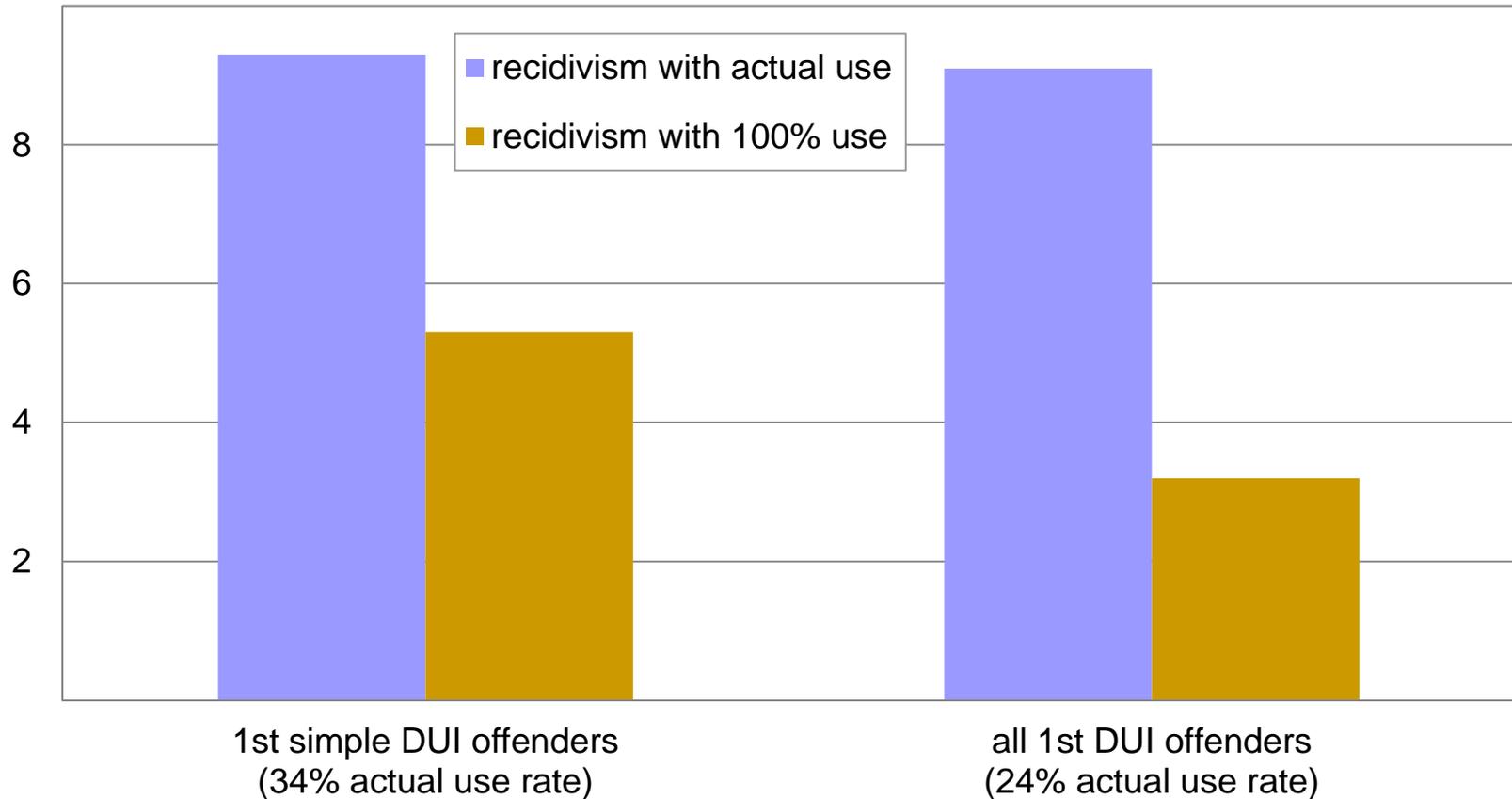
# Predicted cumulative 2-year recidivism rate for 1<sup>st</sup> simple DUI convictions with & without 2004 law change

By quarter of arrest, January 1999-June 2006



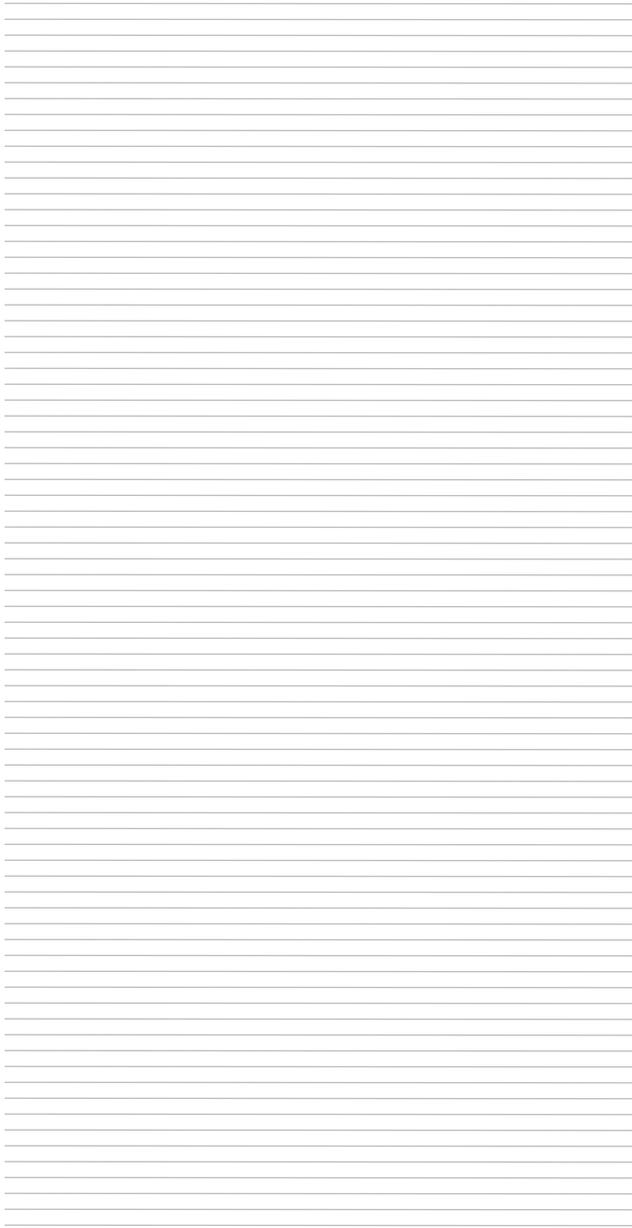
# Cumulative 2-year recidivism rate and projected rate with 100 percent interlock use

Arrests April-June 2006



# Recommendations to states

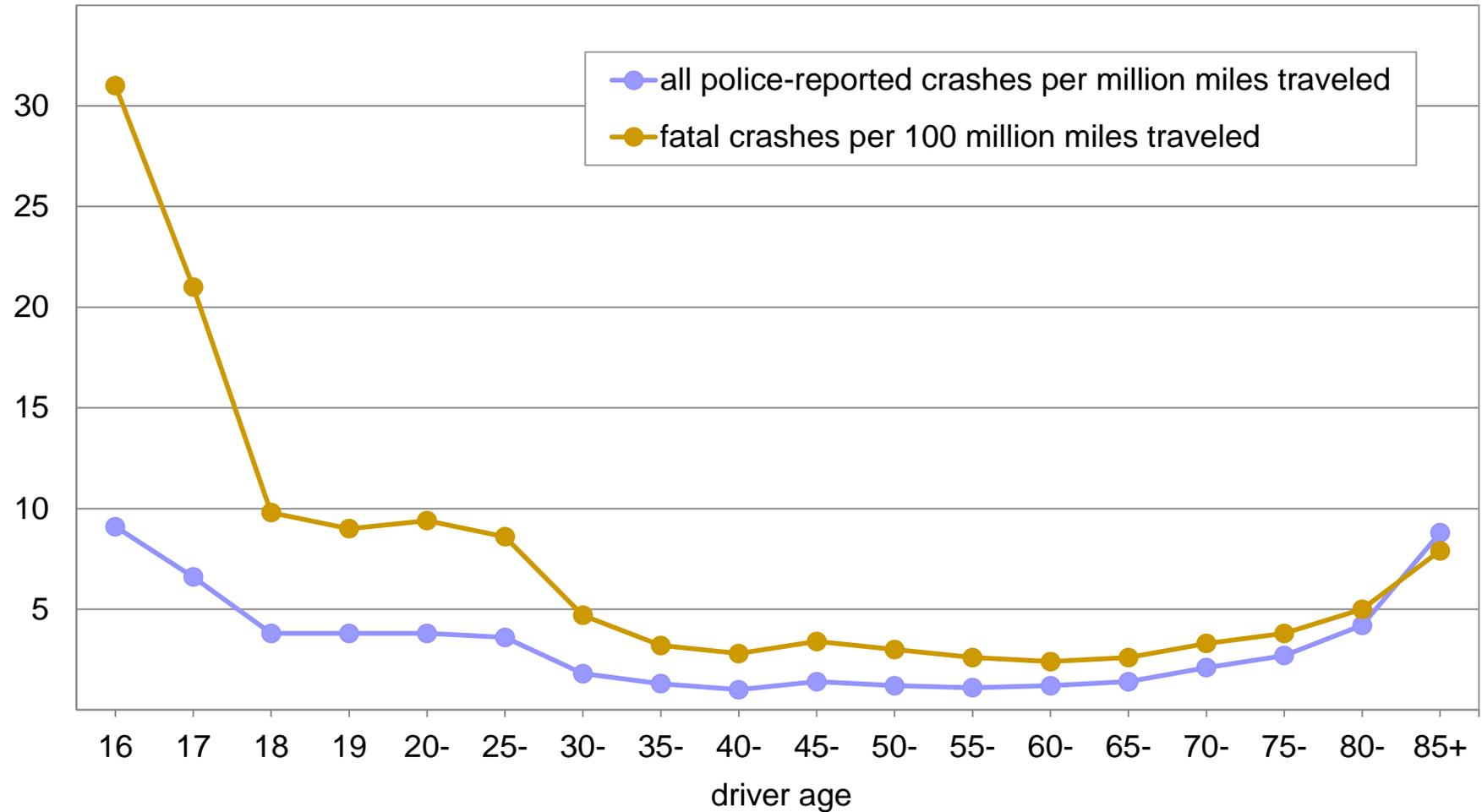
- Extend interlock laws to all DUI offenders
- Seek ways to increase use rates
- Reconsider loopholes that permit reductions in DUI charges to other traffic offenses without interlock requirements
- Publicize interlock laws to deter all drivers from driving when impaired



# Making drivers safer – Graduated driver licensing

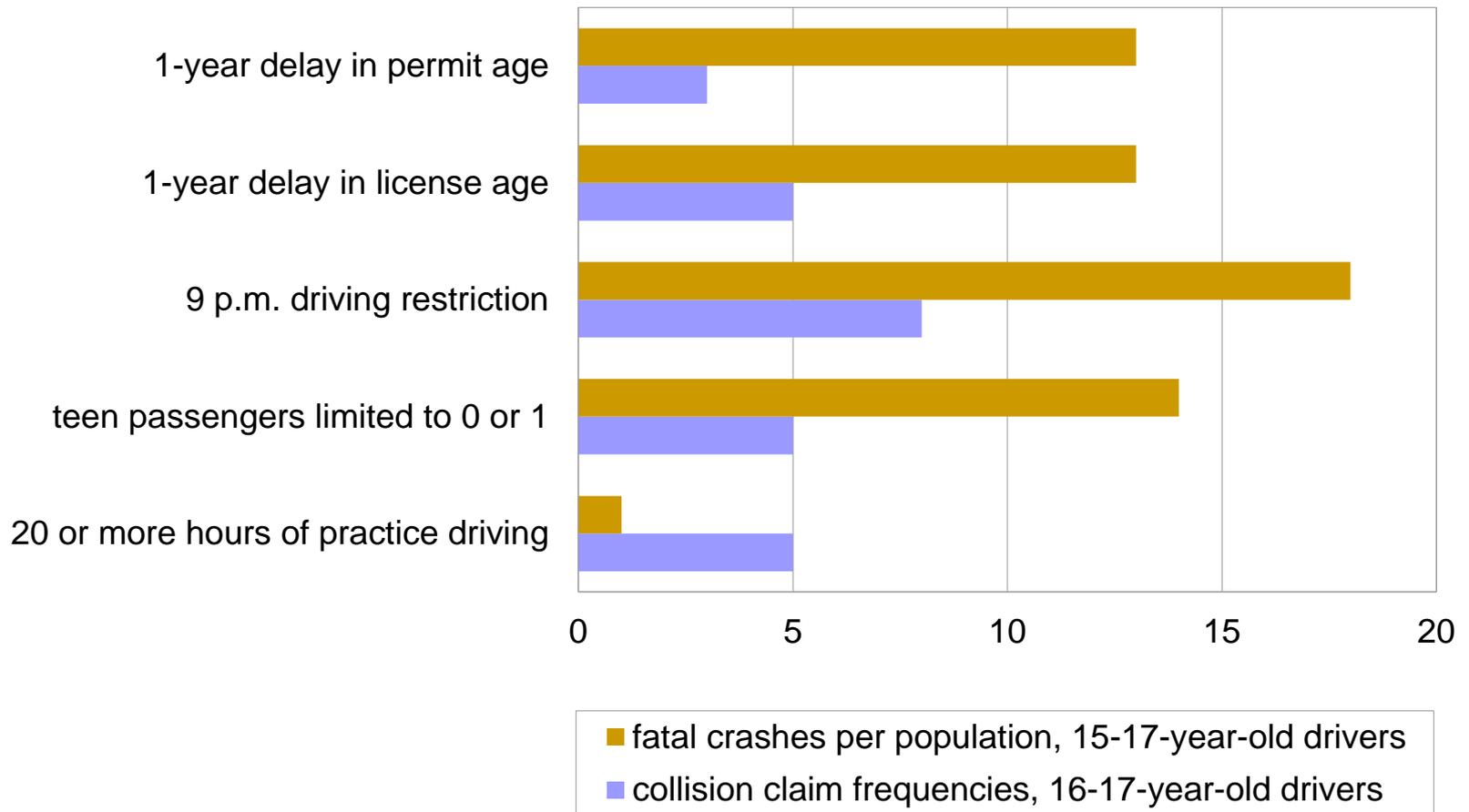
# Passenger vehicle driver crash rates

Per mile traveled, by driver age, 2008



# Percent reduction in teenagers' crash rates

By graduated licensing component



# Graduated Driver Licensing

Best practice provisions, May 2012

- Minimum permit age – 16 years
- Practice hours requirement – 65 hours
- Minimum licensing age (intermediate stage) – 17 years
- Intermediate stage driving restrictions
  - No teenage passengers
  - No nighttime driving beginning at 8 pm

# Estimate the effects of teen driver licensing changes in MICHIGAN

Match the best state provisions

Reset all

Expand all

SELECT ANOTHER STATE

## OVERALL

Overall estimates are based on the combination of the individual GDL component effects shown below.

