

PHASE 2 HEAVY DUTY VEHICLE GHG STANDARDS AND LIGHT DUTY VEHICLE GHG TRENDS/COMPLIANCE

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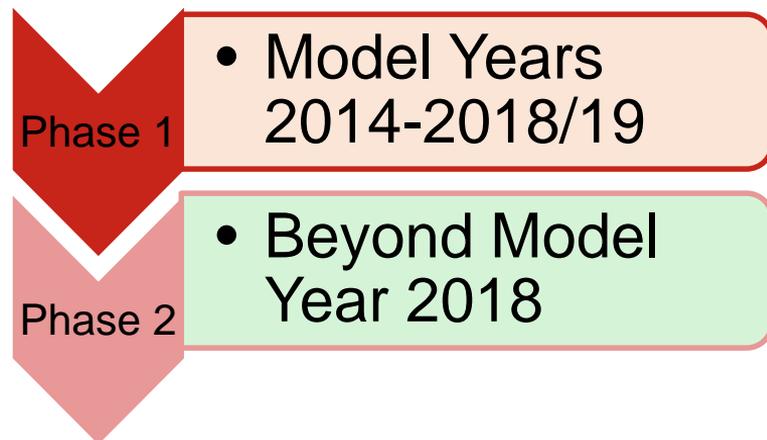
Office of Transportation and Air Quality, U.S. EPA

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Heavy Duty Phase 2

- This spring, EPA and DOT/NHTSA will propose a rule that would establish a phase 2 of the heavy duty GHG and fuel efficiency program
- Builds on Phase 1 structure



Heavy Duty Truck Categories

65% of HD Fuel Consumption
and GHG Inventory
(together)

Line-Haul Tractors



Line-Haul Trailers
(currently unregulated
Federally)



Large Pickups & Vans
14% of HD Fuel Consumption
and GHG Inventory

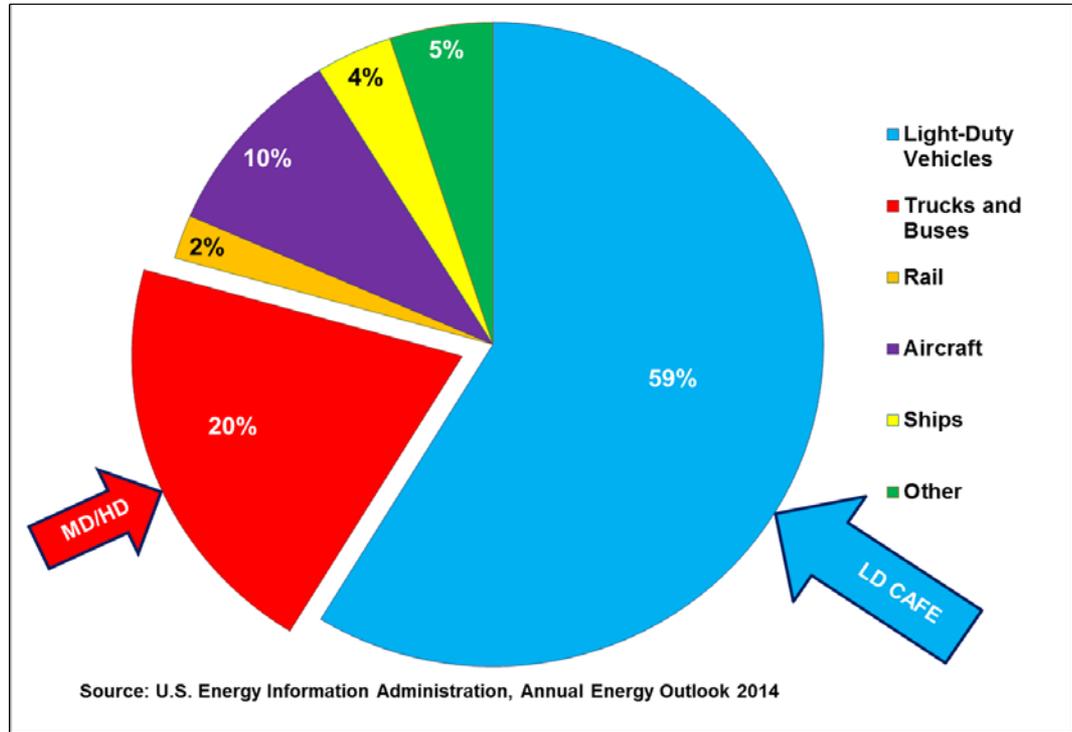


Vocational Vehicles



US Transportation Related GHG Emissions (Tg CO₂eq)

