Technologies for Safe and Efficient Transportation
National University Transportation Center

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T-SET Administration

- Carnegie Mellon University Partnered with University of Pennsylvania
- T-SET managed jointly with Traffic21 Institute, Mobility21 UTC and Metro21 Institute.
- Emphasis on multi-disciplinary research, agency and corporate partnerships and technology deployments.

Thrust Areas

- Vehicle automation technologies
- In-vehicle technologies and human-computer interaction
- Connected vehicle technologies
- Mobility data analytics
- Infrastructure based technologies
- Pedestrian safety technologies
- Transportation policy

Carnegie Mellon University
30 Years of Self-Driving Car Research

Happy Birthday!

1984
- The Terregator's top speed was a few centimeters per second; it could avoid obstacles.
- NavLab launched. Its goal: apply computer vision, sensors and high-speed processors to create vehicles that drive themselves.

1986
Humans or computers controlled NavLab1, a Chevy van. Top speed: 20 mph.

1990
NavLab 2, a US Army HMMWV, wrangled rough terrain at 6 mph. Highway speed: 70 mph.

1995
NavLab 5, a Pontiac Trans Sport, traveled from Pittsburgh to San Diego in the "No Hands Across America Tour."

2000
NavLab 11, a Jeep, was equipped with Virtual Valet.

2005
Sandstorm and Highlander placed 2nd and 3rd in the DARPA Grand Challenge.

2007
Carnegie Mellon's "Boss" won the DARPA Grand Urban Challenge by outmaneuvering other vehicles along the 55-mile course.

2014
Carnegie Mellon's **14th self-driving vehicle** is a Cadillac SRX that:
- avoids pedestrians and cyclists
- takes ramps and merges
- recognizes and obeys traffic lights
- looks like other Cadillac SRXs

www.engineering.cmu.edu

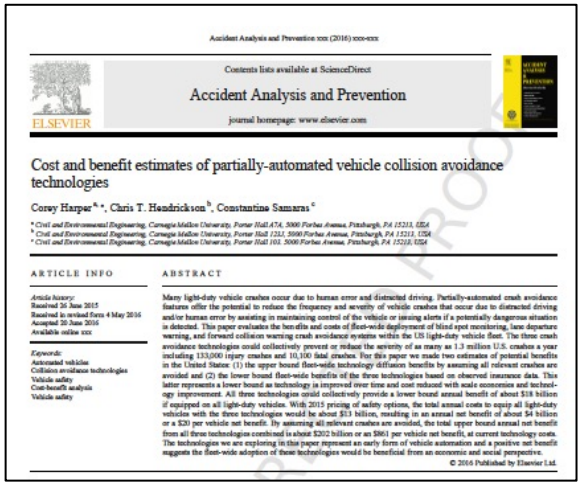
Bringing greater intelligence to vehicles

2007

2012

Cost-Benefit Analysis of Early Automation Features

- Observed insurance data from the Insurance Institute for Highway Safety (IIHS).
- 2012 FARS and GES used to estimate related fatal and non-fatal crashes, respectively.
- Co-authors: Corey Harper and Costa Samaras



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Cost and benefit estimates of partially-automated vehicle collision avoidance technologies

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ABSTRACT

Many light-duty vehicle crashes occur due to human error and distracted driving. Partially-automated crash avoidance features offer the potential to reduce the frequency and severity of vehicle crashes that occur due to distracted driving and/or human error by assisting in maintaining control of the vehicle or issuing alerts if a potentially dangerous situation is detected. This paper evaluates the benefits and costs of fleet-wide deployment of blind spot monitoring, lane departure warning, and forward collision warning crash avoidance systems within the US light-duty vehicle fleet. The three crash avoidance technologies could collectively prevent or reduce the severity of as many as 1.3 million U.S. crashes a year including 133,000 injury crashes and 10,100 fatal crashes. For this paper we made two estimates of potential benefits in the United States: (1) the upper bound fleet-wide technology diffusion benefits by assuming all relevant crashes are avoided and (2) the lower bound fleet-wide benefits of the three technologies based on observed insurance data. This latter represents a lower bound as technology is improved over time and cost reduced with scale economies and technology improvement. All three technologies could collectively provide a lower bound annual benefit of about $18 billion if equipped on all light-duty vehicles. With 2015 pricing of safety options, the total annual costs to equip all light-duty vehicles with the three technologies would be about $13 billion, resulting in an annual net benefit of about $4 billion or a $20 per vehicle net benefit. By assuming all relevant crashes are avoided, the total upper bound annual net benefit from all three technologies combined is about $202 billion or an $861 per vehicle net benefit, at current technology costs. The technologies we are exploring in this paper represent an early form of vehicle automation and a positive net benefit suggests the fleet-wide adoption of these technologies would be beneficial from an economic and social perspective.

