

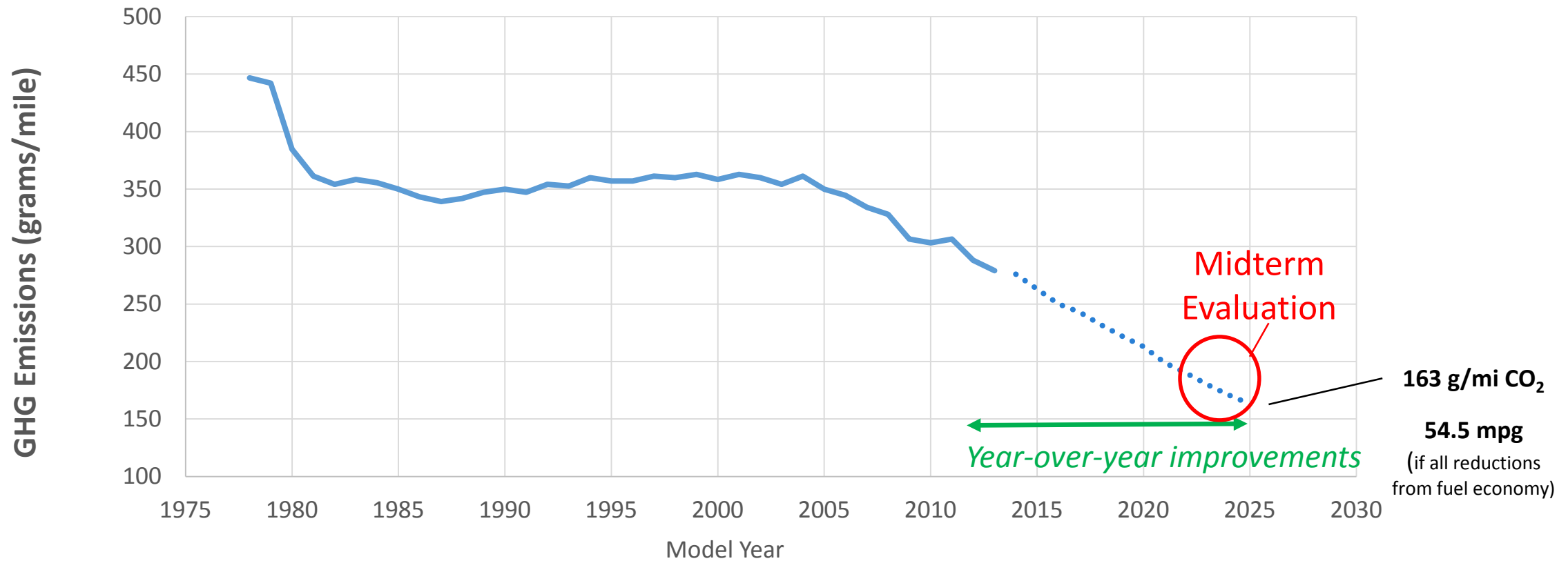
Light-Duty Vehicle Greenhouse Gas Standards

Center for Automotive Research Management Briefing Seminar

August 4, 2015



U.S. GHG/Fuel Economy standards provide significant benefits to climate, oil, consumers



What does the future hold ... Empty Shelf or Smorgasbord?



OR



*“Yet maintaining the current pace of emissions reductions will be challenging because automakers have exhausted available technologies to reduce emissions, leaving **“nothing sitting on the shelf”** Alliance of Automobile Manufacturers, Automotive News, March 26, 2015*