- Heavy-duty vehicles responsible for about one fifth of the energy use and GHG emissions from transportation sources
- In terms of energy use, heavy-duty vehicles are also the fastest growing transportation sector in the U.S. and globally



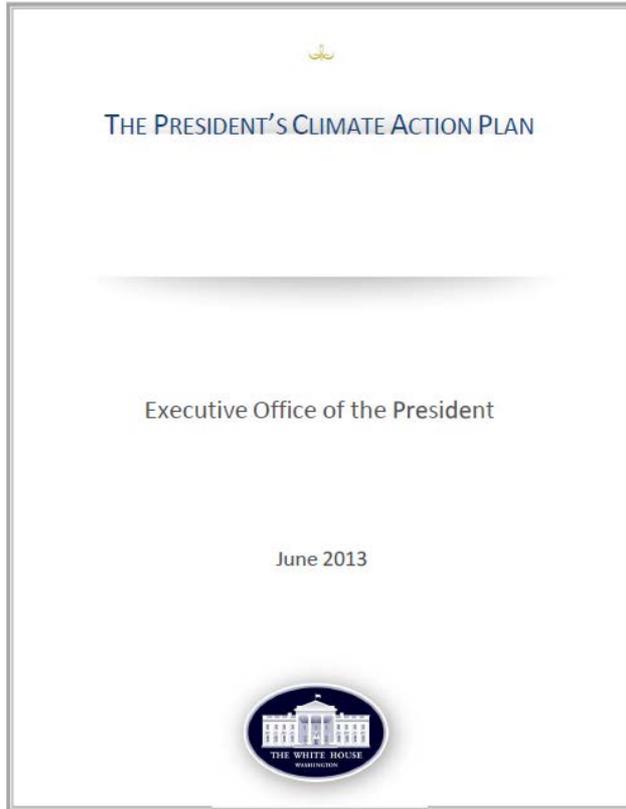
MD/HD Phase 1 – Implementation Highlights

- **Phase 1 standards began in 2014, fully phased-in by 2018**
 - Manufacturers expected to comply primarily with “off-the-shelf” technologies
 - Cost-effective technologies lead to fuel-savings greater than technology cost
- **Phase 1 program for heavy-duty pickups and vans is similar to light-duty program**
 - Vehicle certification based on testing complete vehicle
- **Phase 1 program for other heavy-duty vehicles include:**
 - Engine certification based on EPA’s existing criteria pollutant test procedures
 - Computer simulation certification of vehicle performance (without engine, transmission and axle) – instead of actual vehicle testing
- **Computer simulation is used to certify heavy-duty vehicle performance**
 - HDV size makes complete vehicle testing more difficult and expensive
 - Custom-build aspect of heavy-duty market means thousands of different vehicle configurations – too many to actually test
 - Vehicle simulation brings together the results from a smaller number of vehicle component tests (tires, aerodynamics, etc.)
- **Market:** 2014 tractor sales up 33%, trailers up 42%, vocational up 10.5% vs 2013 (ACT Research Aug 26, 2014)

- 530 million barrels less oil
- 270 MMT lower GHGs
- \$50 billion in fuel savings
- \$49 billion in net benefits



President Obama's 2013 Climate Action Plan and February 2014 Announcement



Climate Action Plan: “During the President’s second term, the Administration will once again partner with industry leaders and other key stakeholders to develop post-2018 fuel economy standards for heavy-duty vehicles”

White House Announcement: “This second round of fuel efficiency standards will build on the first-ever standards for medium- and heavy-duty vehicles (model years 2014 through 2018), and will reach well into the next decade.”

