

EPA GHG UPDATE FOR 2017 FUEL ECONOMY DETROIT

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U.S. Environmental Protection Agency

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Overview

- ❑ **How the EPA GHG Standards Work**
- ❑ **Industry Progress To Date**
- ❑ **What Might the 2025 Time-Frame Look Like**
 - EPA assessment (thus far)
- ❑ **What Comes Next**

Why does EPA have GHG Standards for Light-Duty Vehicles?

U.S. Supreme Court in 2007 on the topic of EPA and regulation of GHGs from motor vehicles:

*“But that DOT sets mileage standards **in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public “health” and “welfare”, a statutory obligation wholly independent of DOT’s mandate to promote energy efficiency.**”*

Clean Air Act directs EPA –

*“The Administrator shall by regulation prescribe ... **standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgement cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.**”*

HOW THE EPA STANDARDS WORK

So What is the 2025 EPA Standard?

Projections for Model Year 2025 Fleet CO₂ Compliance Target Fuel Prices/Fleet Mix Affect EPA's PROJECTION of 2025 Standard

	2012 Projection	Summer 2016 Projection	Fall 2016 Projection
Fuel Price (\$/gallon)	\$3.87	\$2.95	\$2.97
Car/truck mix	67/33%	52/48%	53/47%
2025 Fleet CO ₂ Compliance Level (g/mi, 2-cycle)	163	175	173
MPG-e (2-cycle)	54.5	50.8	51.4

EPA DOT Fuel Economy and Environment Gasoline Vehicle

These are industry compliance values.
For consumers, the 2025 average real-world value is
~ 36 MPG

emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Share via QR Code

2025 CO2 Standard is a Function of Car & Truck Production Volume and Vehicle Footprint

Passenger Car Target (g/mi) = (3.26 x **footprint**) – 3.2

- for vehicle footprints >41 and < 56 square feet

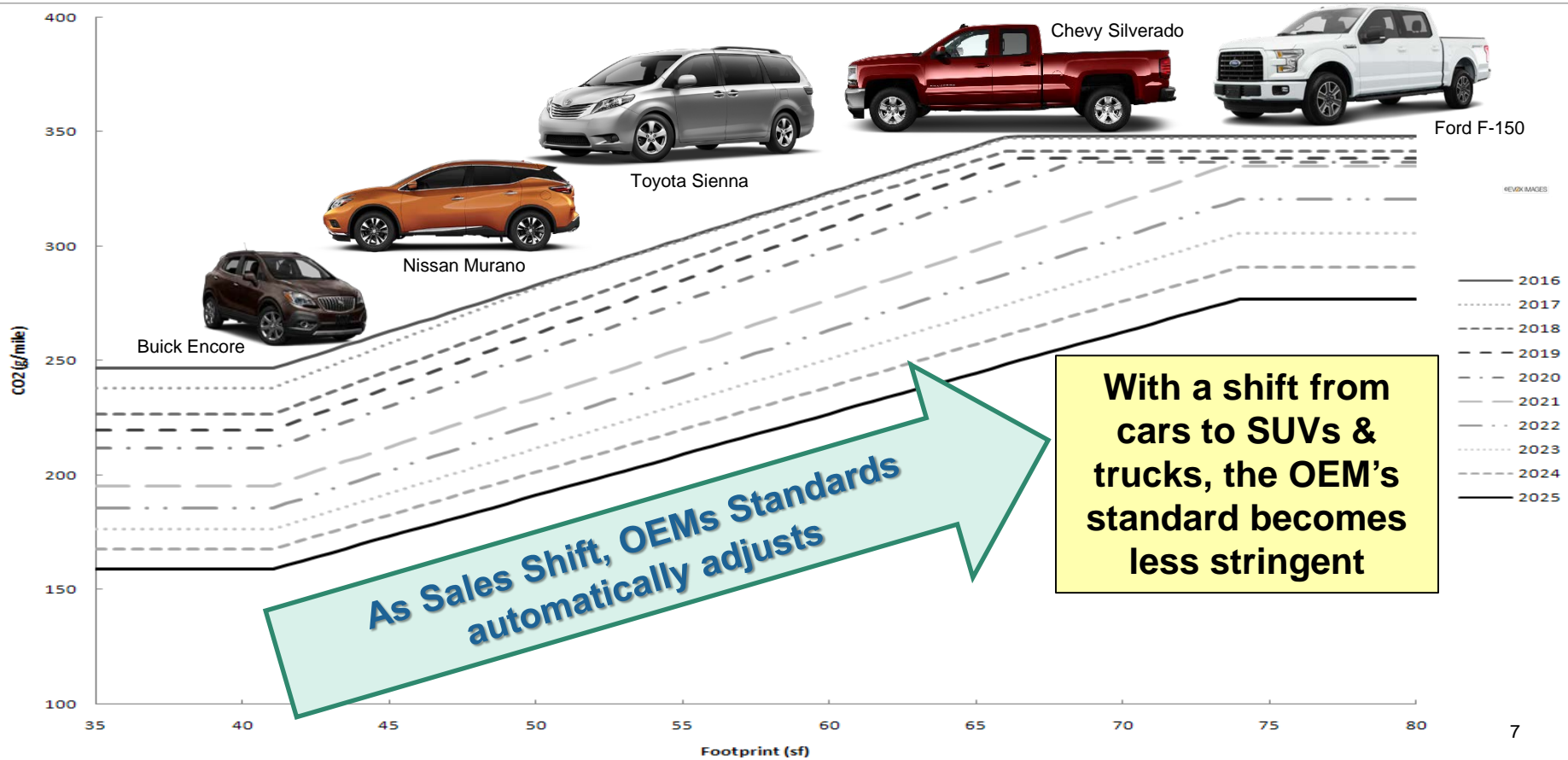
Light-Truck Target (g/mi) = (3.58 x **footprint**) +12.5