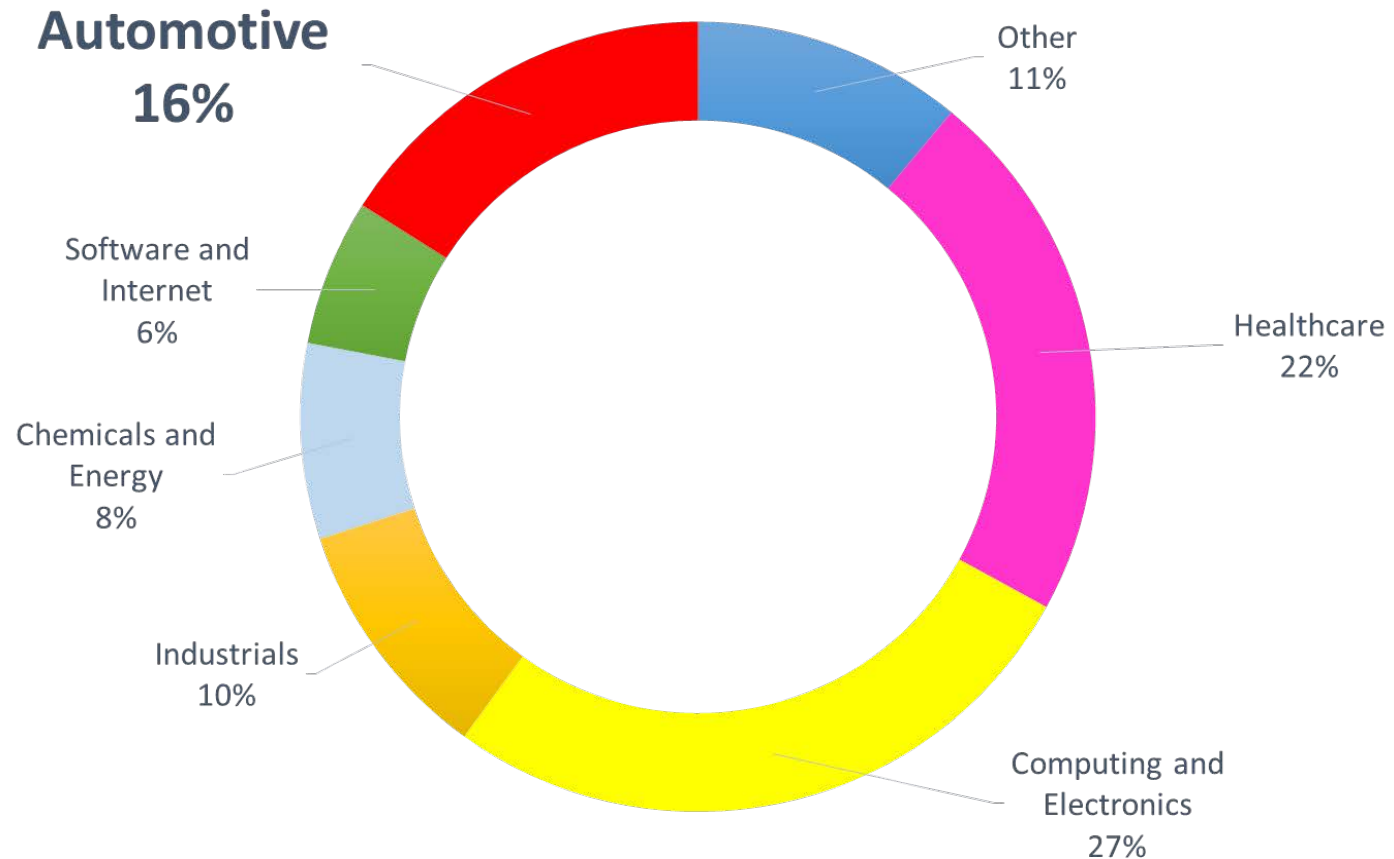
*“We’ve got a **whole smorgasbord** or buffet of technology that can be implemented”*

Mark Reuss, GM President of North America, Automotive News, February 5, 2011

Auto industry ranks 3rd largest sector for global R&D investment

Auto R&D Budget

> \$100 Billion/year
(>\$270 Million/day)



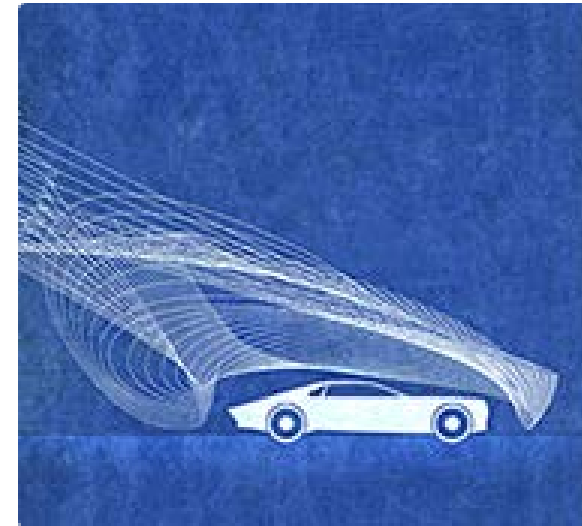
Source: Booz & Co.