Heavy-duty Phase 2: Objectives Discussed in Phase 1 Rule

- **Joint NHTSA/EPA rulemaking process with notice and opportunity for public review and comment.**
- **Heavy-duty Phase 2 may include:**
 - Looking beyond off-the-shelf technology
 - Potential inclusion of trailers
 - Additional and new technologies beyond Phase 1
 - Refined test procedures and updates to the GEM vehicle simulation compliance model—a full vehicle approach that includes engines
 - Full SBREFA panel process to develop solutions for small businesses
 - Updated technology, economic and environmental assessments

Phase 2 – NHTSA/EPA Research

➤ **Technology evaluations**

- In-house and contractor modeling and testing of fuel-efficiency technologies for medium- and heavy-duty vehicles in the years prior to and in the Phase 2 timeframe
- Evaluating the effectiveness and the costs

➤ **Test procedure development, refinement and validation studies**

- Evaluating improvements to Phase 1 drive cycles, and additional idle cycle
- Validating new aerodynamic and powertrain test procedure approaches
- Validating a wide range of improvements to Greenhouse Gas Emissions compliance model (GEM) to fully recognize new technologies

NHTSA/EPA Research: Engine Technologies

Advanced Bottoming Cycle

Air Handling Improvement

Coolant Pump

Cylinder Deactivation

Down-sizing & Boosted vs. NA

Electric Turbo-compounding

Engine Down-sizing

**Engine Down-speeding (reduced cruise RPM,
combined with transmission technology)**

Engine Friction Reduction

Engine Oil Pump Improvement

GDI + Cooled EGR

**Improved Selective Catalytic Reduction (SCR)
Conversion, combined with reducing or
removing EGR**

Lean Burn GDI w/ SCR

Lower Friction Engine Oil

Mechanical Turbo-compounding

Natural Gas

Reduced After-treatment Backpressure

Stoichiometric Gasoline Direct Injection (GDI)

Stop / Start

Turbo Efficiency Improvement

Variable Valve Timing

Technology application varies by vehicle class, vocation, and engine fuel type

Research on Vehicle & Trailer Technologies

A/C Reduced Reheat

Air Compressor Improvements

Automated Manual Transmission

Automatic Engine Shutdown

Automatic Tire Pressure Control

Battery Auxiliary Power Unit

Cab Insulation to Reduce A/C

Chassis Friction Reduction & Improved Lube

Diesel Auxiliary Power Unit

Driver Coaching Features

Driver Management Features

Dual Clutch Transmission

Fan Power Demand Reduction

Fuel Fired Heater

Full EV

Hybrid Technologies

Improved Aerodynamics

Improved Transmissions (more gears, higher ratio spread, shift points)

Low Rolling Resistance Tires

Manual Transmission

Shore Power

Single Wide Tires

Tractor Axle 6X2 or Clutched 6X4

Speed limiters

Weight Reduction

Technology application will vary by vehicle class, vocation, and engine fuel type

National Academies of Science

- **2010**

- Issued, “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles”
- EPA and NHTSA considered this study in support of Phase 1; similar for Phase 2

- **2014**

- As required by 2007 Energy Independence and Security Act, NHTSA sponsored a second NAS study for heavy-duty
- Published an interim report in April 2014 to help inform Phase 2 considerations; focused on recommendations that were nearly 100% in-line with EPA and NHTSA staff-level thinking
- Final report expected in 2016 to inform considerations beyond Phase 2

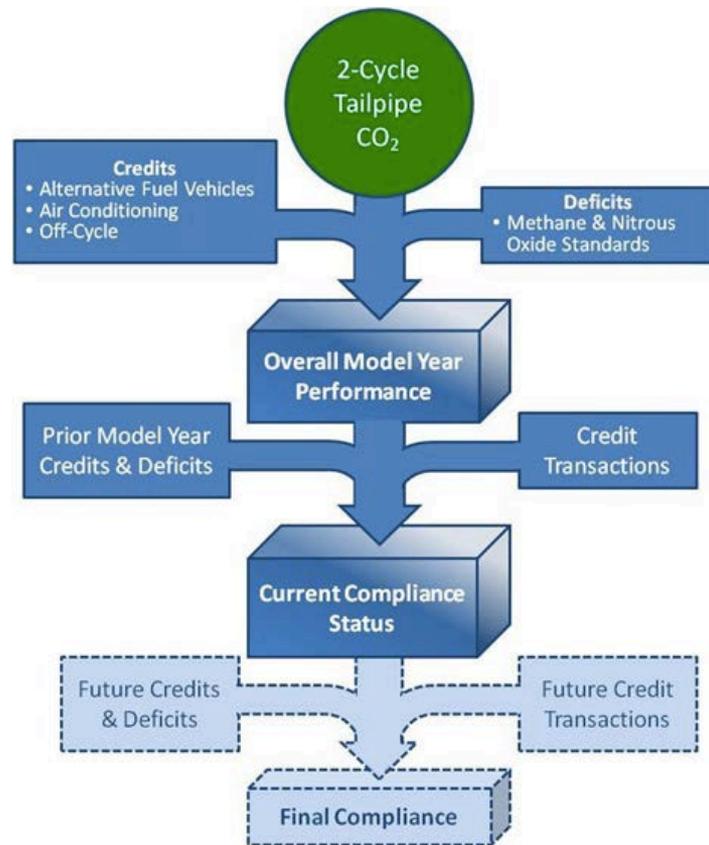
What's Happening in California?