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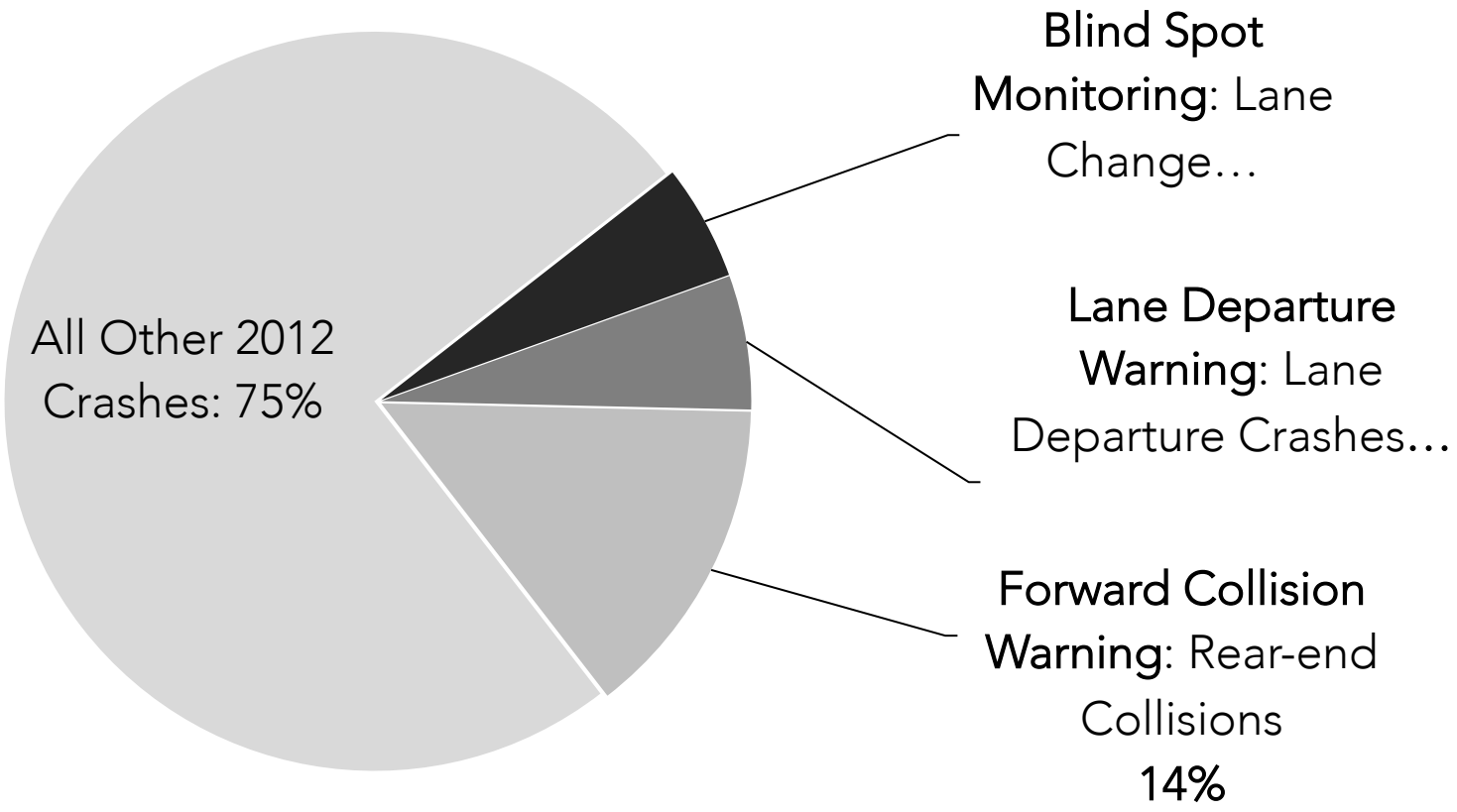
Injury Crashes Addressed by Each Technology