BCG report: Fuel economy standards are spurring auto innovation

*“Regulatory and marketplace demands with respect to **fuel efficiency**, connectivity, and safety ... **may well herald a new golden age of automotive innovation.**”*

*“Consumers cite innovation – generally in key areas such as connectivity, safety, and **fuel economy** – as an important consideration in their purchase decision.”*

bcg.perspectives
by THE BOSTON CONSULTING GROUP



**Accelerating Innovation:
New Challenges for
Automakers** (January 2014)

Thompson Reuters lists Fuel Economy among the 5 “hottest areas” of automotive innovation

TABLE 1: HOTTEST AREAS OF AUTOMOTIVE INNOVATION

TOPIC AREA	DEFINITION	CATEGORY
Fuel Economy	Also known as fuel efficiency, or the maximization of the distance traveled on a unit of fuel	Propulsion
Telematics	Global Positioning System technology integrated with computers and mobile communications technology in automotive navigation systems	Navigation
Autonomous Driving	Automobiles that are capable of driving themselves without input from a human passenger	Handling
Driver Assistance	Various systems such as auto braking, lane departure warning, and traffic sign recognition that help the driver become aware of and avoid road hazards	Safety & Security
Heads-Up Displays (HUDs)	Systems for displaying data from a smartphone to the windshield of an automobile so a driver can keep his/her eyes on the road	Entertainment

*“Technology is most certainly playing a key role in developing next generation automobiles that will be **more fuel efficient**, safer, and fun to drive.”*

Table 2—List of Hot Topic Areas, Definitions, and Corresponding Categories
Source: Thomson Innovation & Thomson Reuters Derwent World Patents Index

Powertrain suppliers have a key role – and opportunity – to lead innovation



Half of the 2015 PACE awards (7 of 14) went to supplier innovations to improve fuel economy

"A new level of efficiency is being achieved with basic science -- new materials and electronics"

J. Ferron, Director of Judging, PACE Awards

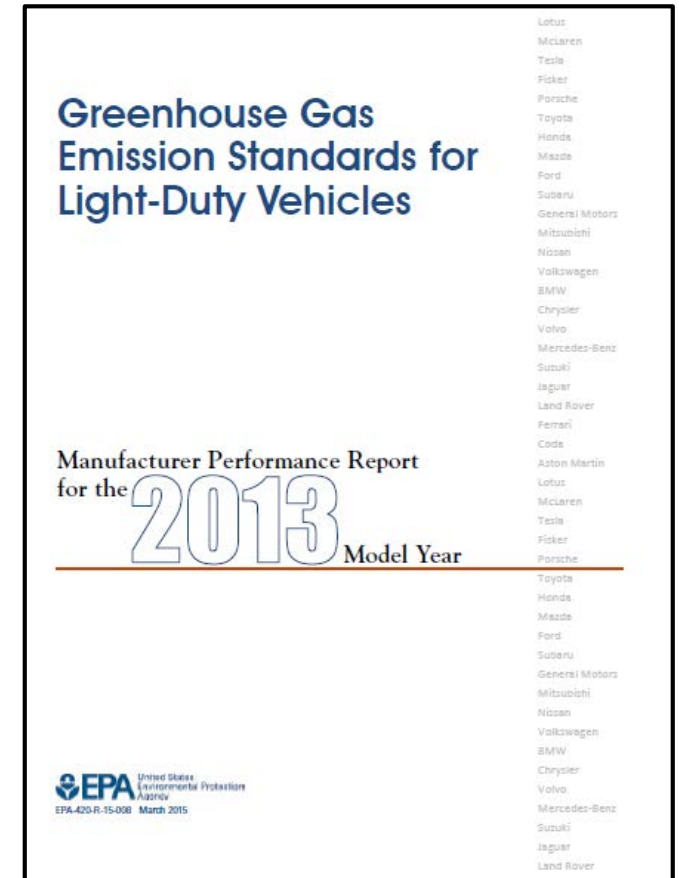
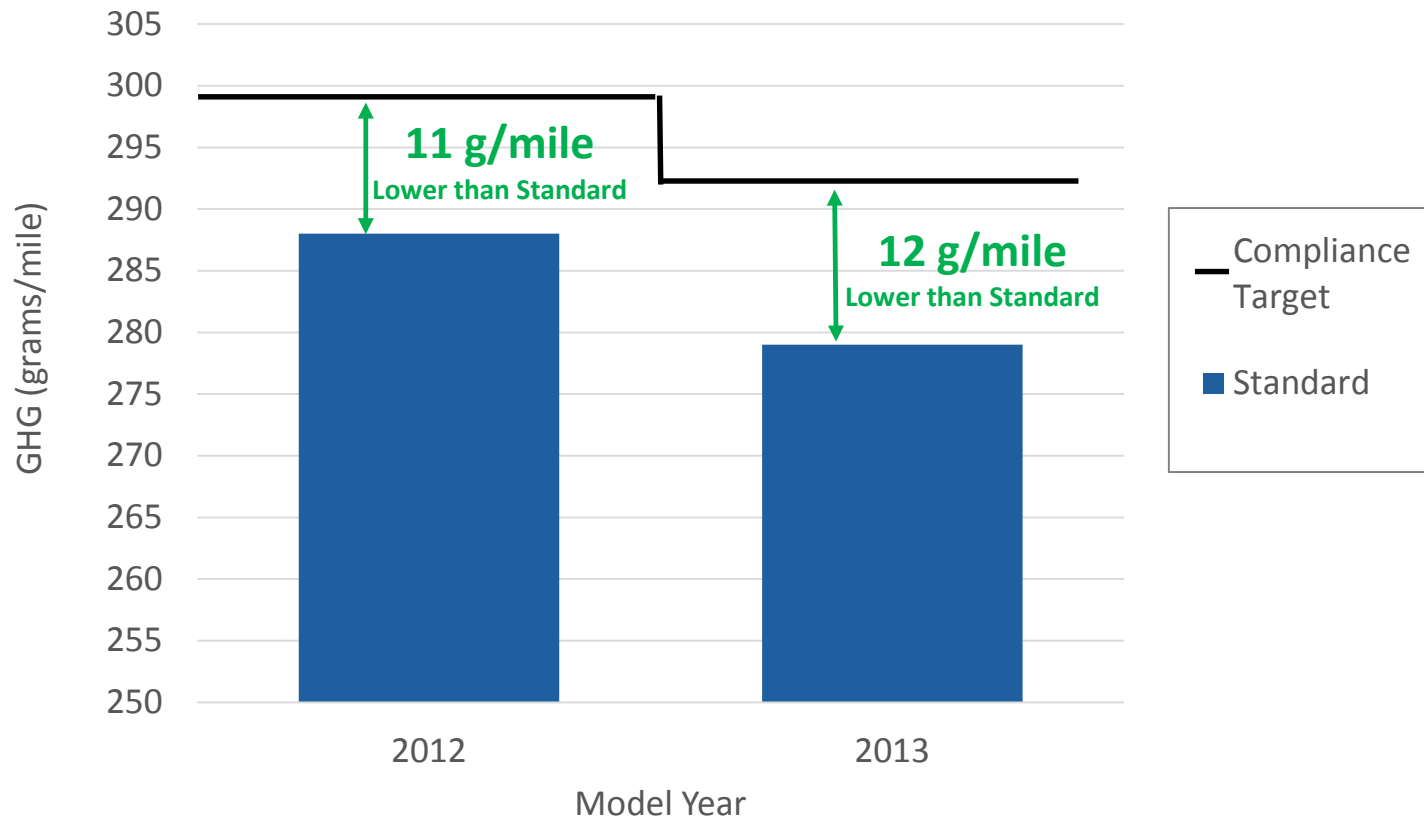
7th Annual
**GLOBAL AUTOMOTIVE
INNOVATION CHALLENGE**