- **2008: ARB adopted mandatory fleet-level requirements for tractors and trailers**
 - Based on EPA SmartWay performance
- **2012: ARB Released 2050 Vision for Clean Air document**
 - Calls for significant additional NO_x and CO₂ reductions from heavy-duty sector
- **2013: Adopted EPA GHG Phase 1 Standards**
 - Board hearing in December 2013
 - Similar to ARB's adoption of HD criteria emissions standards
 - Also adopting new voluntary Low NOx standards for heavy-duty
 - Signaled intent to move beyond Federal Phase 1
 - Sunsetting CA fleet-level program for tractors, but not for trailers
- **2014: ARB is significantly engaged on Phase 2**

Light Duty Vehicle GHG Program Compliance

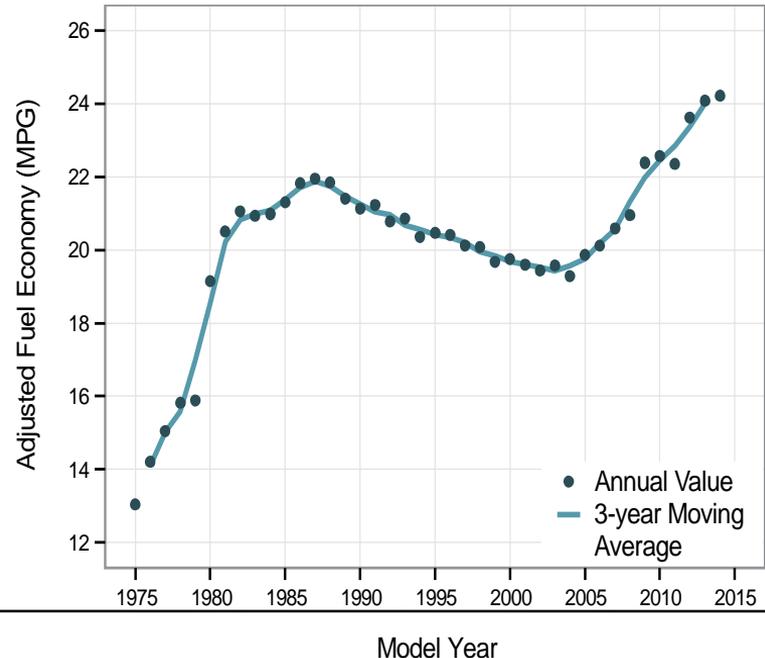
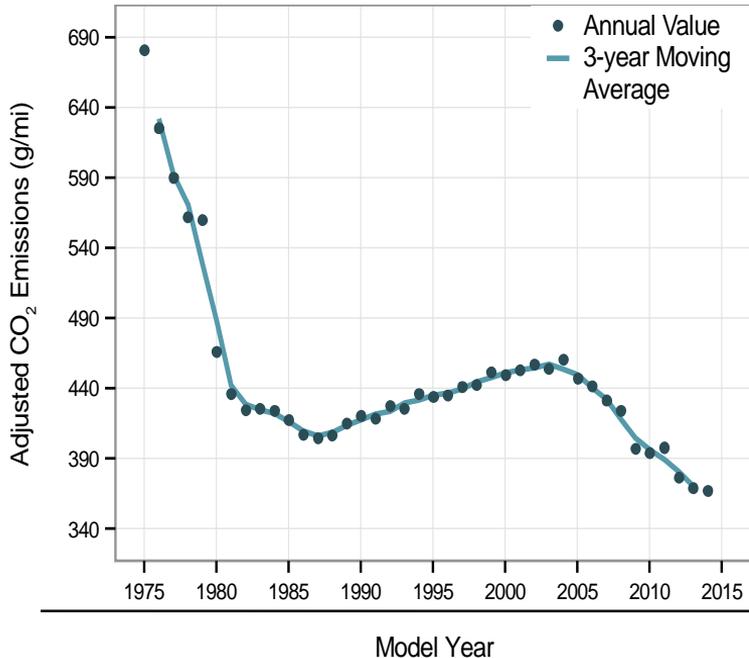
- **Highlights from Manufacturer Performance Report for MY 2013, published March 2015**