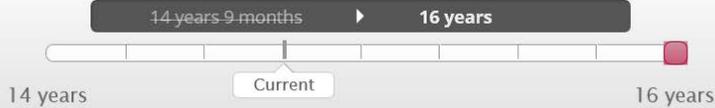
COLLISION CLAIMS ?

16%  
REDUCTION

FATAL CRASHES ?

42%  
REDUCTION

## PERMIT AGE



About this provision

COLLISION CLAIMS ?

4%  
REDUCTION

FATAL CRASHES ?

16%  
REDUCTION

## PRACTICE HOURS



About this provision

COLLISION CLAIMS ?

5%  
REDUCTION

FATAL CRASHES ?

1%  
REDUCTION

## LICENSE AGE



About this provision

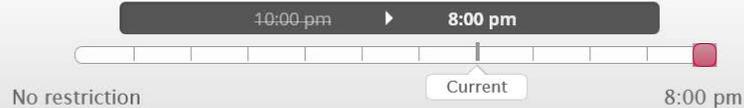
COLLISION CLAIMS ?

5%  
REDUCTION

FATAL CRASHES ?

13%  
REDUCTION

## NIGHT DRIVING



About this provision

COLLISION CLAIMS ?

2%  
REDUCTION

FATAL CRASHES ?

5%  
REDUCTION

## PASSENGERS



About this provision

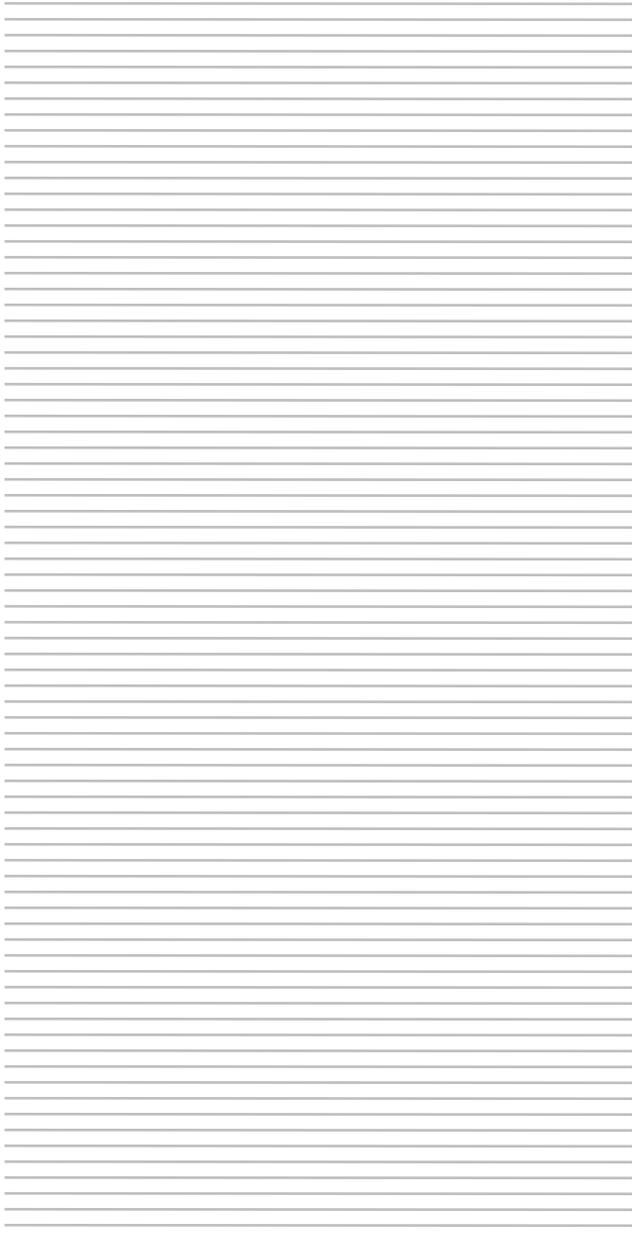
COLLISION CLAIMS ?

0%  
REDUCTION

FATAL CRASHES ?

16%  
REDUCTION

Estimated effects of teen driver licensing changes in Michigan



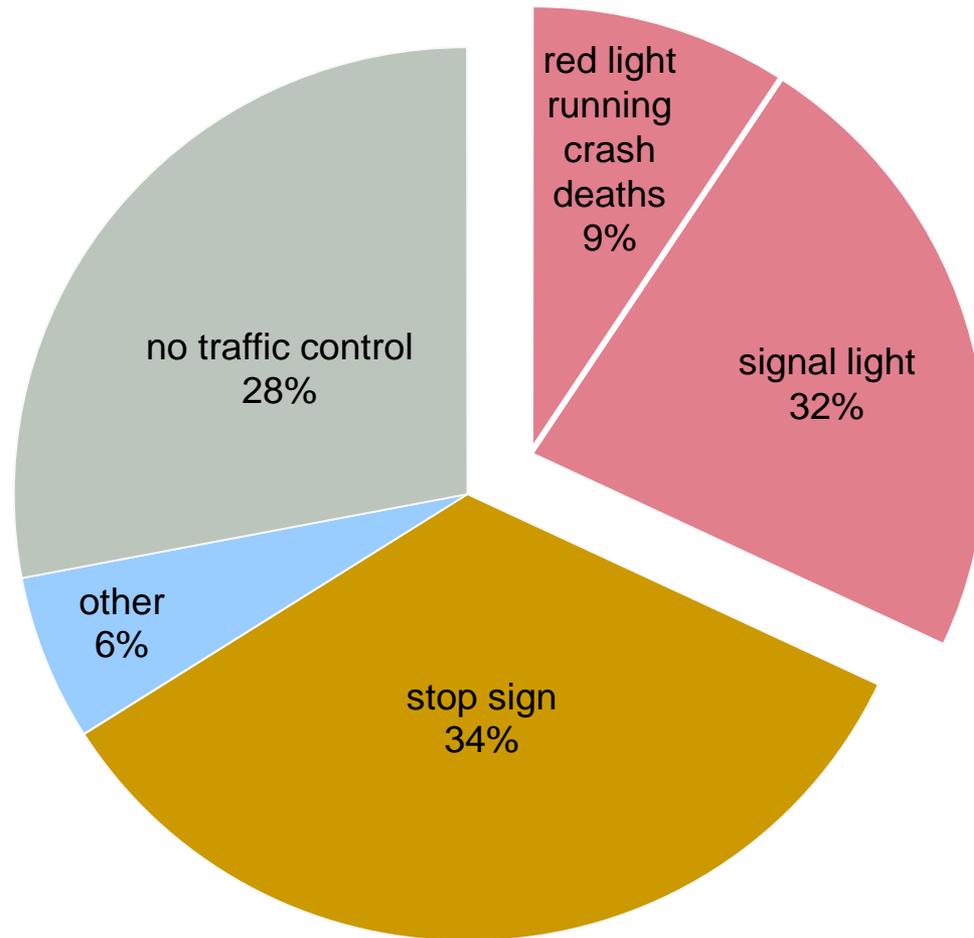
# Making roads safer – Roundabouts

Simpsons  
excerpt

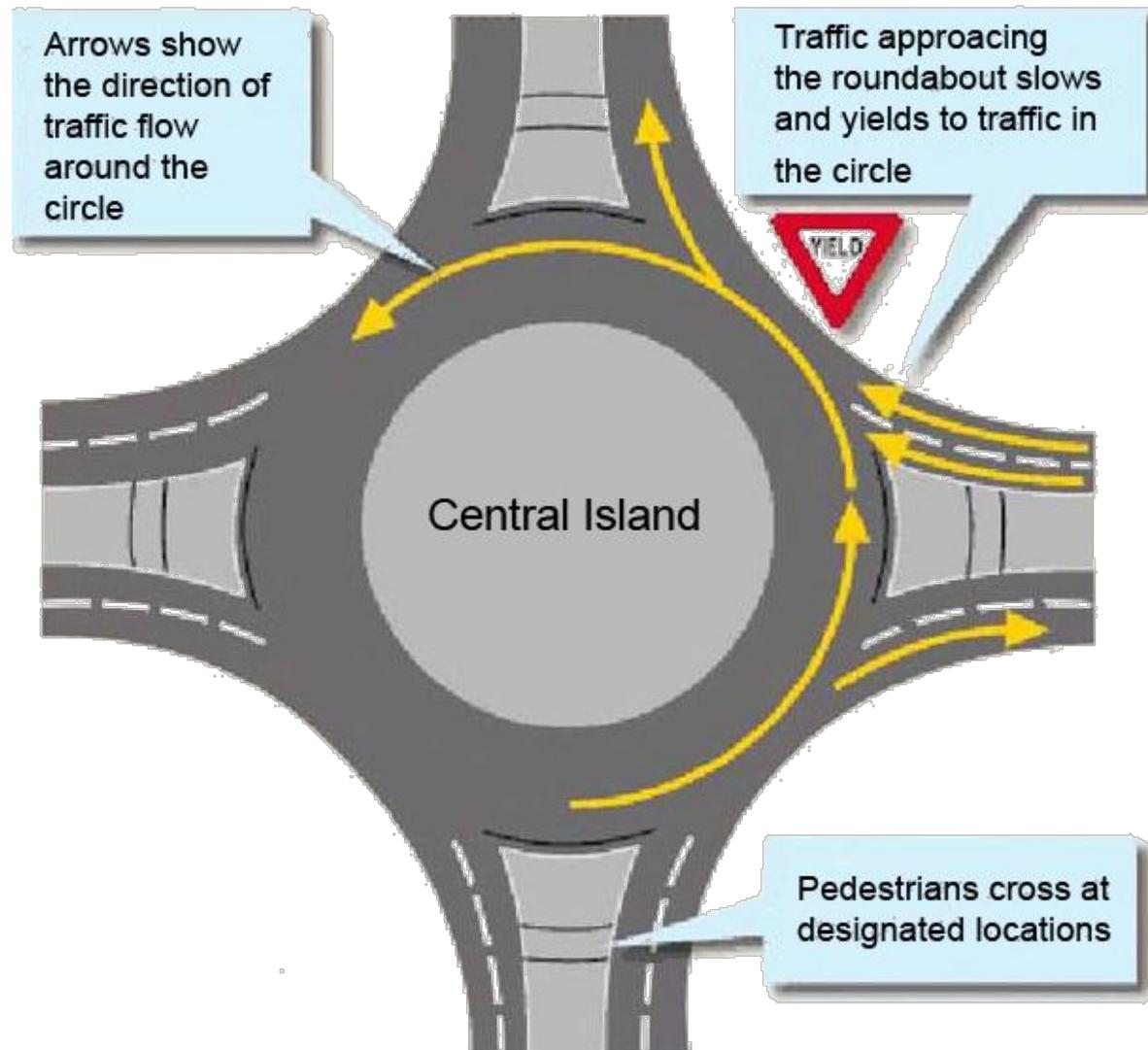
ertz  
rent a car

# 7,707 deaths at intersections in 2010

Distribution by type of traffic control



# Roundabouts are circular intersections with design features that eliminate the need for stop signs or traffic signals



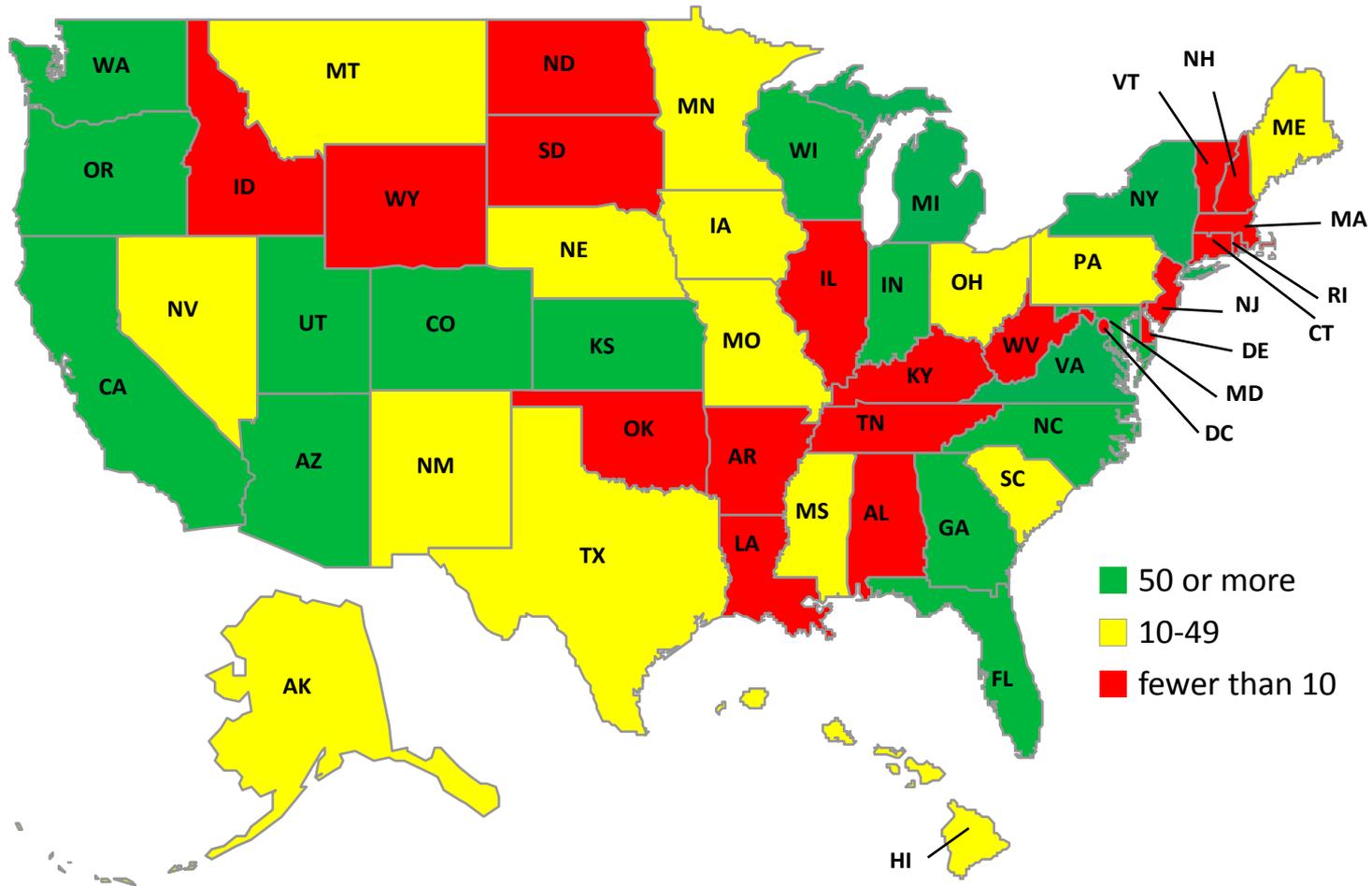


Conversion of stop sign and traffic signal intersections to roundabouts:

- 40% reduction in all crashes
- 80% reduction in injury crashes
- 90% reduction in fatal & incapacitating injury crashes

# Progress in building roundabouts

March 2014



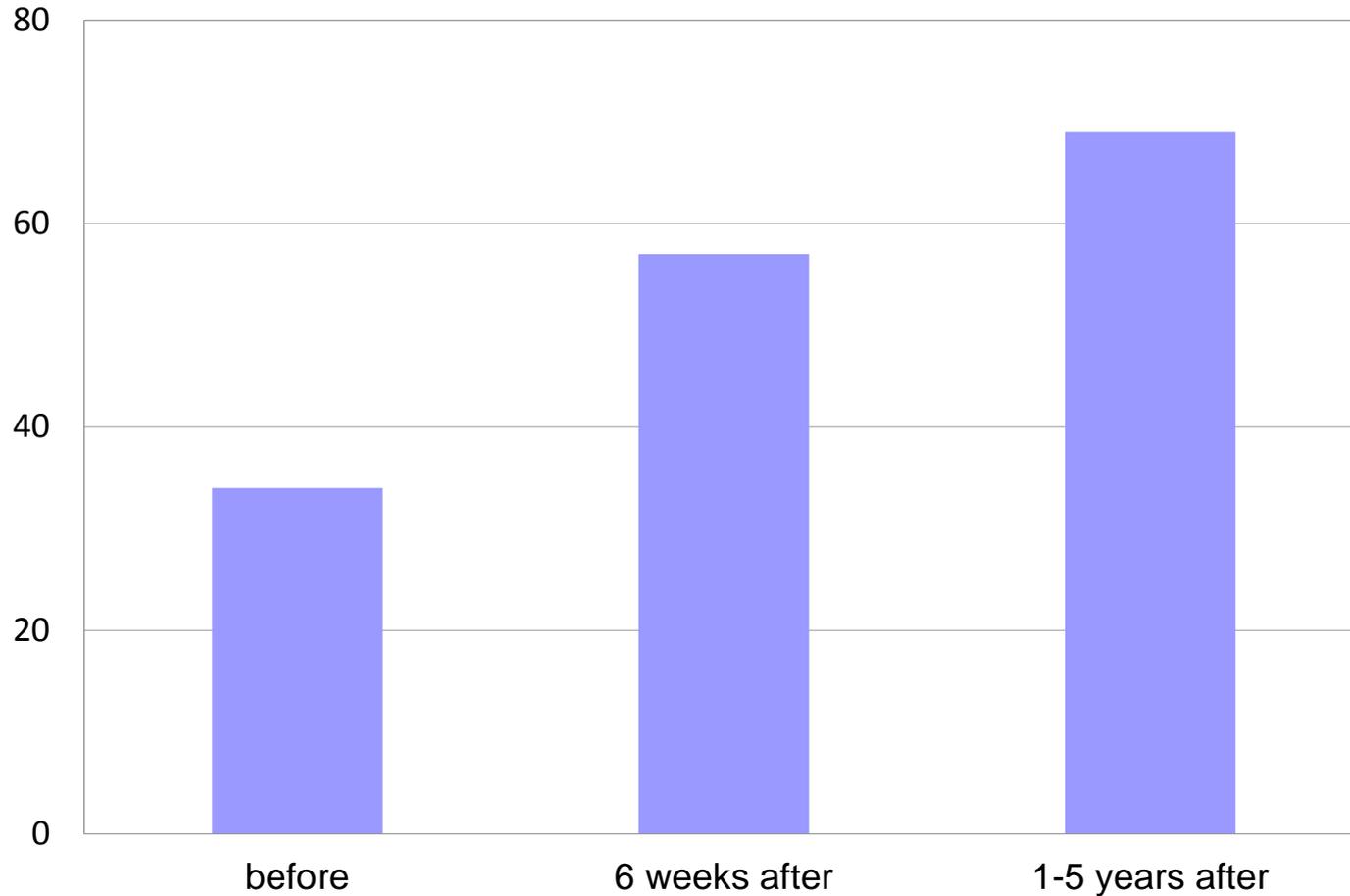


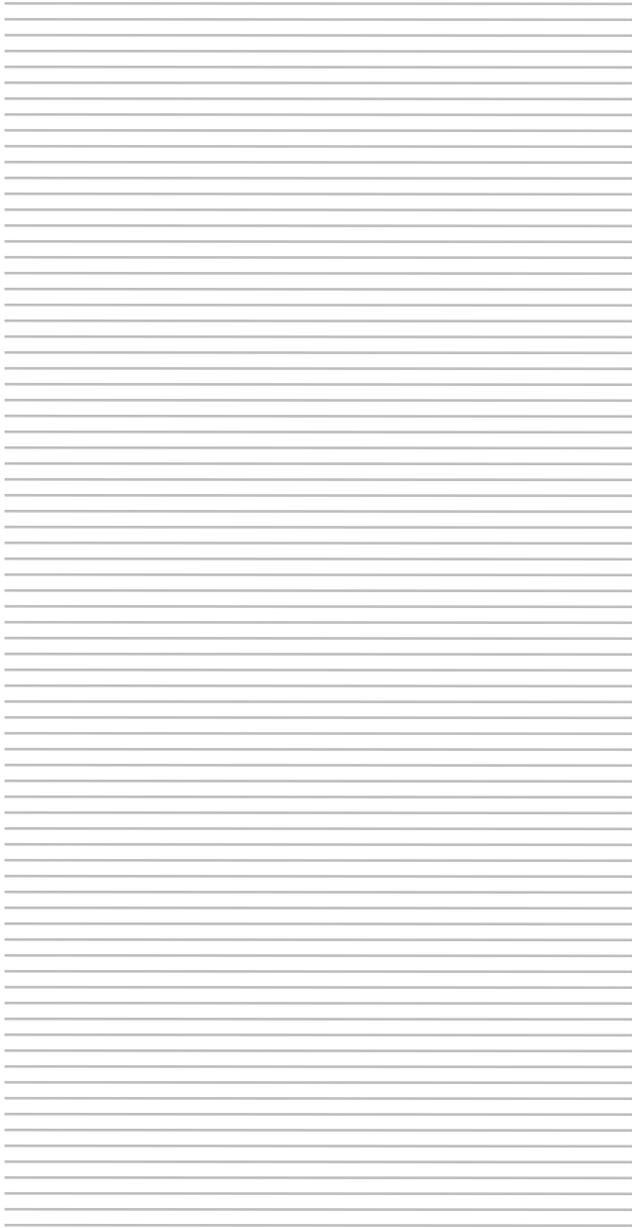
# If 10 percent of signalized intersections in the United States were converted to roundabouts

- Approximately 43,000 crashes prevented in 2011 including:
  - 170 fatal crashes
  - 28,000 injury crashes
- Vehicle delays reduced by more than 900 million hours
- Fuel consumption reduced by more than 600 million gallons

# Percent of residents who favor roundabouts

Before and after construction





# Making vehicles safer – Crashworthiness testing

# IIHS crashworthiness tests



- Front moderate overlap, beginning 1995
- Side impact, beginning 2003
- Rear crash (whiplash mitigation), beginning 2004
- Roof strength, beginning 2009

# Video of Poor vs. Good crash test performance



# Side impact crash test at 30 mph



# Two models both subjected to 15,000 lbs roof crush test



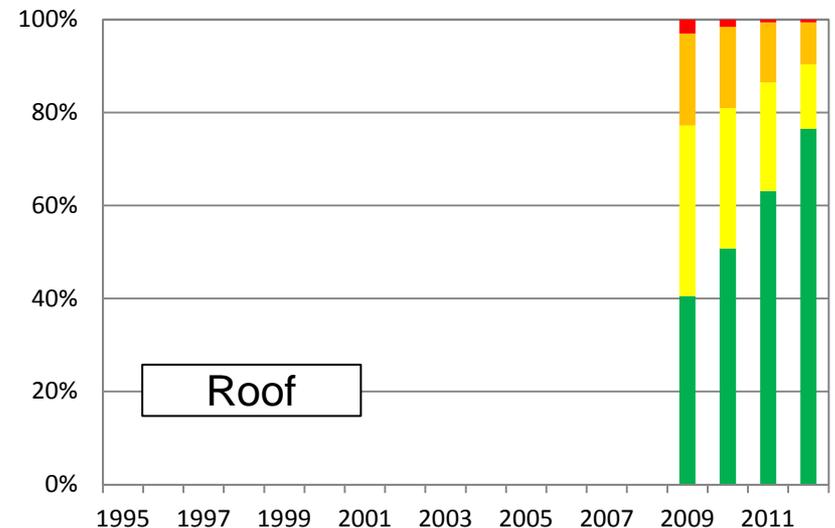
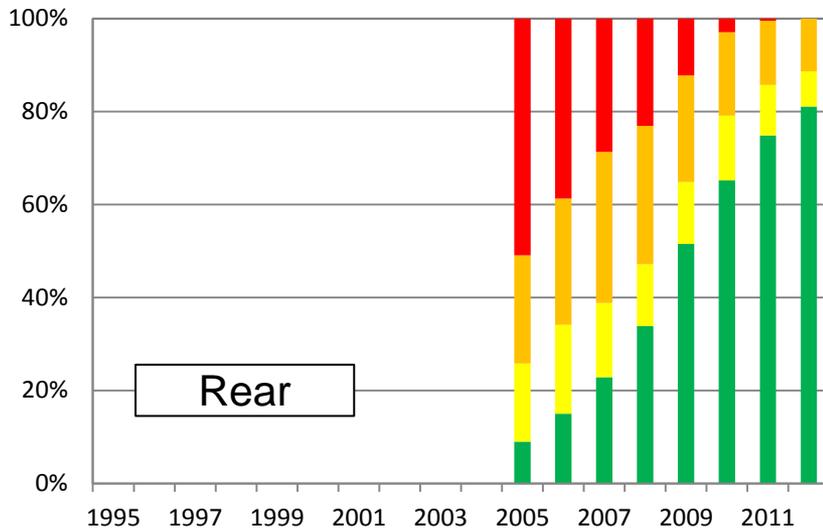
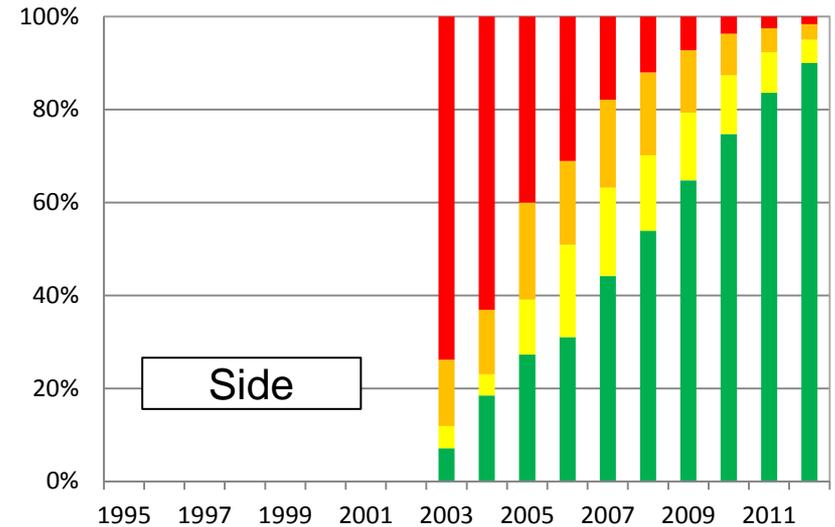
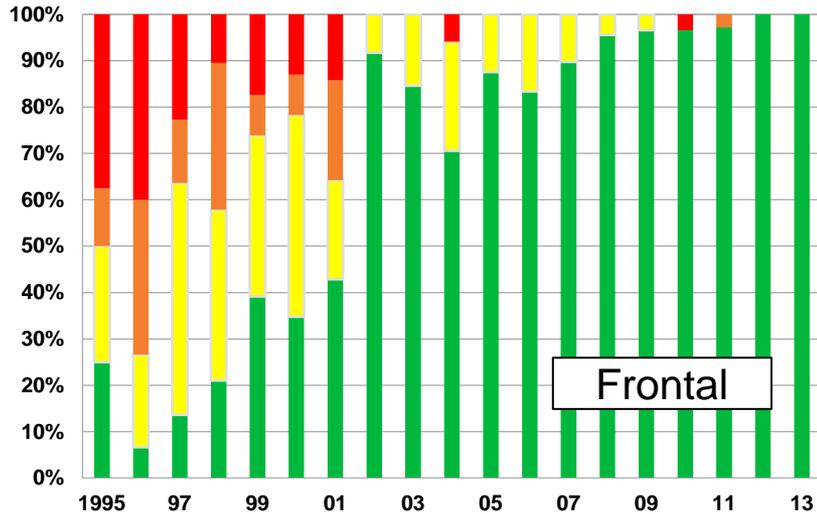
# Death and injury reductions