sponsored by SAE, MIT Alliance of MI, and NextEnergy

Half of the Global Automotive Innovation Challenge awards (6 of 12) were also related to fuel economy technologies

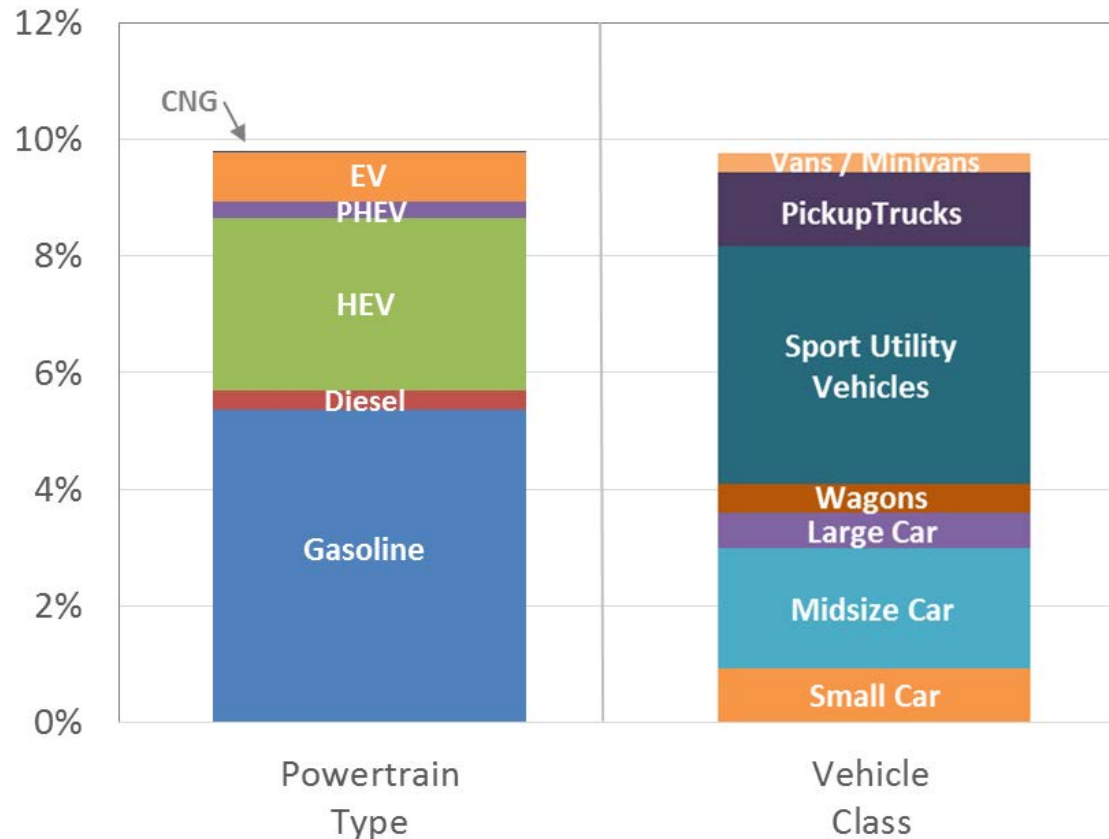
GHG Compliance ... Good News So Far

Automakers beat standards first two years; widespread use of credit flexibilities



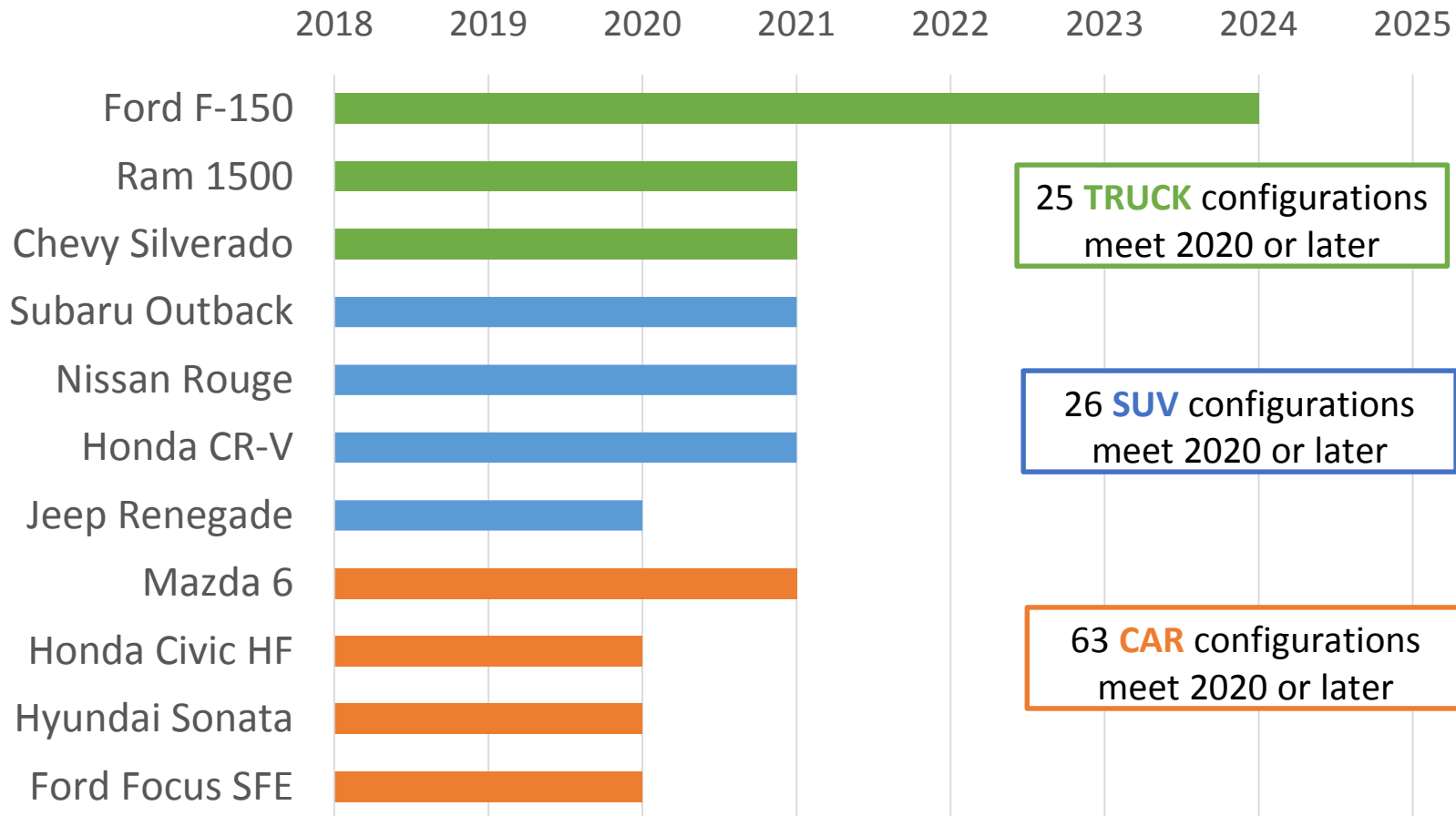
Vehicles are meeting future standards with a variety of powertrains – mostly gasoline