1. For the second consecutive year, the auto industry outperformed the GHG standard by a substantial margin
2. Most manufacturers outperformed their individual 2013 standard
3. All large manufacturers are in compliance with the 2012 and 2013 GHG standards
4. Manufacturers continue to use a wide variety of compliance flexibilities that were designed into the program

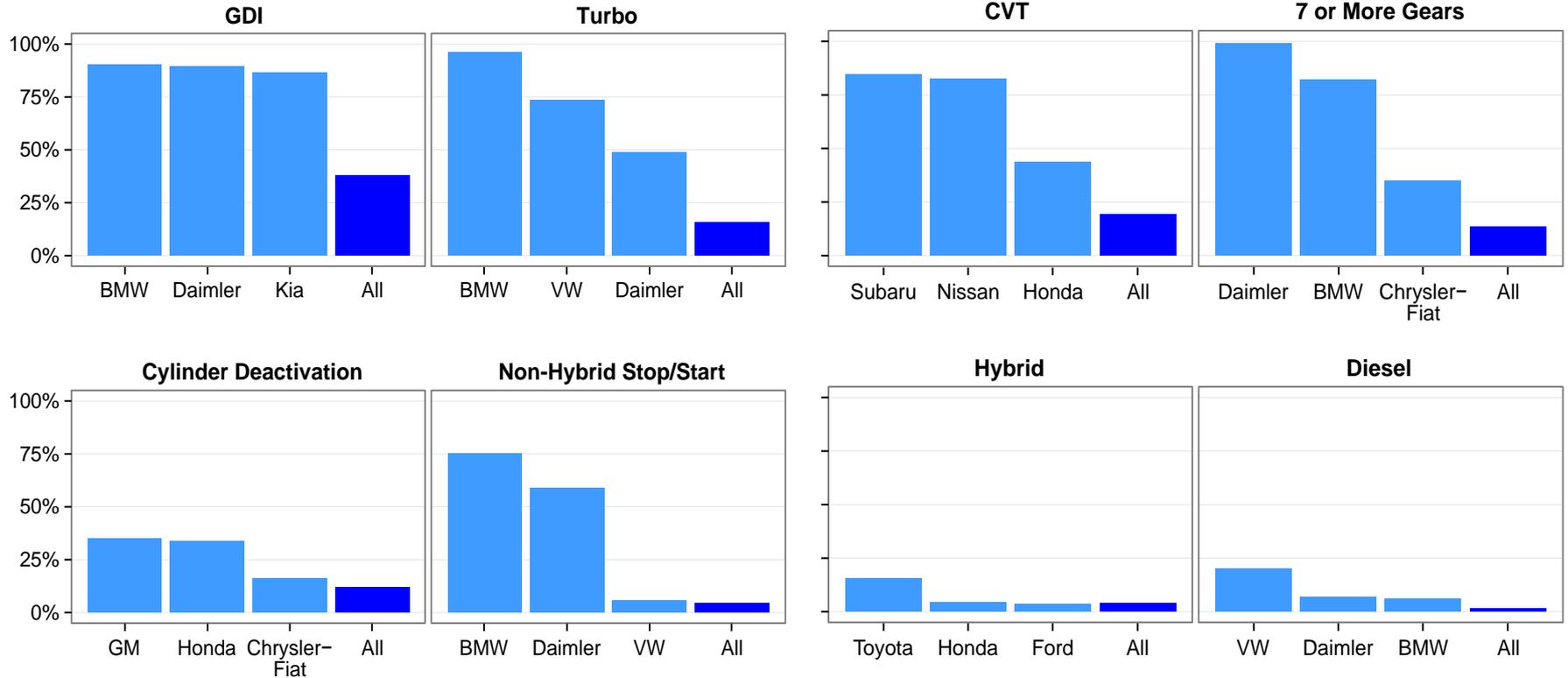


LDV Fuel Economy Trends (2014 report)