- for vehicle footprints >41 and < 74 square feet

For each individual company the Car & Truck standards are a function of the **# vehicles produced** & each vehicle's **footprint**

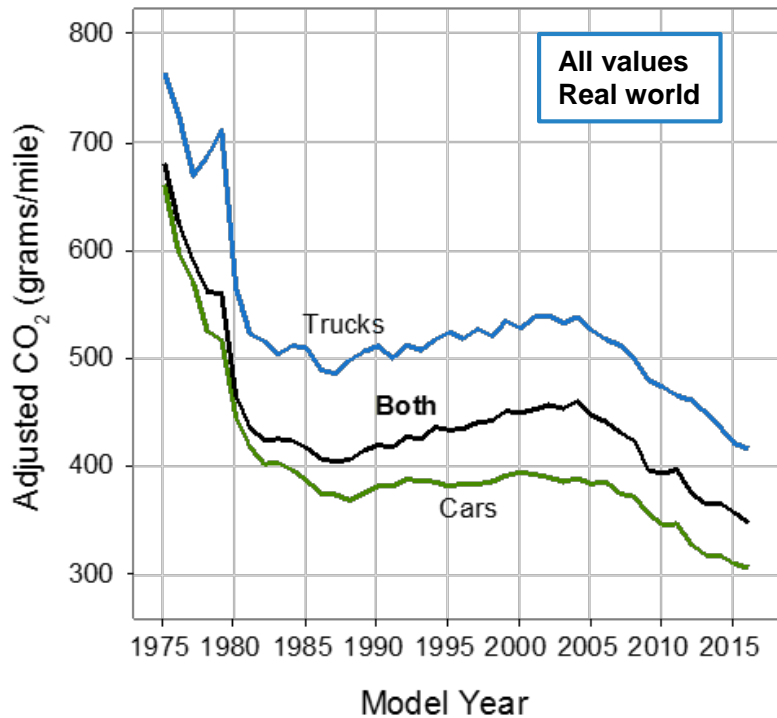
Footprint-based CO₂ Target Curves for Trucks – “The Standards”

[separate footprint curve for Cars]