Good compared with Poor rating in IIHS tests

- Front offset with moderate overlap test at 40 mph
  - Fatality risk in head-on crashes is 46 percent lower
- Side impact crash test at 30 mph
  - Fatality risk in side impact crashes 70 percent lower
- Rear impact test simulates being struck from behind at 20 mph
  - Neck injury risk is 15 percent lower
  - Risk of neck injury requiring 3+ months treatment is 35 percent lower

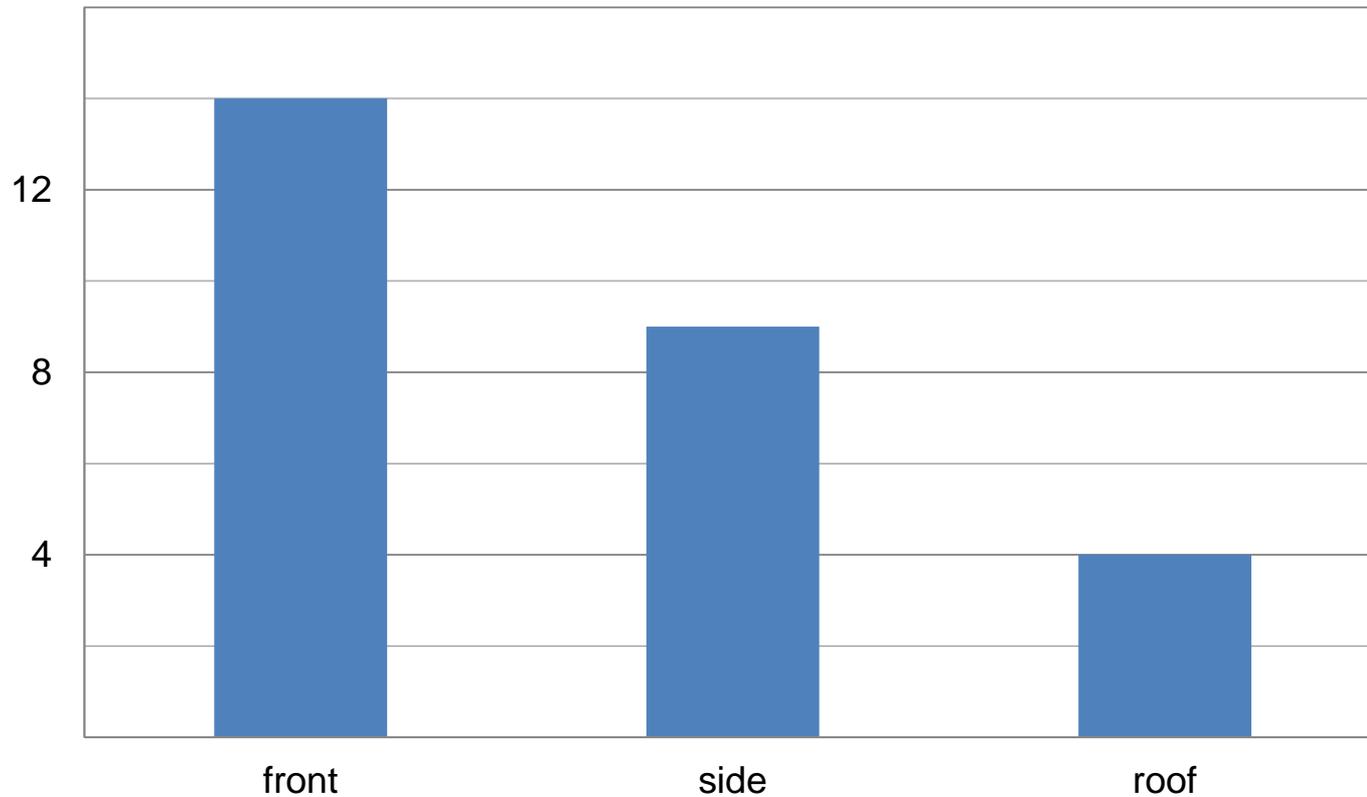
# Crash protection ratings by model year

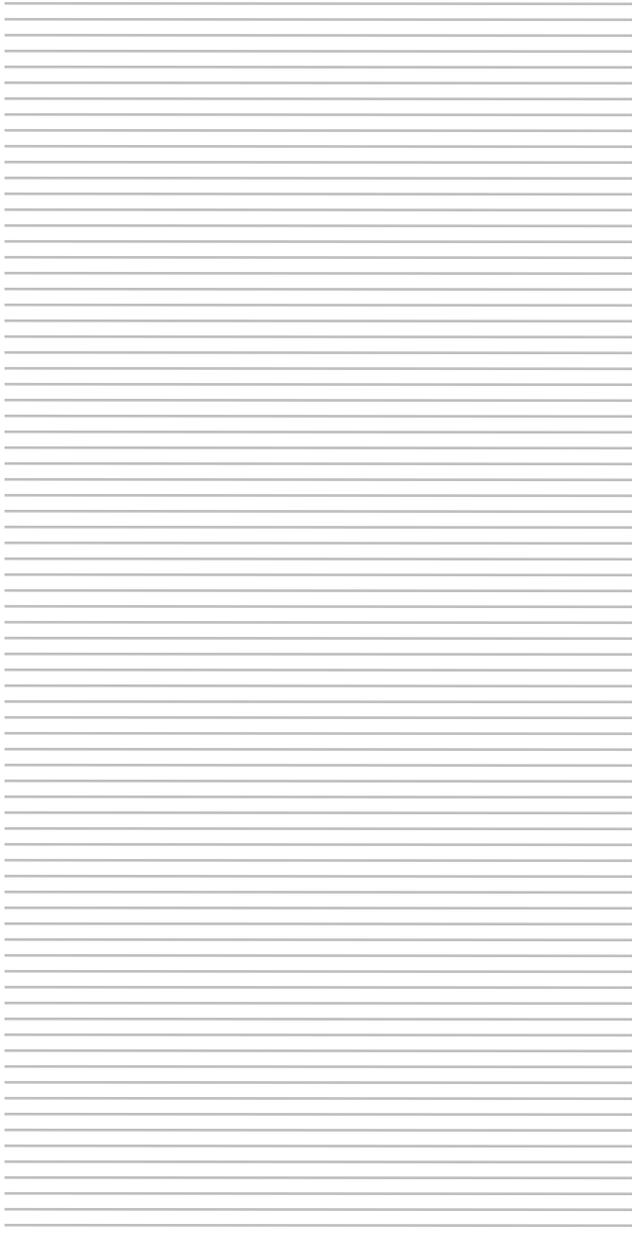
Improvements: Beginning in 1995



# Calendar years until 50% of rated vehicles are rated good

Rated vehicles only



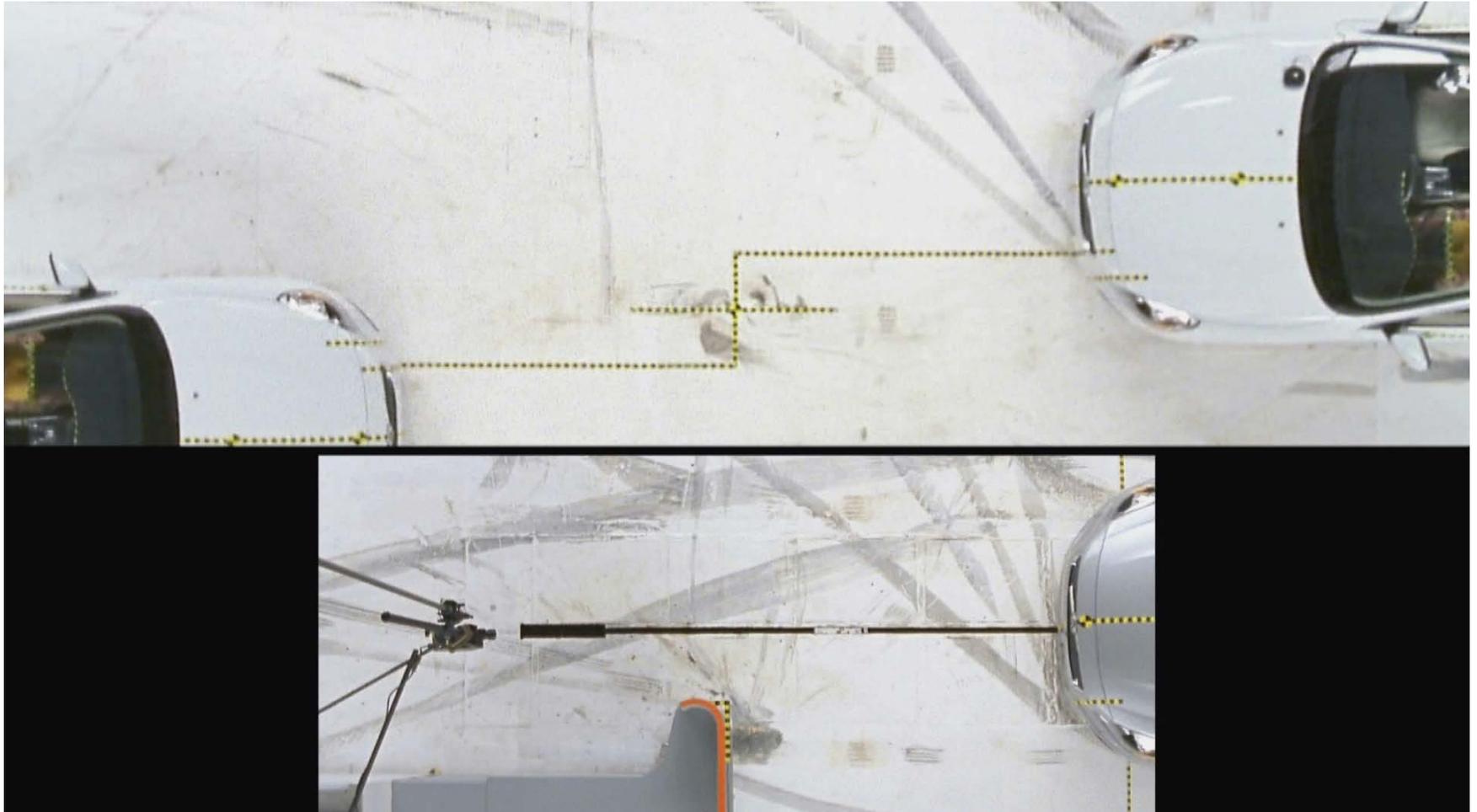


## **Making vehicles safer – Small overlap crash test**

# Serious injuries in frontal crashes, by configuration



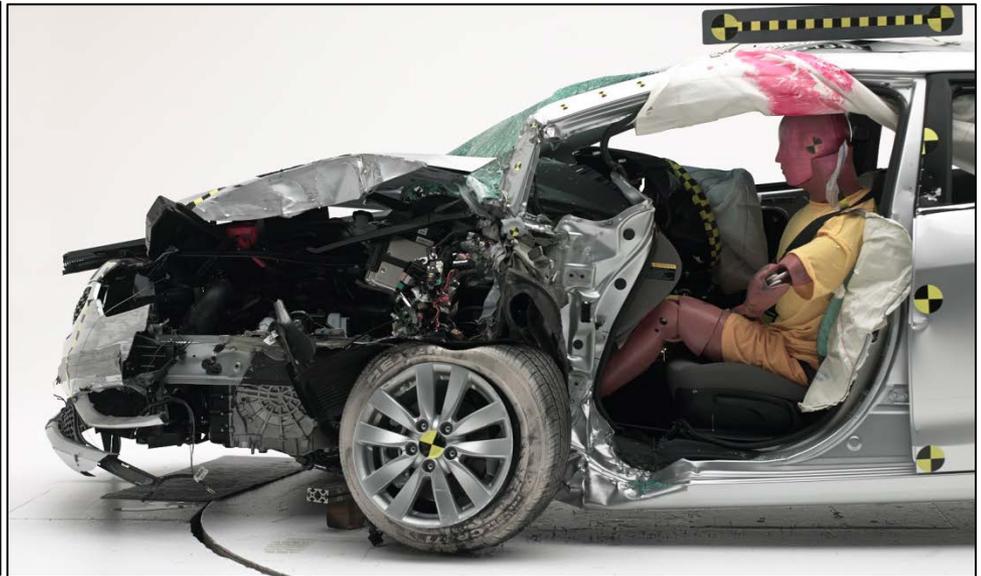
# Overhead video small overlap test (car-to-car and car-to-barrier)



# Structure



2013 Honda Civic - Good



2014 Kia Forte - Poor

# Restraints and kinematics

2014 Kia Forte - Poor



# Restraints and kinematics

2013 Honda Civic - Good



# Small car small overlap ratings

	Overall	Structure	Restraints & kinematics	Injury measures			
				Head & neck	Chest	Hip & thigh	Lower leg & foot
<b>2013 Honda Civic 4-door</b>	G	G	G	G	G	G	A
<b>2013 Honda Civic 2-door</b>	G	G	G	G	G	G	M
2013 Dodge Dart	A	A	M	G	G	G	G
2013 Ford Focus	A	M	A	G	G	G	G
2013 Hyundai Elantra	A	M	A	G	G	G	G
2014 Scion tC	A	M	A	G	G	G	A
2013 Chevrolet Sonic	M	A	M	G	G	G	M
2013 Volkswagen Beetle	M	A	P	G	G	G	G
2013 Chevrolet Cruze	M	P	M	G	G	G	G
2013 Nissan Sentra	P	P	M	G	G	A	M
2013 Kia Soul	P	P	P	G	G	G	M
2014 Kia Forte	P	P	P	A	G	P	M

  changed for small overlap test
 Good
 Acceptable
 Marginal
 Poor

BACK-TO-SCHOOL

"BLACK FRIDAY"

- 2012's busiest shopping day was August 18
- This year's busiest shopping day is expected to be Saturday (the 17th)
- Foursquare ranked most shopping check-ins last year

Television coverage:

Small overlap crash tests  
small cars

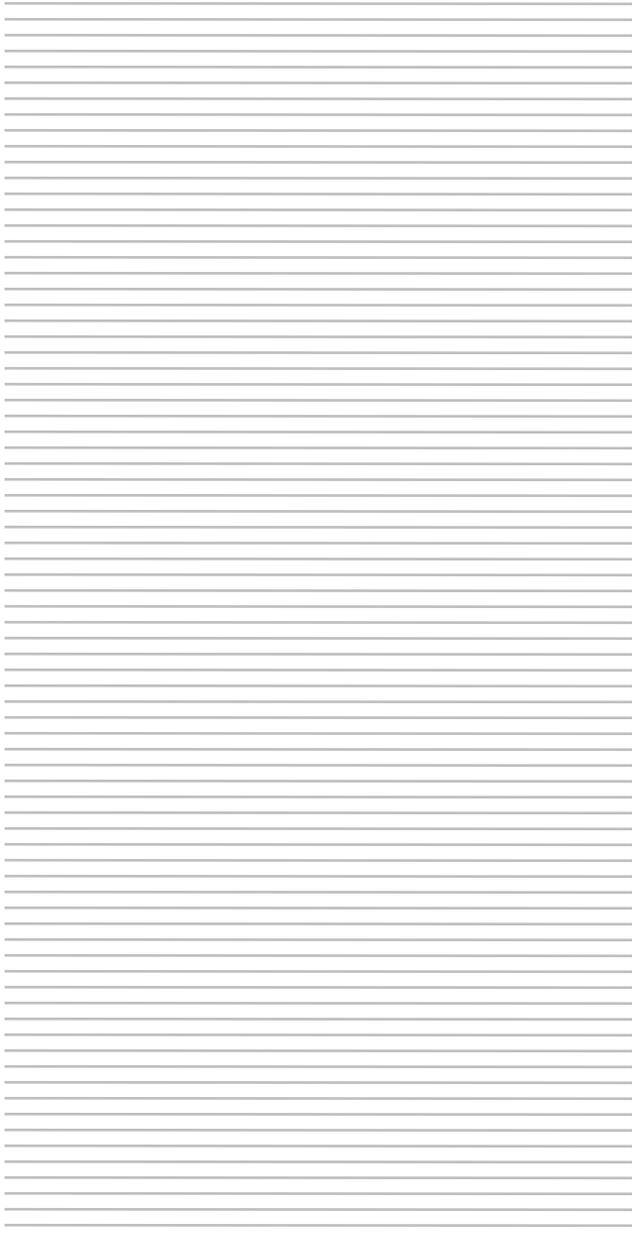


LIVE

HLN

MORNING  
EXPRESS

6:42AM CT



# Effect of crash ratings on consumer behavior

# IIHS top 5 video news release audiences

	date	viewers	broadcasts
Side impact crash tests – midsize cars	April 18, 2004	239 million	2,412
First side impact crash tests – small SUVs	June 17, 2003	234 million	2,316
Frontal crash tests – large pickups	June 4, 2001	213 million	1,855
First small overlap crash tests – midsize luxury cars	August 14, 2012	204 million	2,550
Children's booster seat ratings	December 22, 2009	183 million	3,669

# Survey of dealerships



- Volvo S60, rated good
  - Results announced August 14, 2012
  - Surveyed 206 U.S. Volvo dealerships August-September 2012
- 



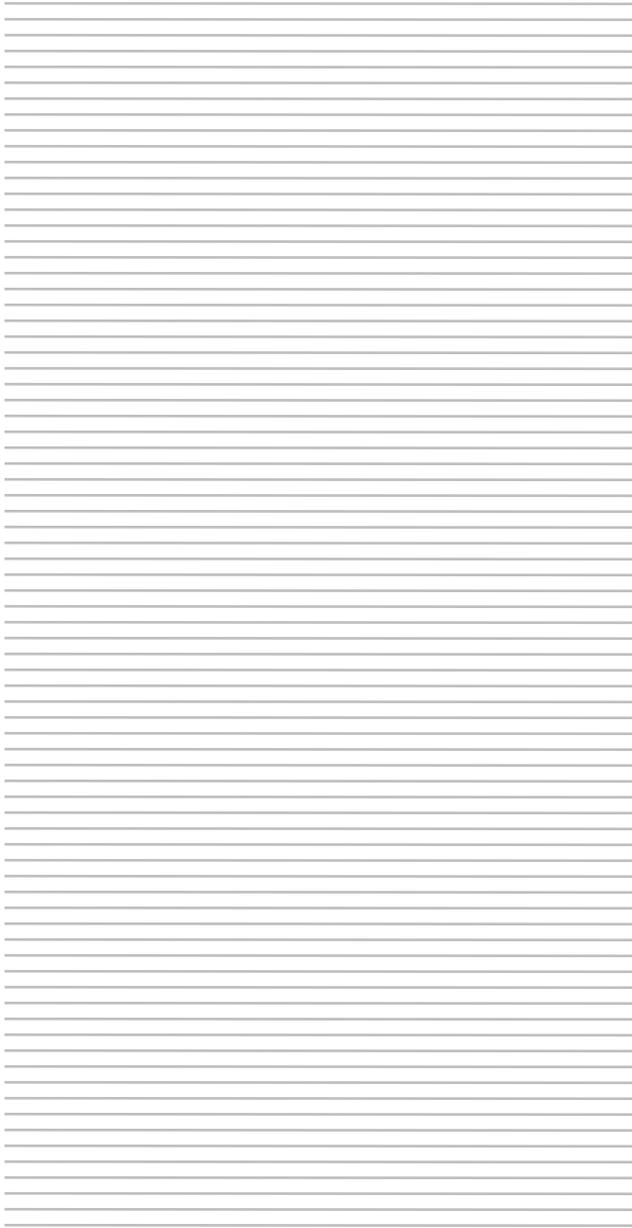
- Subaru Forester, rated good
- Jeep Patriot, rated poor



- Results announced May 16, 2013
- Surveyed 275 U.S. Subaru and Jeep dealerships June-July 2013

# Sales before and after small overlap release

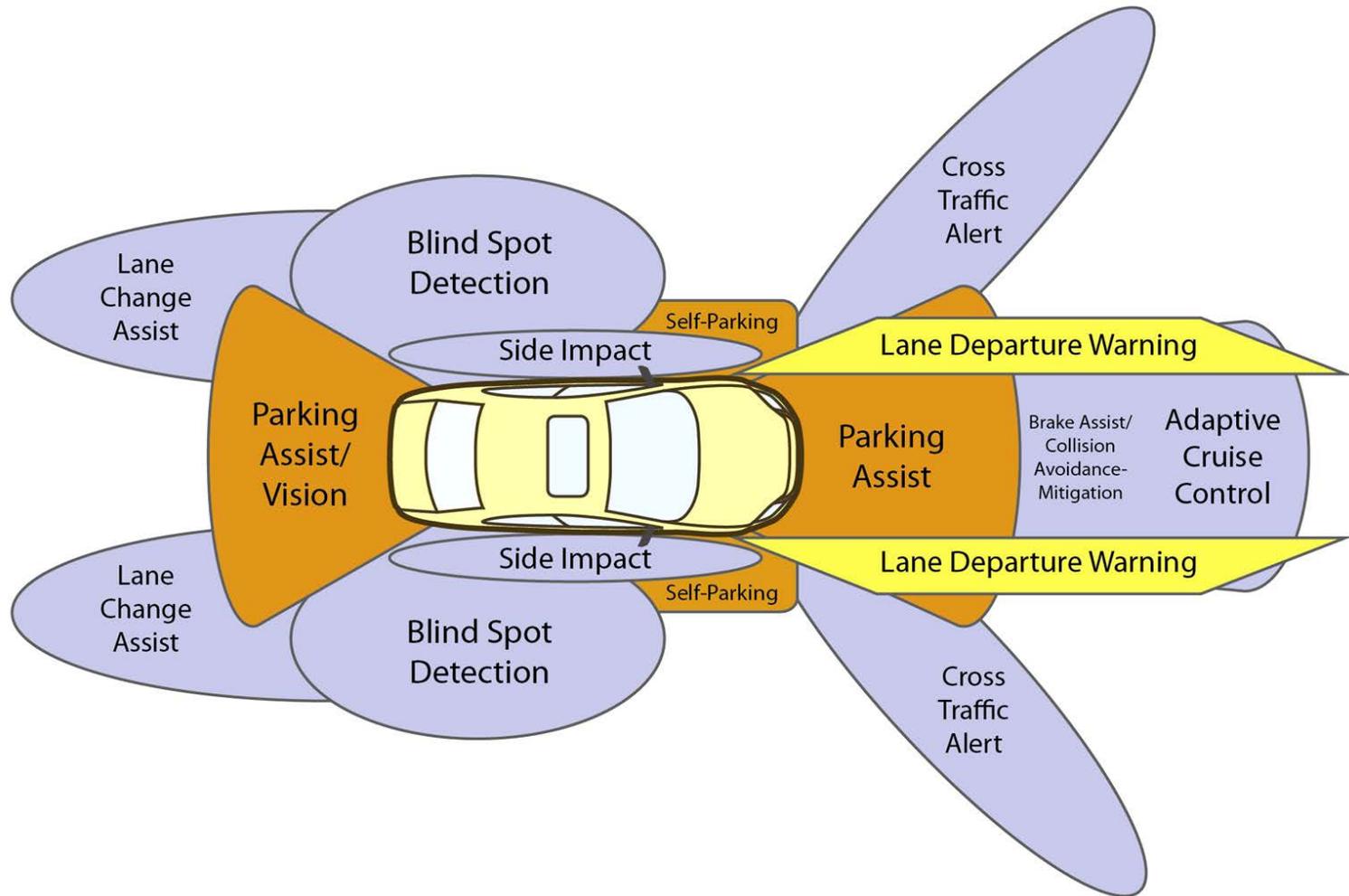
	week before announcement	week after announcement	percent change
S60	267	376	41
all Volvo models	809	956	18
Forester	1,243	1,422	14
all Subaru models	3,970	4,397	11
Patriot	426	419	-2
all Jeep models	2,314	2,325	<1



# Making vehicles safer – Evaluating crash avoidance technologies

# Driver assistance features

Radar, LIDAR, ultrasonic, infrared, cameras, GPS

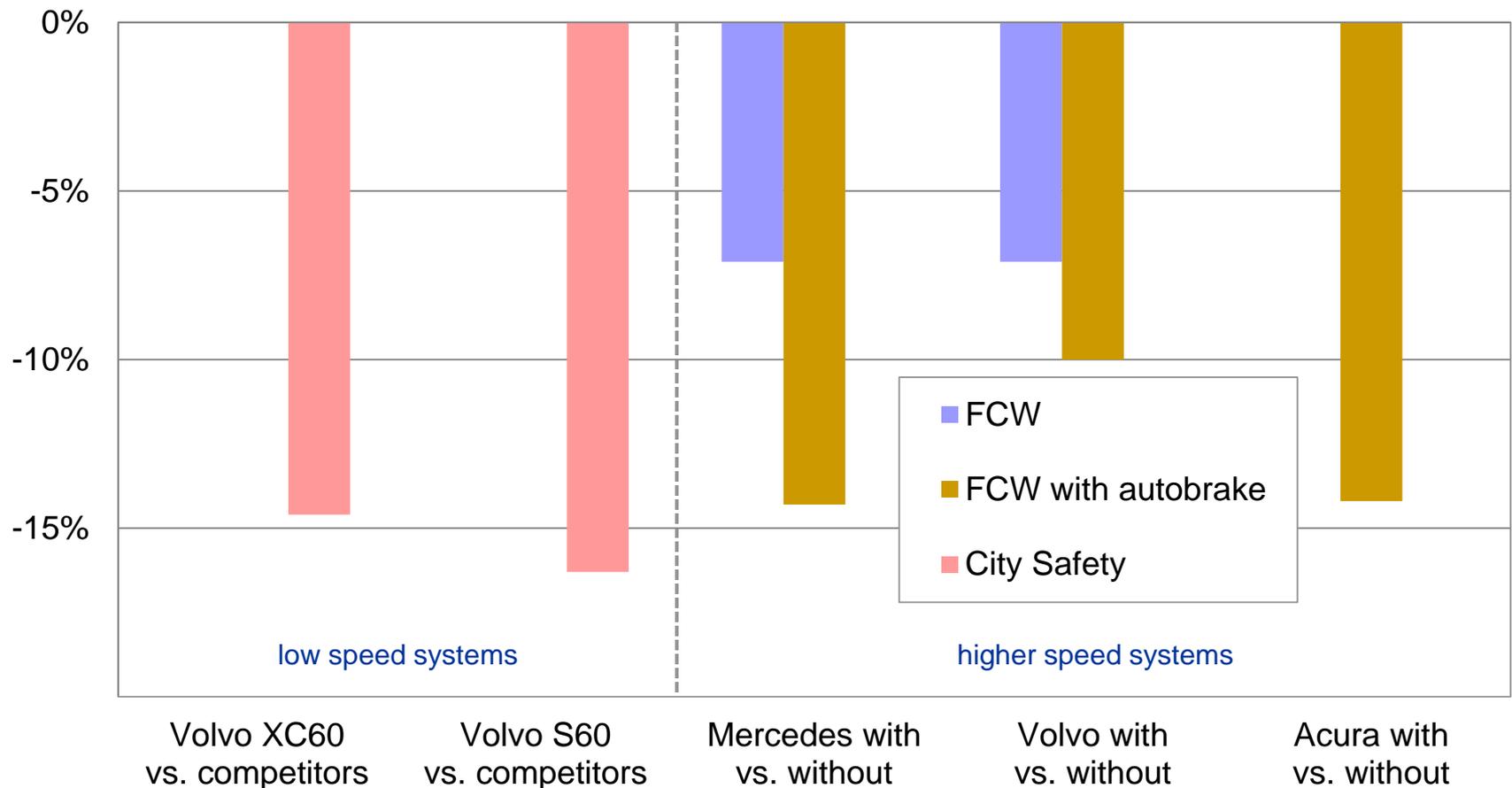




- Forward collision prevention systems are working
- Adaptive headlights are working
- The benefits of these systems are less clear –
  - Lane departure warning
  - Blind spot warning
  - Rearview cameras
  - Parking proximity sensors