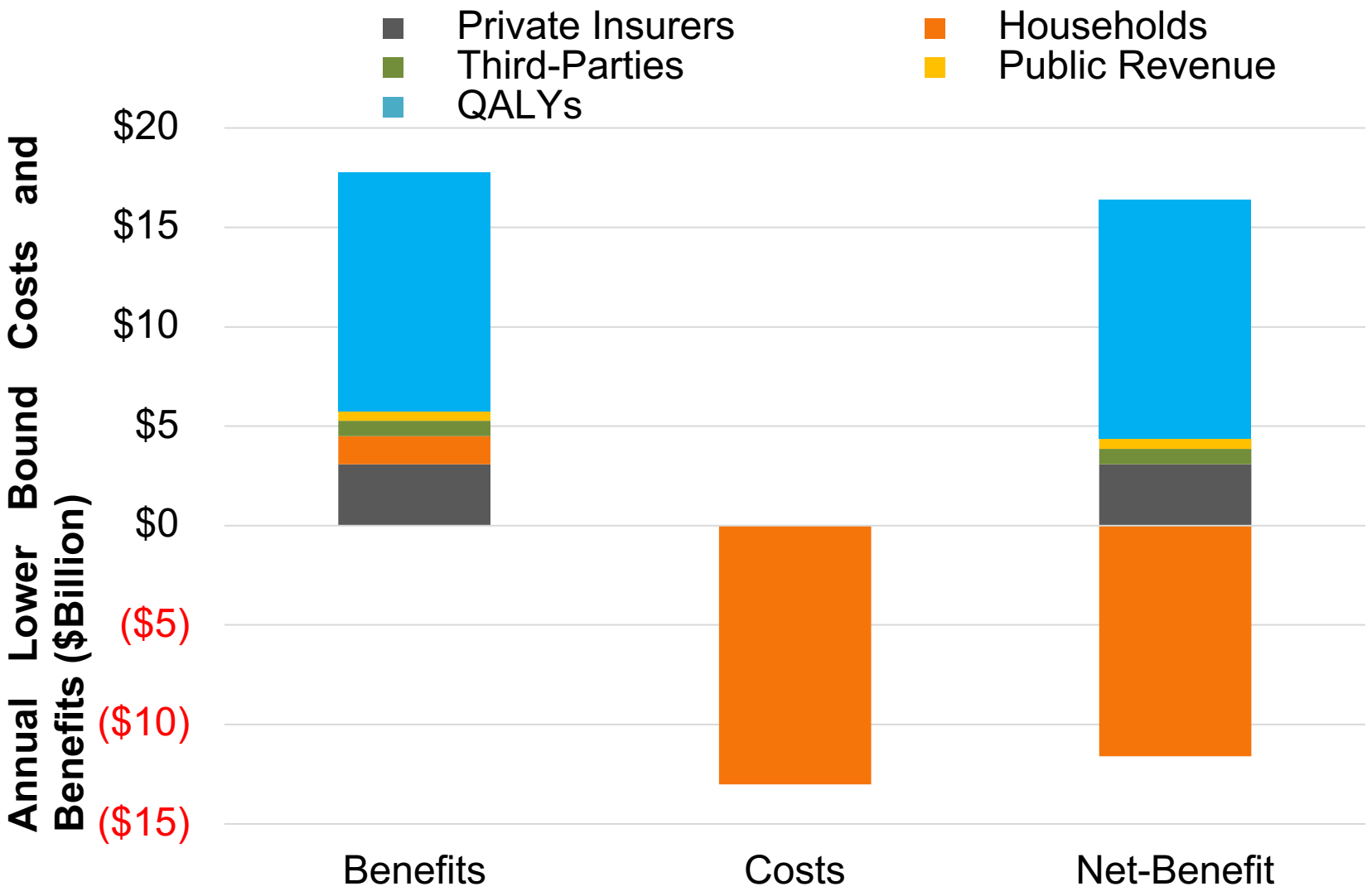


Three Existing Level 1 Technologies Will Dramatically Improve Safety

Technology	All Crashes	Injury Crashes	Fatal Crashes
Blind Spot Monitoring	267,000	17,000	280
Lane Departure Warning	262,000	58,100	9,000
Forward Collision Warning	795,000	58,000	750
Total	1,320,000	133,100	10,100
Percent of Total Crashes	23.5%	8.2%	32.6%

Source: Harper et al. 2016

Lower Bound Observed Net-Benefit About $4B



Upper Bound Potential Net-Benefit is About $200B