MY 2015 Fleet Volume That Meets MY 2020 Standards



More than 1.3 million MY 2015 vehicles are already meeting future standards for MY 2020 or beyond

Many of today's top-selling vehicles* can already meet future standards



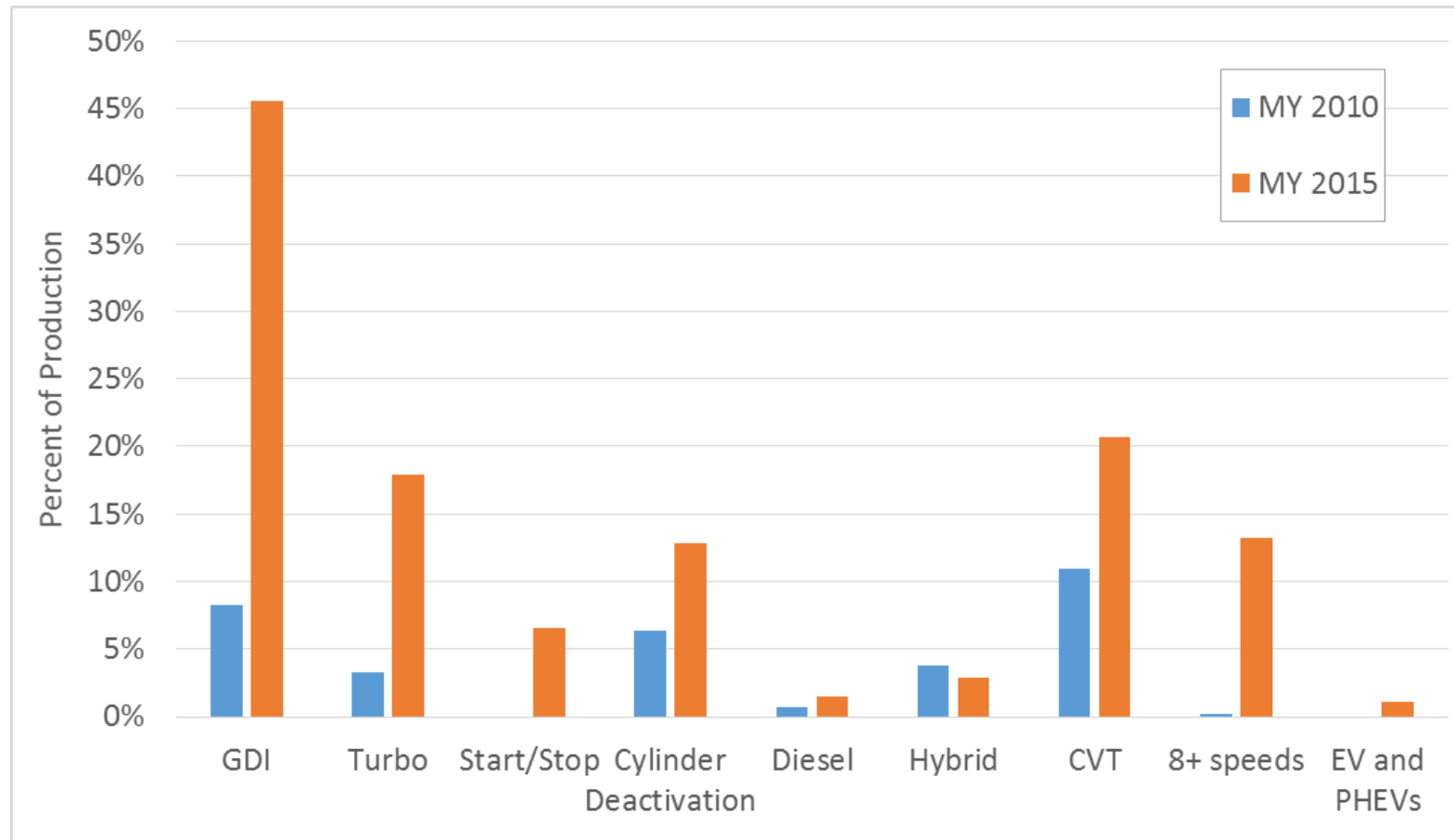
*At least one variant of vehicle model

Vehicles are meeting future standards with a variety of technologies

		Trucks			SUVs				Cars			
		Ford F-150	Ram 1500	Chevy Silverado	Subaru Outback	Nissan Rouge	Honda CR-V	Jeep Renegade	Mazda 6	Honda Civic HF	Hyundai Sonata	Ford Focus SFE
Engine	Diesel		X									
	Turbocharging	X						X			X	X
	High Compression Atkinson								X			
	GDI	X		X			X		X		X	X
	Cylinder Deactivation			X								
	Stop-start	X										
Transmission	8+ Speed Transmissions		X									
	CVT				X	X	X			X		
Road Loads	Mass Reduction*	X					X		X			