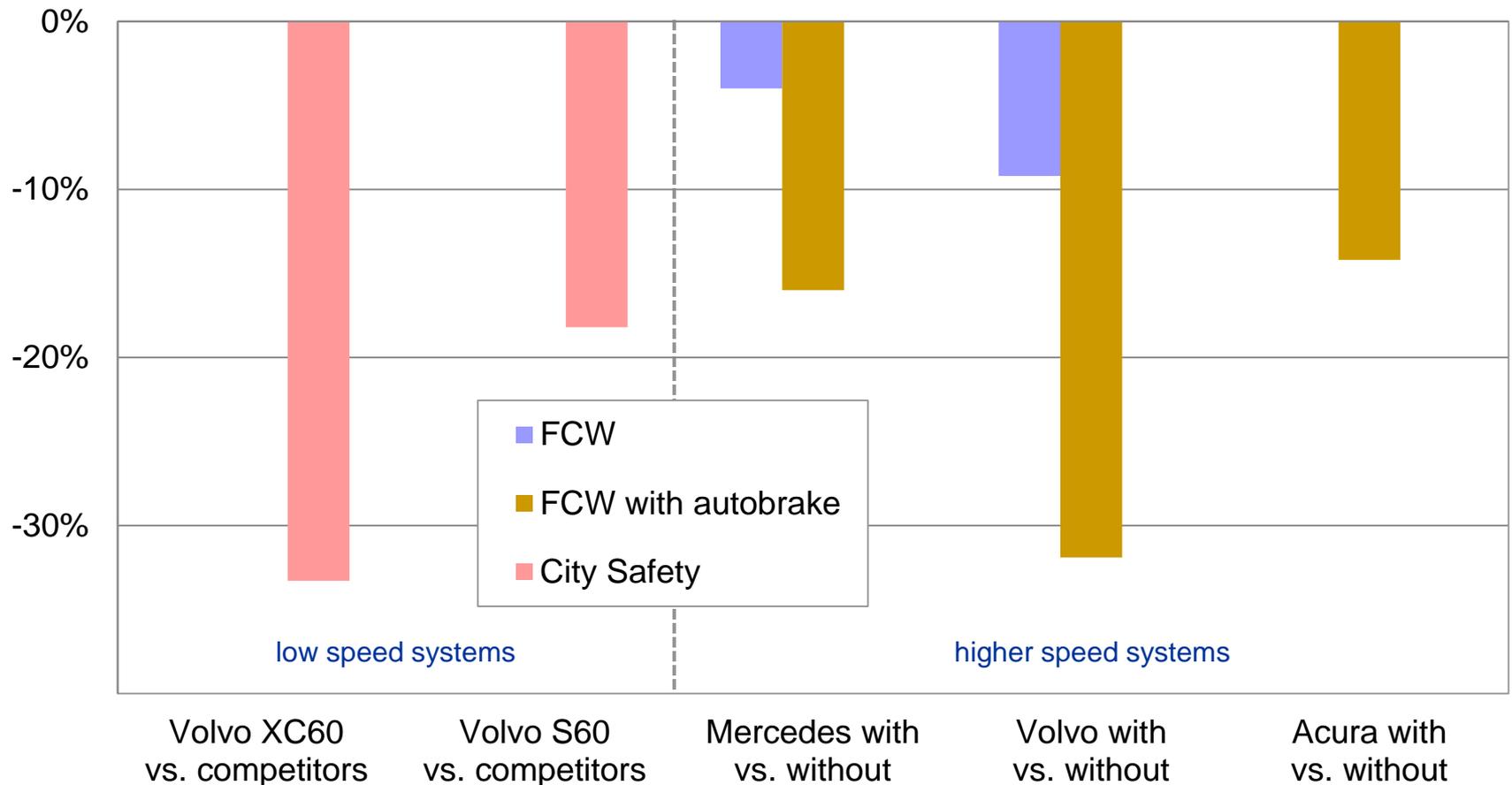
# Front crash prevention systems are helping drivers avoid crashes

Reductions in property damage liability claim frequency



# Front crash prevention systems are preventing injuries

Reductions in bodily injury liability claim frequency



# Front crash prevention evaluations

## Consumer messages

- Forward collision warning (FCW) is beneficial
- Autobrake is more beneficial than FCW alone
  - Collision mitigation braking in combination with FCW
    - e.g. Acura Collision Mitigation Brake System, Mercedes-Benz Distronic Plus
  - Low-speed collision prevention/mitigation alone
    - e.g. Volvo City Safety
- Autobrake systems with greater capability than those HLDI studied are available
  - Examples
    - Subaru EyeSight
    - Volvo Collision Warning with Full Auto Brake and Pedestrian Detection

# NHTSA identifies models with FCW (1 point)

Established criteria since 2010

**Search Results by Model** Filter results by year

**Explanation of 1990–2010 compared to 2011–Newer**  
Starting with 2011 models, NHTSA has introduced tougher tests and rigorous new 5-Star Safety Ratings that provide information about safety feature performance and crash avoidance technologies. Because of the more stringent tests, -newer model ratings are not comparable to 1990–2010 vehicles.

Year/Make/Model	Overall	Frontal Crash	Side Crash	Rollover	Recommended Technologies
<a href="#">2014 Cadillac ATS 4 DR RWD</a>	★★★★★	★★★★★	★★★★★	★★★★★	  
<a href="#">2014 Cadillac ATS 4 DR AWD</a>	★★★★★	★★★★★	★★★★★	★★★★★	  
<a href="#">2013 Cadillac ATS 4 DR AWD</a>	★★★★★	★★★★★	★★★★★	★★★★★	  
<a href="#">2013 Cadillac ATS 4 DR RWD</a>	★★★★★	★★★★★	★★★★★	★★★★★	  

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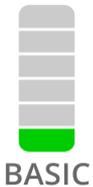
Displaying 1–4 of 4 Results

**Key**  Electronic Stability Control  Forward Collision Warning  Lane Departure Warning

# 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

# Autobrake performance tests

25 mph



Subaru Outback  
with EyeSight



Mercedes-Benz  
E350 with  
Distronic Plus

# Benefits of Autobrake: Mercedes-Benz C-Class into Chevrolet Malibu at 25 and 12 mph



25 mph

\$28,131



12 mph

\$5,715

# Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

## Rating models for **front** crash prevention



**ALSO IN  
THIS ISSUE**  
Vol. 40, No. 7  
September 27, 2013

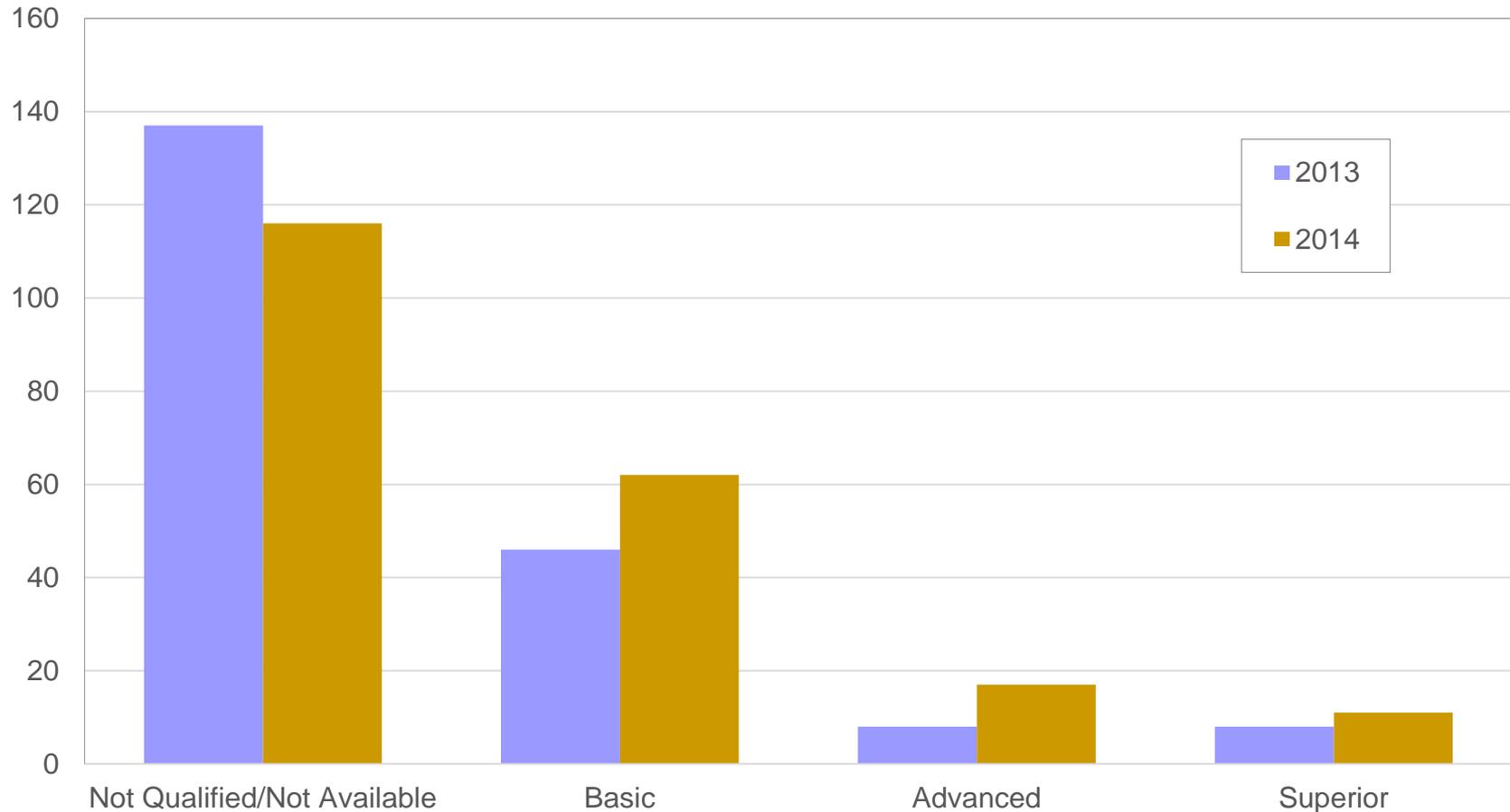
- ▶ Crash tests show why  
autobrake systems are important
- ▶ ESC, strong roofs help  
reduce rollover deaths
- ▶ Dealers see sales boost from  
small overlap ratings

First public release of  
IIHS crash avoidance ratings

September 27, 2013

# IIHS front crash prevention

Rating counts – 2013 and 2014 models



# Requirements for *TOP SAFETY PICK* awards



- G** rating in moderate overlap front test
- G** rating in side test
- G** rating in roof strength test
- G** rating in head restraint test
- G** or **A** rating in small overlap front test



meets *TOP SAFETY PICK* criteria,  
**plus earns basic, advanced or superior rating  
for front crash prevention**



# 2014 *TOP SAFETY PICK*+ winners

February 2014

## Small cars

- Honda Civic 4-door
- Mazda 3
- Toyota Prius

## Midsize moderately priced cars

- Ford Fusion
- Honda Accord 2-door
- Honda Accord 4-door
- Mazda 6
- Subaru Legacy
- Subaru Outback