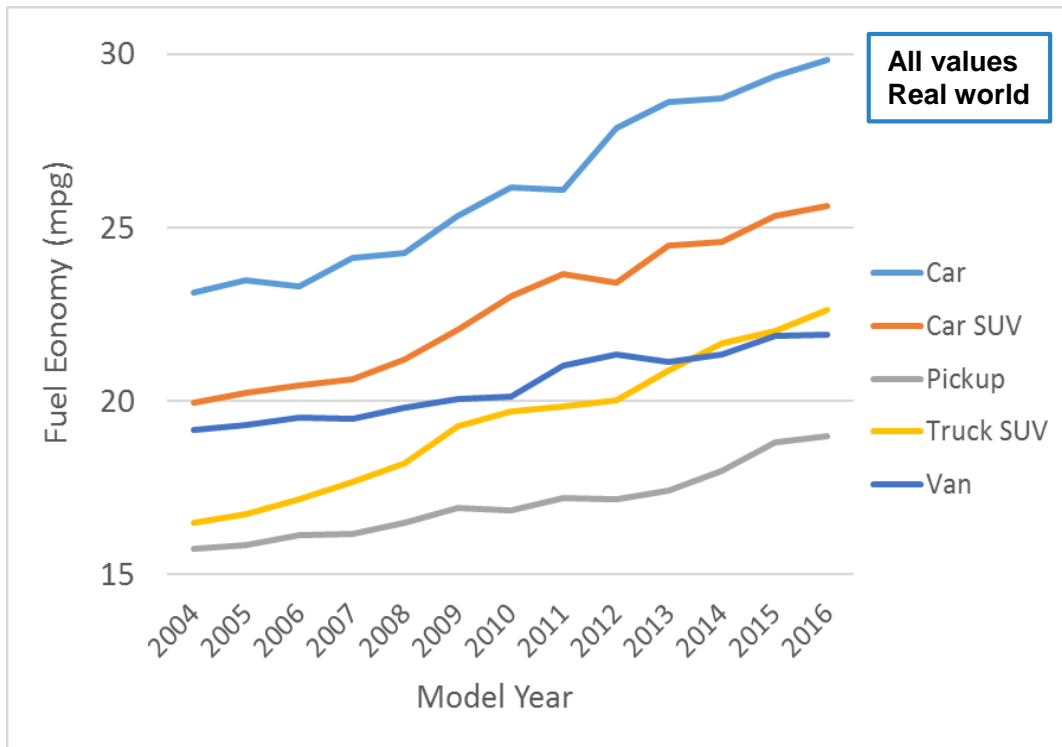


INDUSTRY PROGRESS TO DATE

Vehicle CO₂ Emissions at Record Low – every major vehicle category improving



MY2015: 358 g/mi CO₂ (24.8 mpg)
MY 2016 Projected : 25.6 mpg



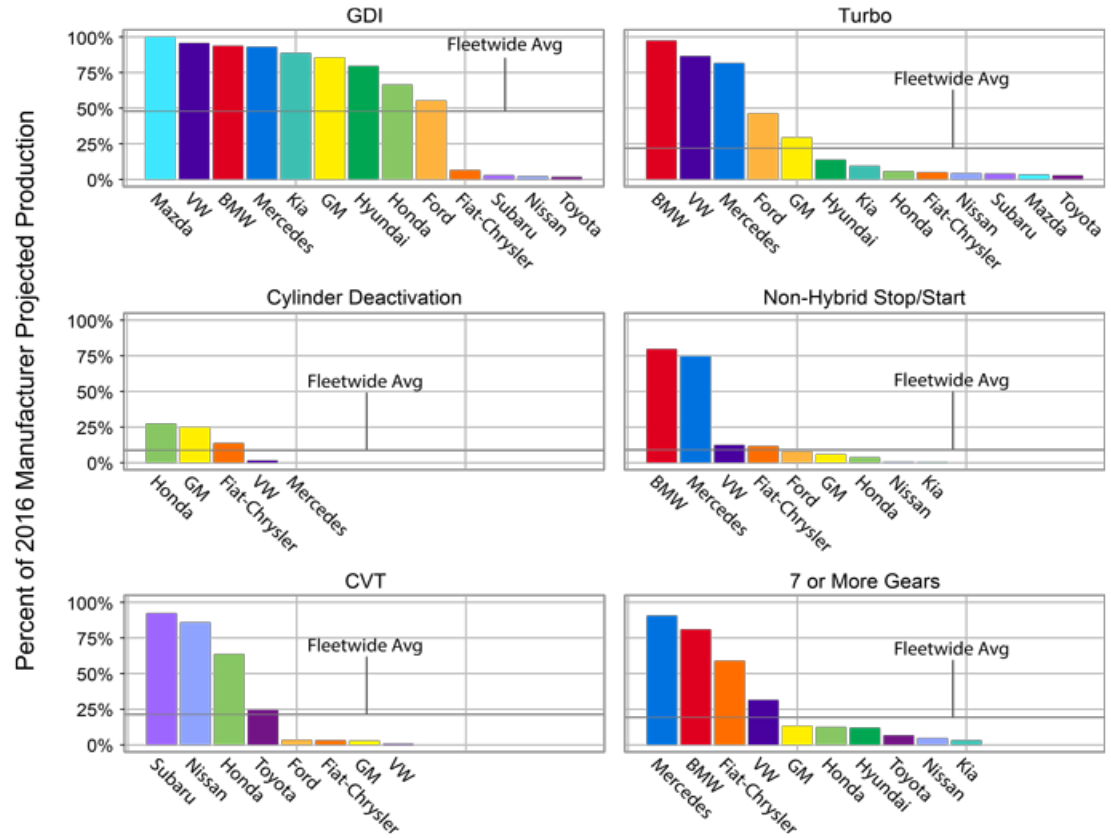
Truck SUVs highest % improvement since 2004, up 33%
Pickups improved most in past year, up 0.8 mpg to 18.8 mpg