	Tires**		X			X	X		X	X	X	
	Aero**	X	X	X							X	X

*compared to MY2008 curb weight
 ** Top 25% of class + other active/passive features

Manufacturers are aggressively adopting technology



NAS Report on Fuel Economy Technologies

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

- Comprehensive study – good early input to MTE process
- Affirmed that 2025 standards can be met through advanced gasoline vehicle technologies
- Many recommendations in line with our research plan already underway, others help prioritize

MYTHS



Standards ignore consumer choice

- Footprint-based standards designed to preserve consumer choice

Low gasoline prices threaten compliance

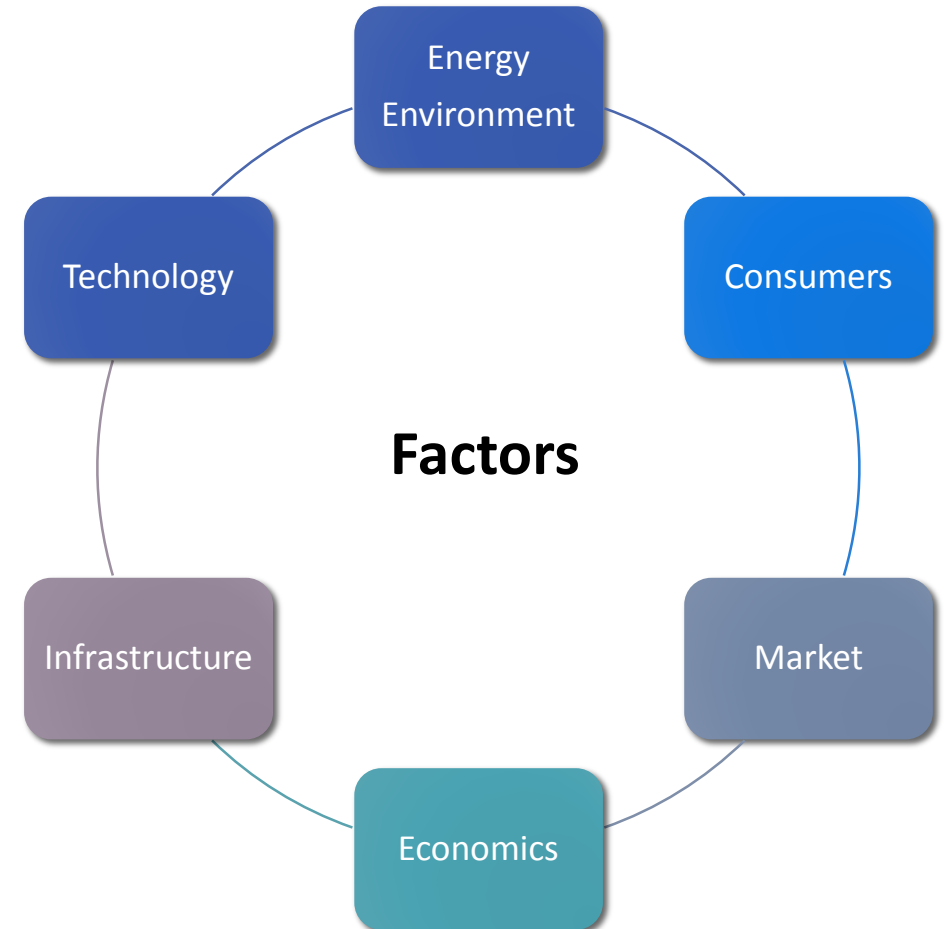
- Industry is complying as sales are booming
- If fleet mix changes, standards adjust