## Midsize luxury/near luxury cars

- Infiniti Q50
- Lincoln MKZ
- Volvo S60

## Large luxury cars

- Acura RLX
- Volvo S80

## Small SUVs

- Mazda CX-5
- Mitsubishi Outlander
- Subaru Forester

## Midsize SUVs

- Toyota Highlander

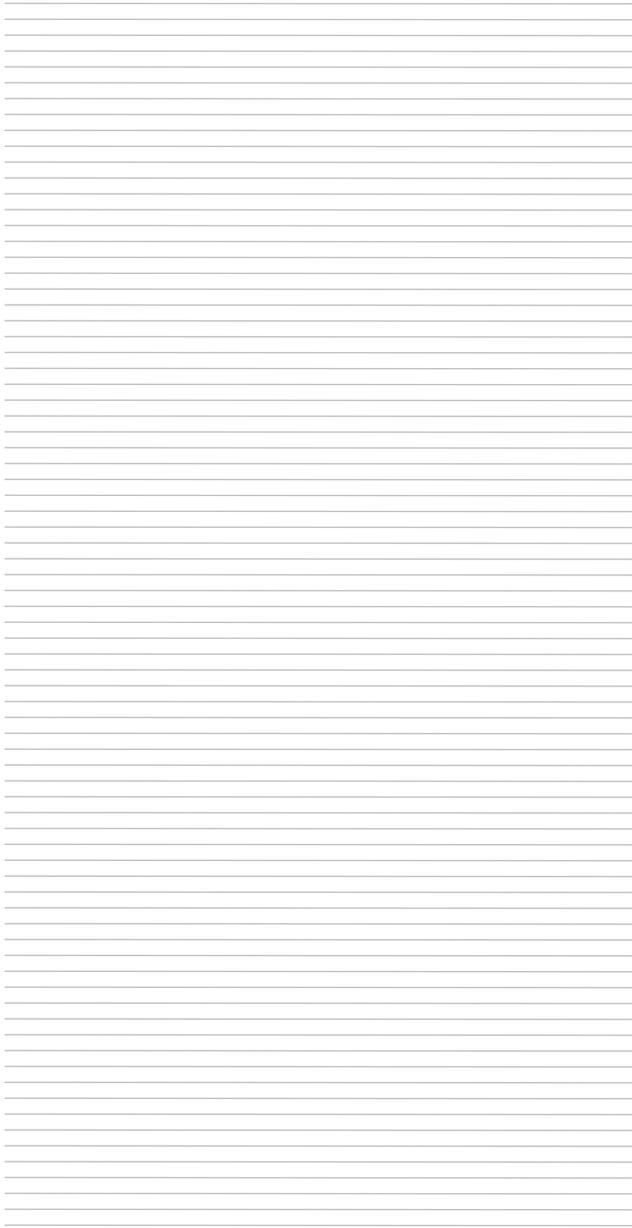
## Midsize luxury SUVs

- Acura MDX
- Mercedes M class
- Volvo XC60

## Minivans

- Honda Odyssey

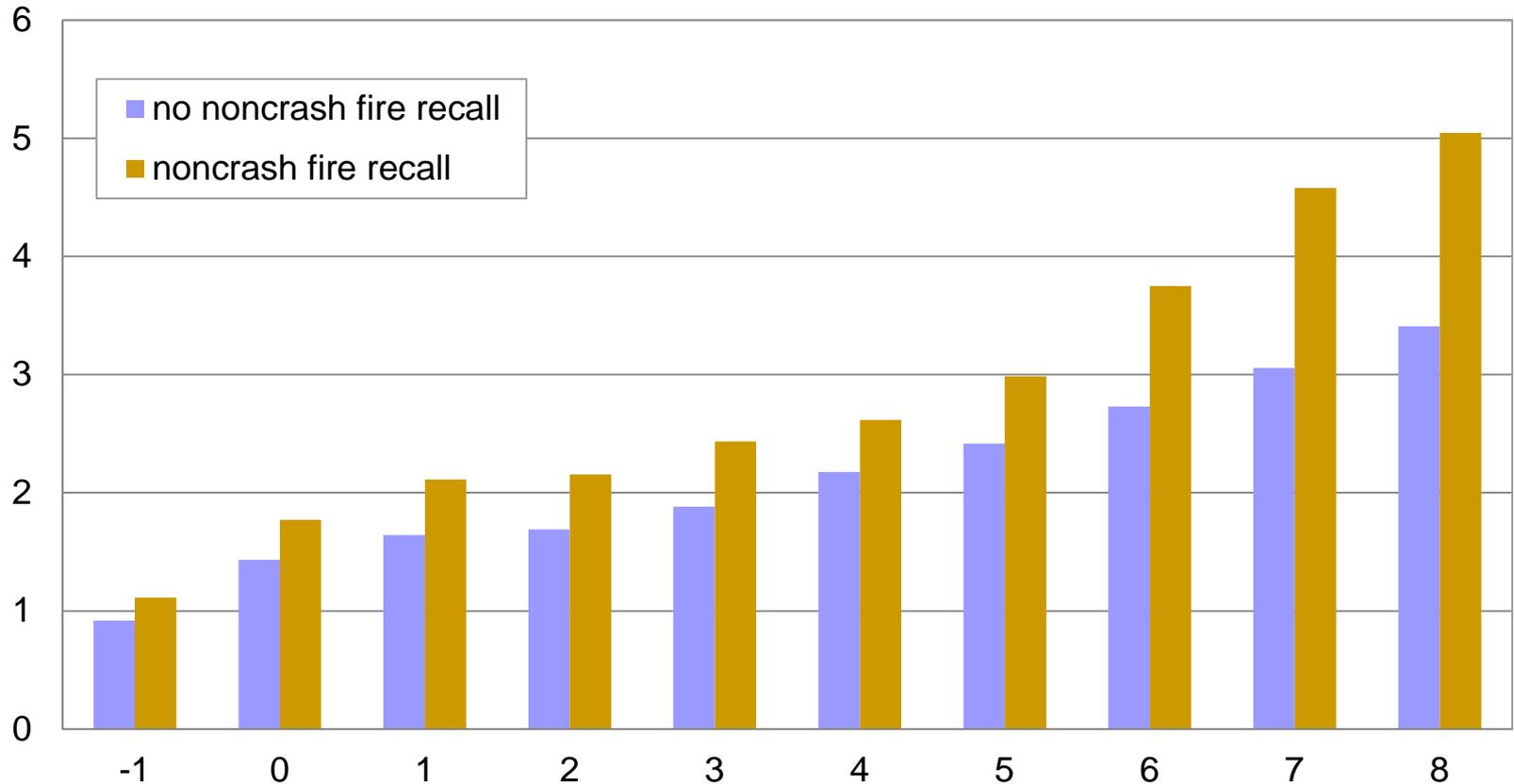




# **Making vehicles safer – The importance of safety recalls**

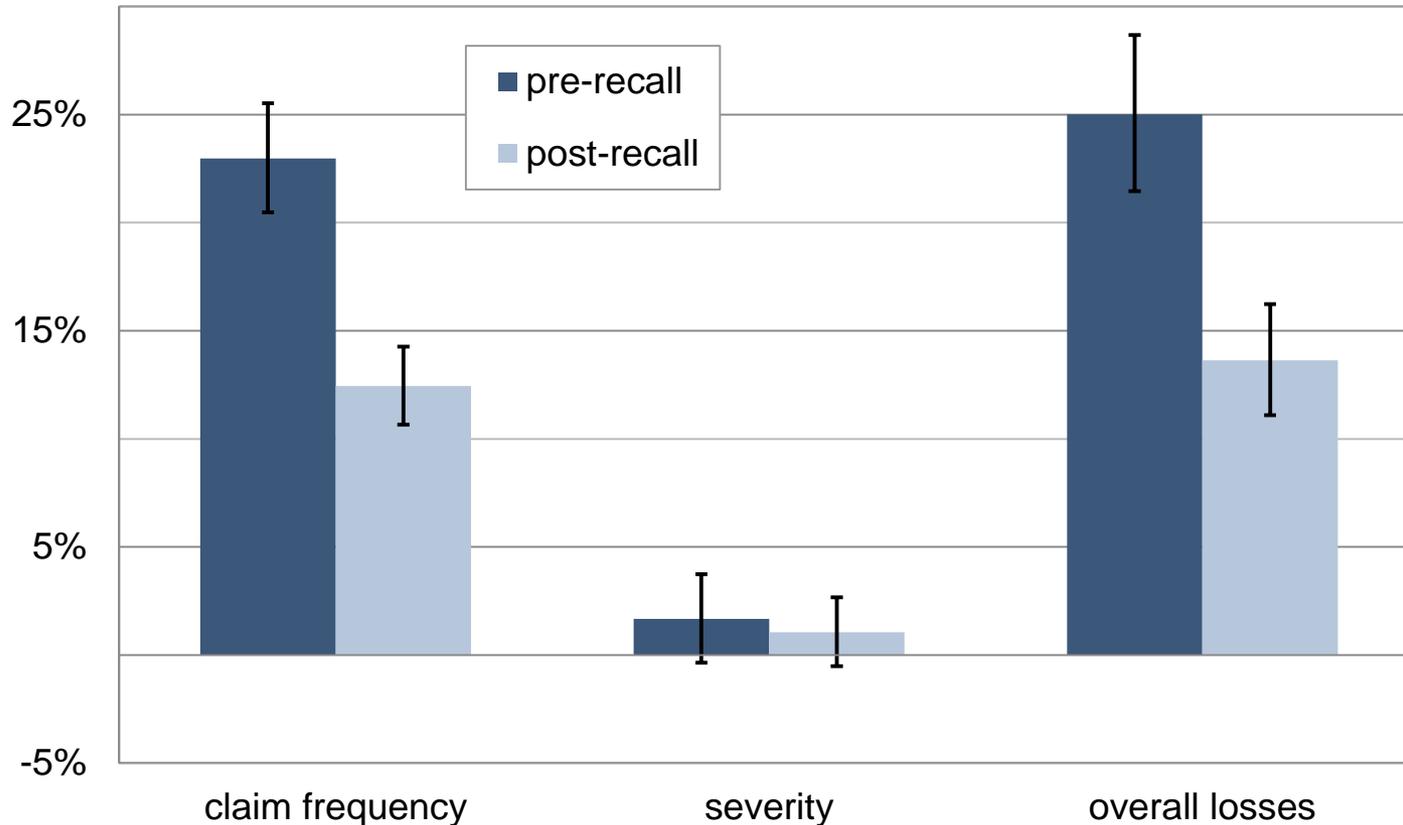
# Claim frequencies for noncrash fire losses