Automakers Adopting a Wide Array of Technologies at Rapid Rates

- **GDI** use on nearly half of all vehicles (up from 3% in MY2008), with Mazda at 100%, 6 more OEMs above 75%

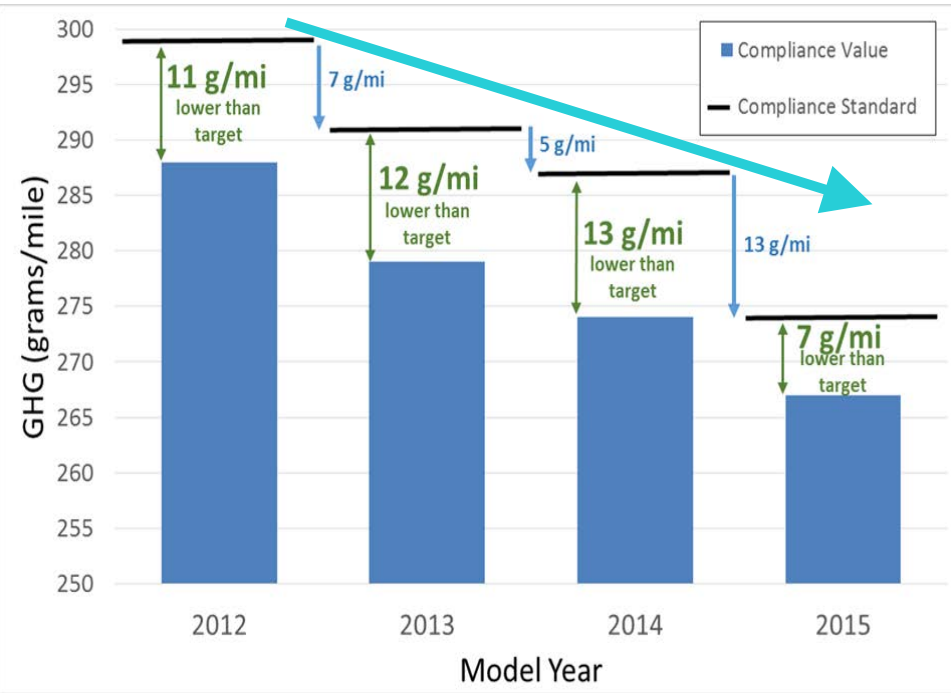
- ~20% fleet use **7+ speed transmissions**, led by Mercedes, BMW, and Fiat-Chrysler