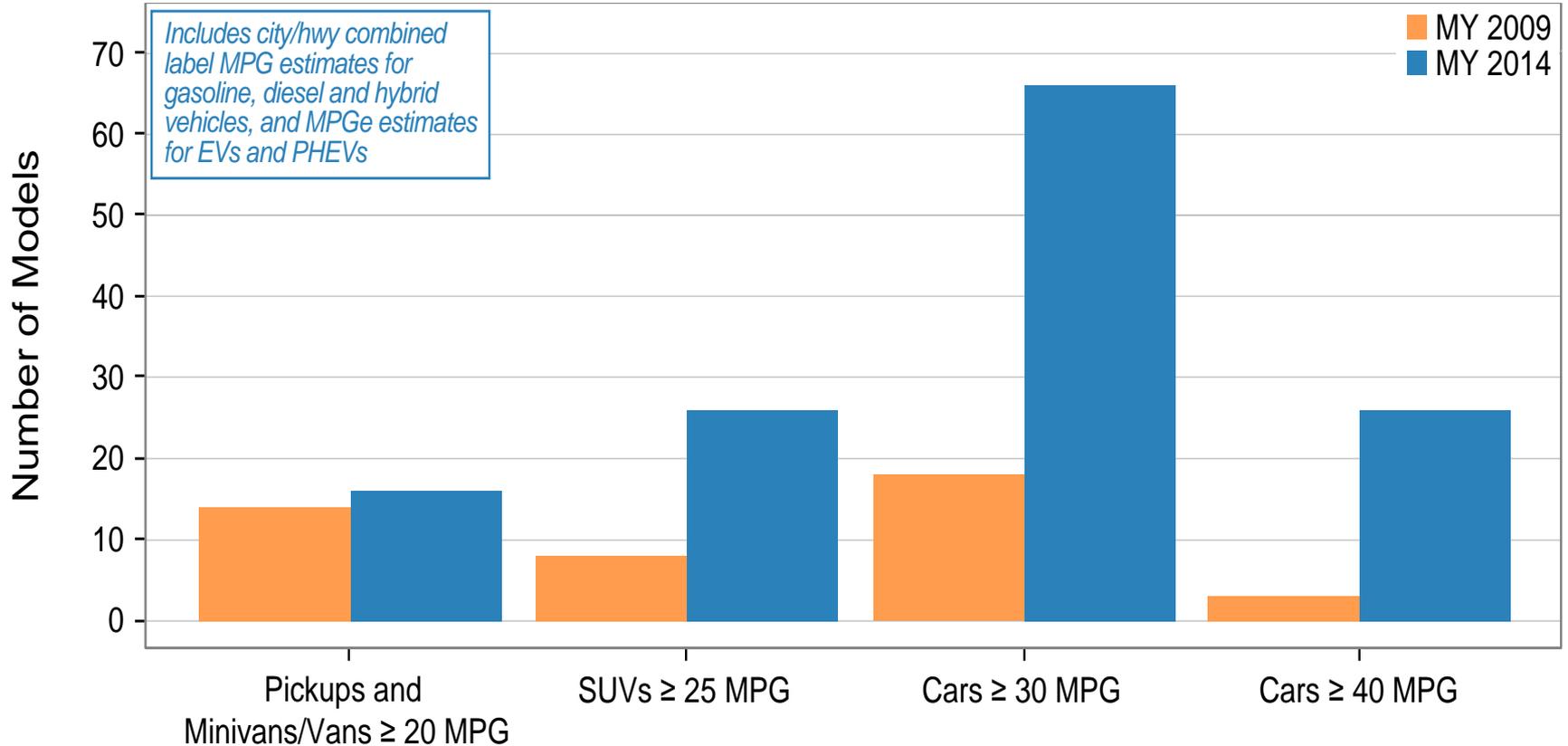
- Fuel Economy is at a record high: 24.1 mpg for MY 2013
- CO₂ is at a record low: 369 g/mile for MY 2013
- Fuel Economy has improved 8 of the last 9 years (25% improvement)



Manufacturers Are Using Multiple Technology Pathways



Consumers have more choices



QUESTIONS