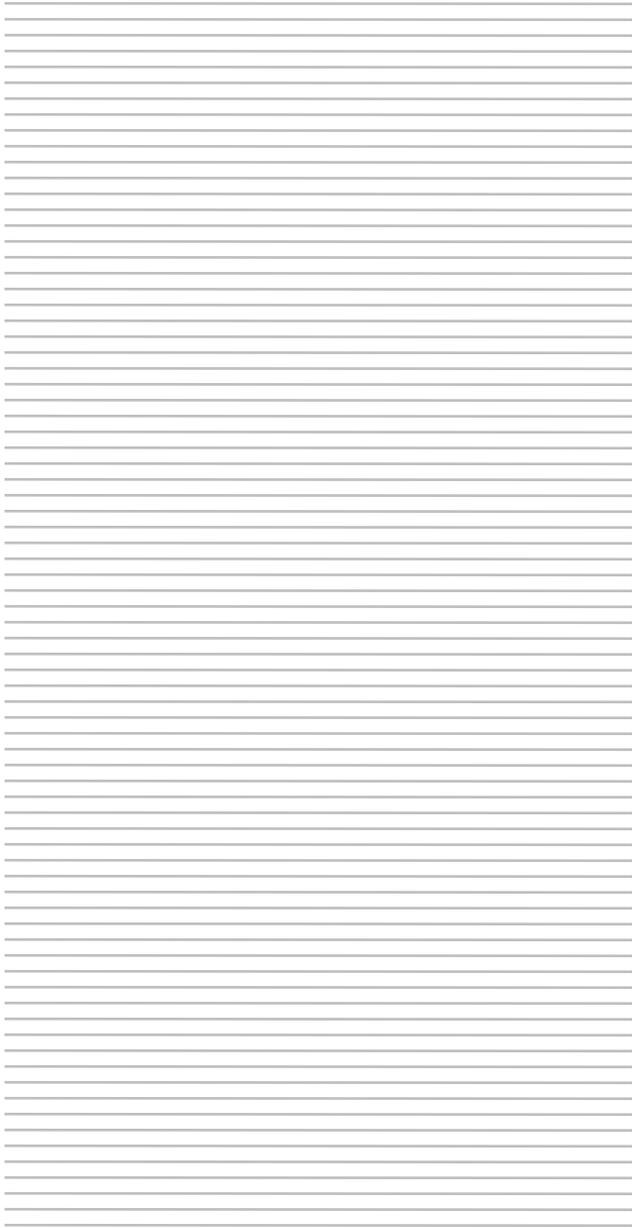
By vehicle age



# Noncrash fire insurance losses

Recalled vehicles compared with nonrecalled vehicles

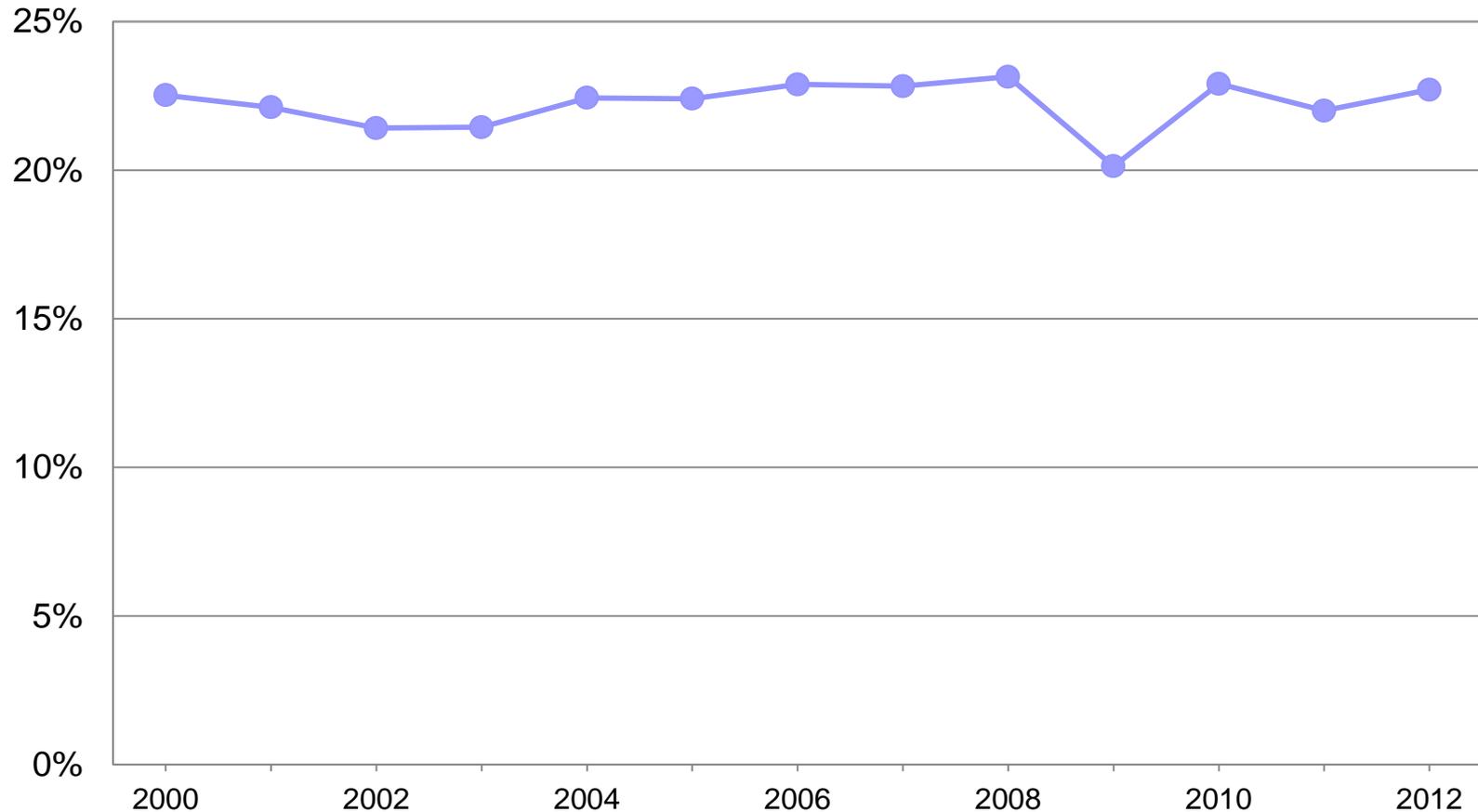




## **Making vehicles safer – Trailer underride guards**

# Large trucks are still common crash partners

Involvement when passenger vehicle occupant killed in a multiple-vehicle crash

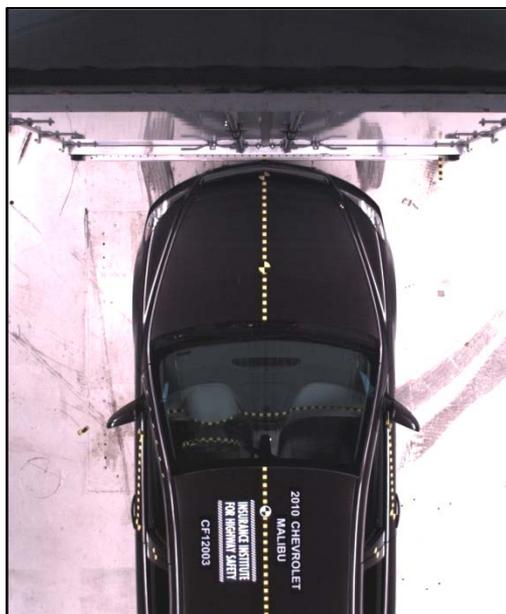


# 2010 IIHS study found inadequate real-world performance

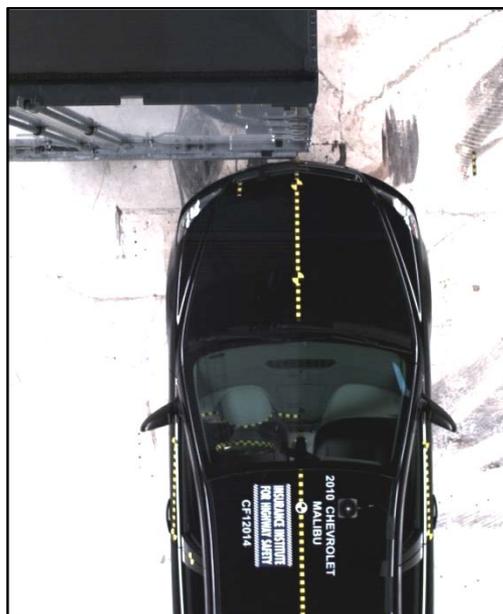


# 2012 test program with 3 configurations

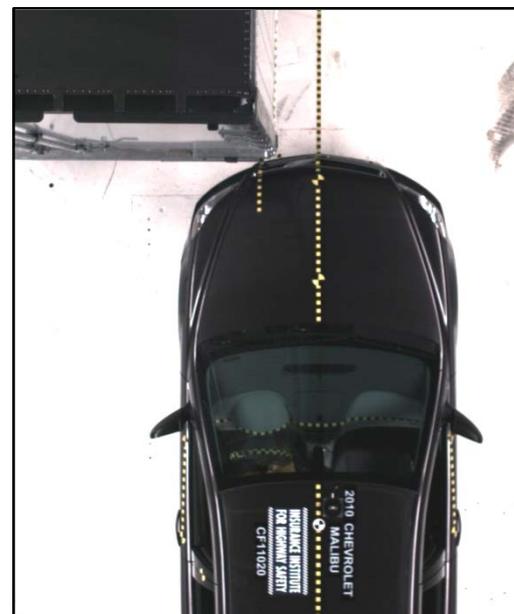
- Trailers produced by top 8 manufacturers: Wabash, Great Dane, Utility, Hyundai, Stoughton, Vanguard, Manac and Strick
- All tests conducted with 2010 Chevrolet Malibu



100% (full-width) overlap  
@ 35 mph



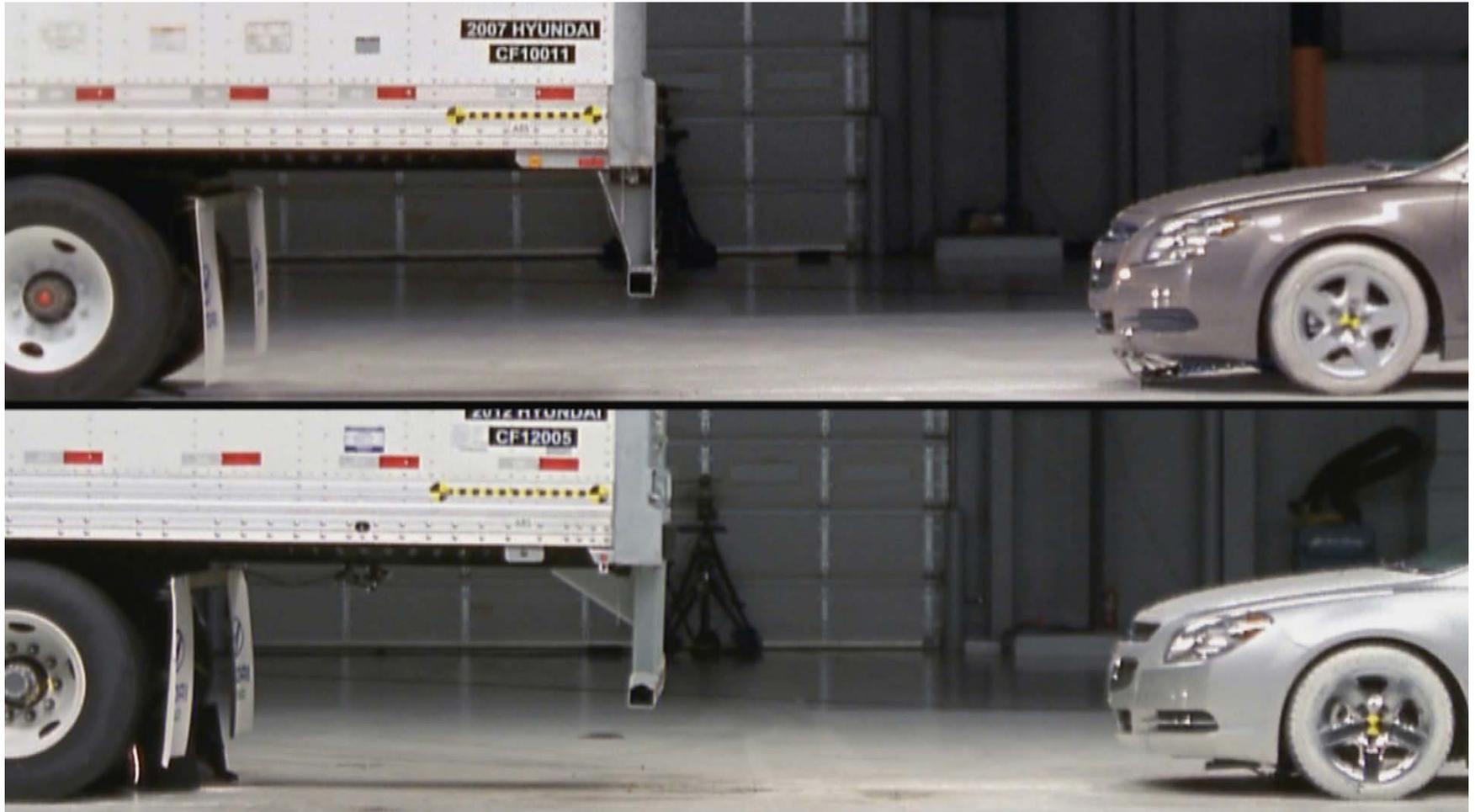
50% overlap  
@ 35 mph



30% overlap  
@ 35 mph

# Hyundai guard improvement

Full-width test of old and new design



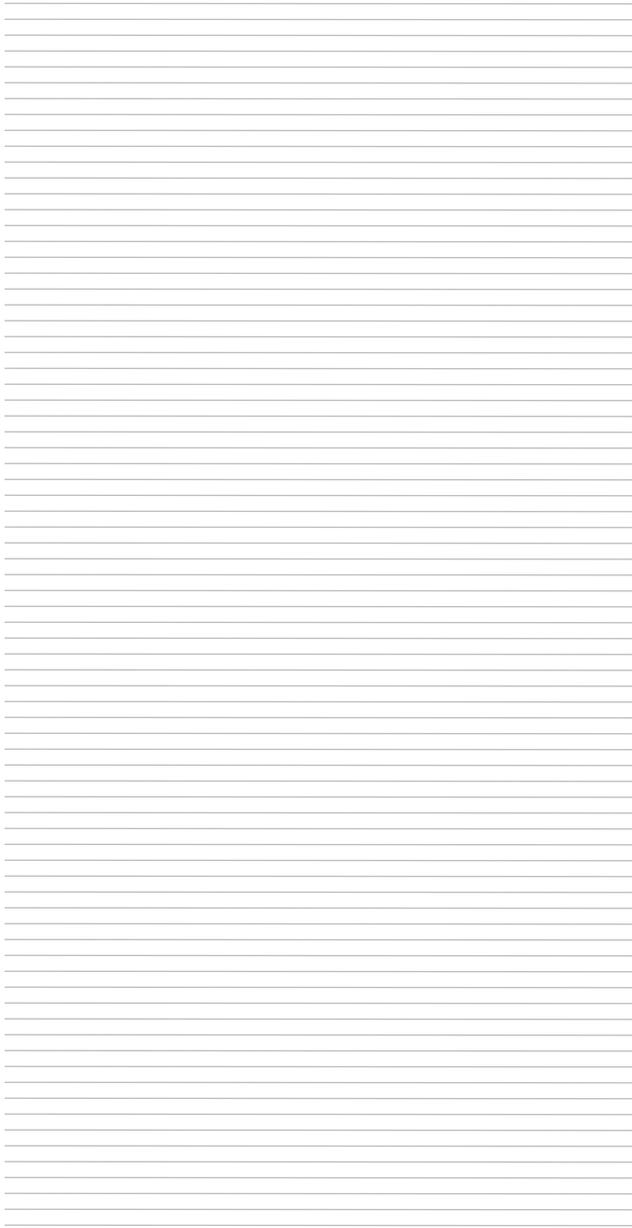
# Test results

Indicating success or failure to prevent underride

	full-width	50% overlap	30% overlap
Wabash	pass	pass	fail
Great Dane	pass	pass	fail
Utility	pass	pass	fail
Stoughton	pass	pass	fail
Hyundai	2007-11 fail	2012-13 pass	fail
Vanguard	pass	fail	N/A*
Manac	pass	pass	pass
Strick	pass	pass	fail

All are 2012 or newer models except where noted

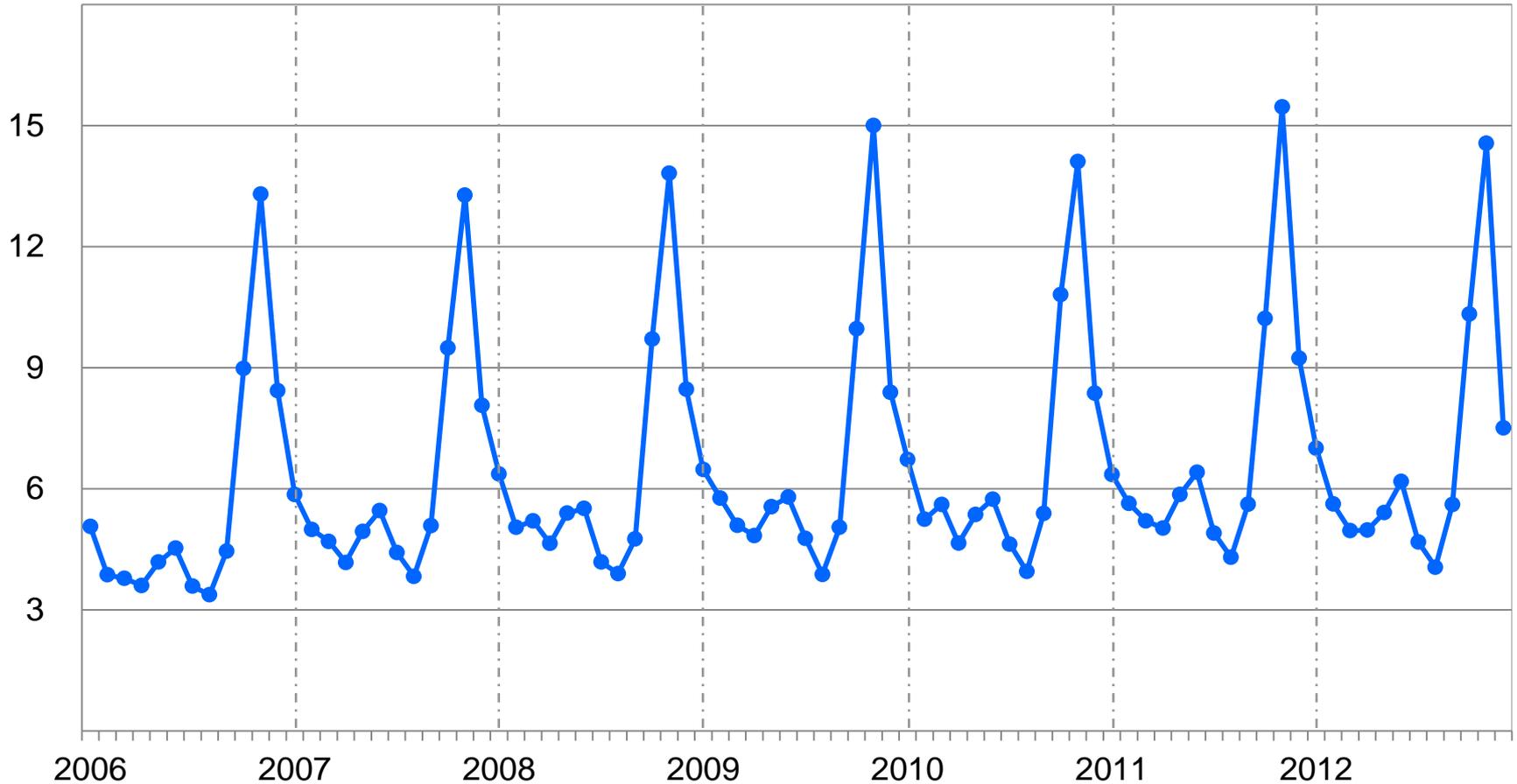
\* 30% overlap test not necessary since failure at 50%



## Animal strikes

# National comprehensive claim frequencies for animal strikes

January 2006 through December 2012







INSURANCE INSTITUTE  
FOR HIGHWAY SAFETY

HIGHWAY LOSS  
DATA INSTITUTE

[www.hldi.org](http://www.hldi.org)

Source of insurance loss statistics on most car, SUV, pickup, and motorcycle models on the road