Low HEV/EV/PHEV sales mean 2025 standards can't be met

- EPA standards are performance-based – no technology mandate
- EPA projected – and NAS reaffirmed – compliance largely from gasoline vehicles

Midterm Evaluation – Overview

- Technical review of longer term standards for 2022-2025
- In coordination with NHTSA and CARB
- EPA's decision could go one of 3 ways:
 - Standards remain same; more stringent; less stringent



Midterm Evaluation – Technology Assessment

- Advanced technology assessment
- Mass reduction feasibility/cost study
- Cost teardowns
- Modeling tools
- Collaboration: NHTSA, CARB, DOE, Canada



Midterm Evaluation – Powertrain Benchmarking

- Testing 23 vehicles/engines across a wide range of powertrains and segments
 - Cars, SUVs, pickups
 - Naturally aspirated and boosted engines
 - Gasoline and diesel
 - I4 and V6 engines
 - 6 and 8+ speed AT/DCT transmissions and CVTs

Midterm Evaluation – Market Research

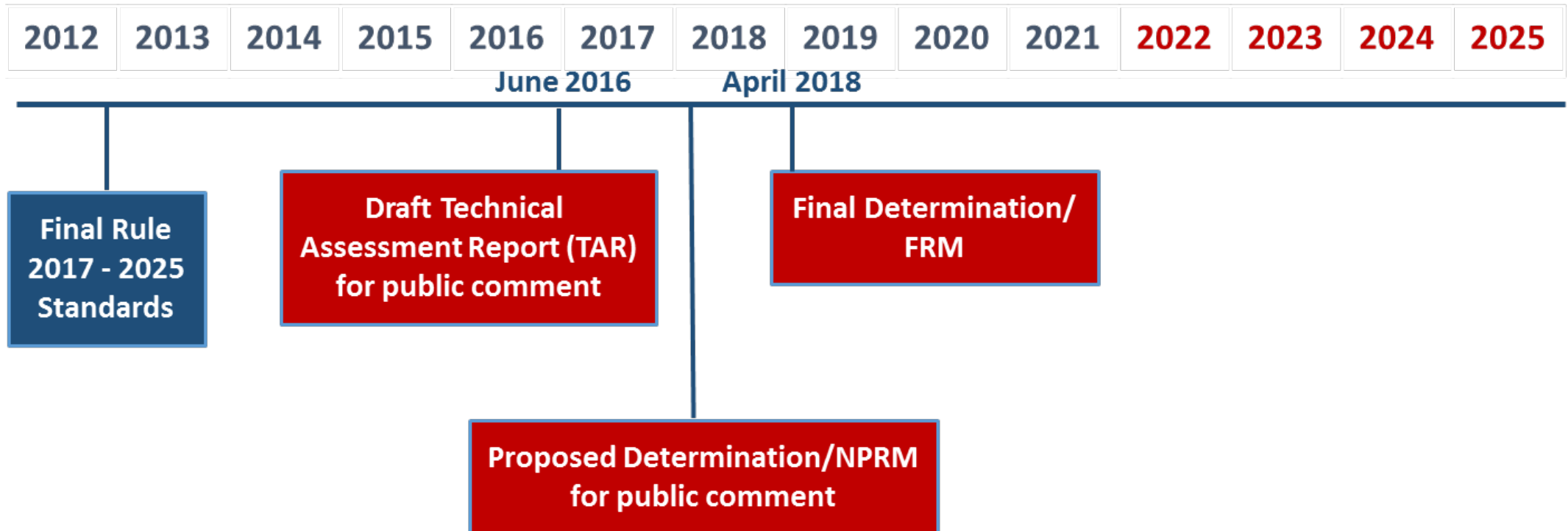
- Vehicle sales
- Fleet mix changes (cars v. trucks)
- Technology penetration in fleet
- Consumer satisfaction surveys
- Automotive reviews

Automotive Reviewers Like Fuel Economy Technologies

- EPA study finds 4 out of 5 mentions of FE technologies in auto reviews have positive or neutral ratings
- Most positives (80-100%): active aero, mass reduction, cylinder deactivation, LEDs, GDI, turbocharging
- Most negatives (~30%): CVTs and stop-start
- But no universal issues with technologies -- some manufactures implementing better than others



Midterm Evaluation Timeline



Going forward

- Extensive stakeholder outreach
- Data-driven
- Transparent: we'll share results of technical work along the way

www.epa.gov/otaq/climate/mte.htm