- >20% fleet use **CVTs**, led by Subaru, Nissan, and Honda

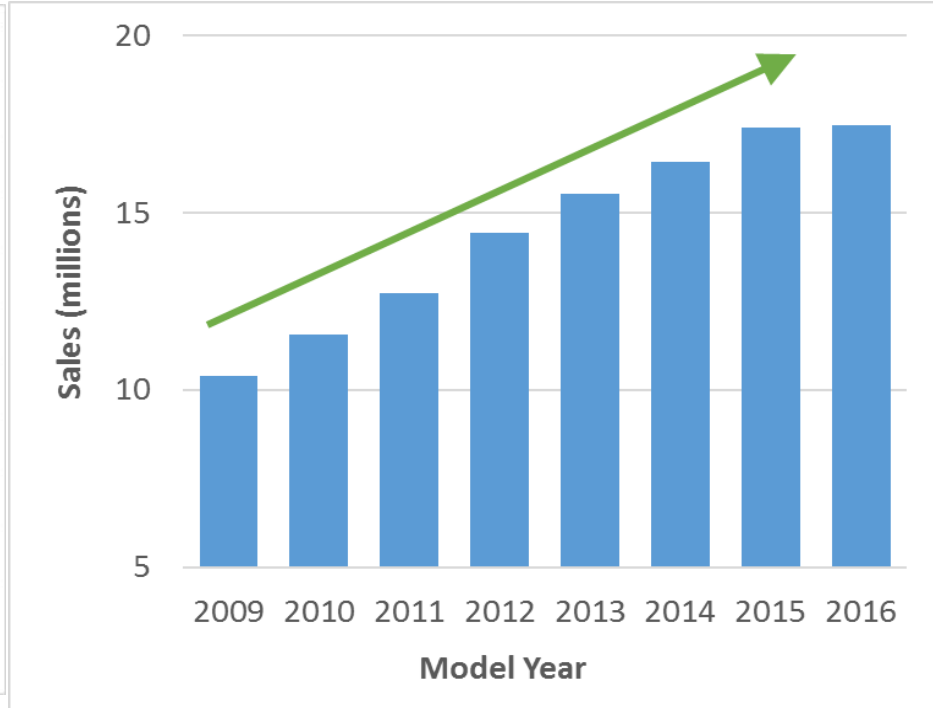


Early Years of Program Producing Positive Results

Industry Outperforming Standards



7 Years of Sales Increases Thru 2016 First Time in 100 Years



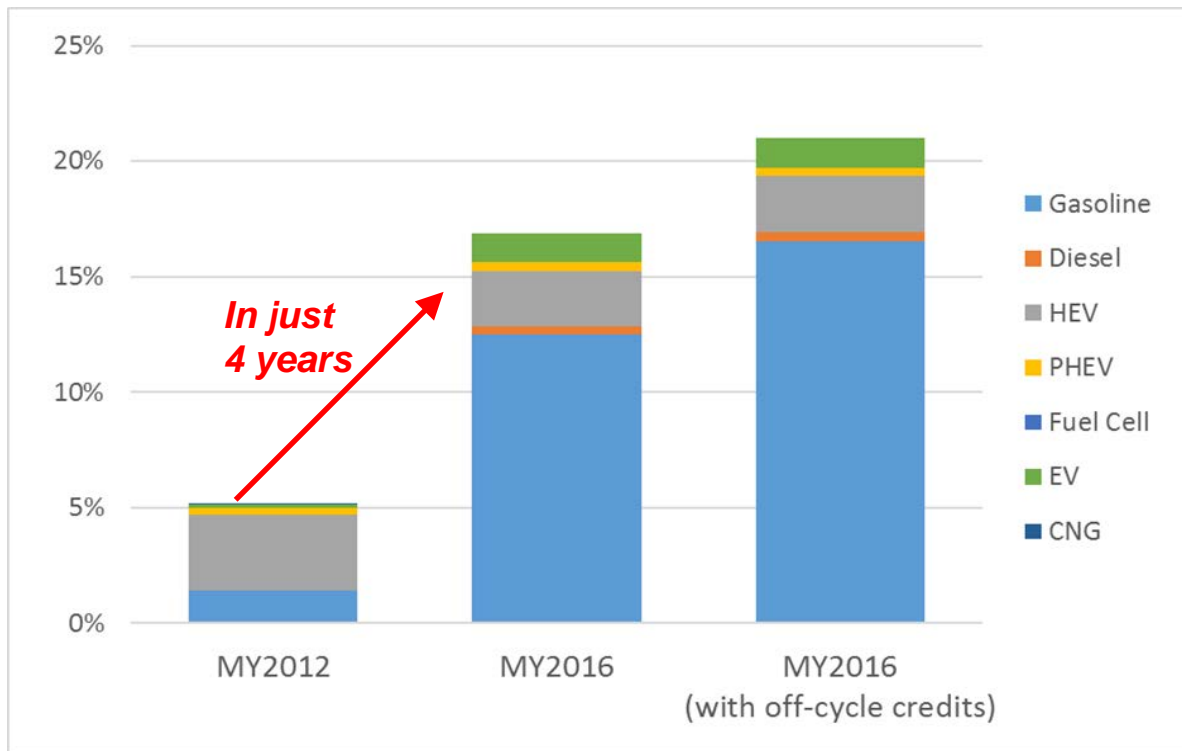
What Happens to the Over Compliance?

GHG Program is a Multi-Year Program, multiple layers of flexibility for OEMs

- No single year determines compliance.
- Program includes emissions banking and trading
- Credits last at least 5 model years, and early credits last longer.
- Debits can be carried forward for 3 model years.
- Today, the bank is **280 Million Megagrams CO₂**
 - What's a Megagram?
 - 280M worth about **80 grams CO₂/mile** for the entire U.S. fleet
 - Would allow the MY2015 fleet to comply with EPA standards through 2019, if all firms participated fully in credit trading
 - Through MY2015, 12 OEMs involved in credit trading

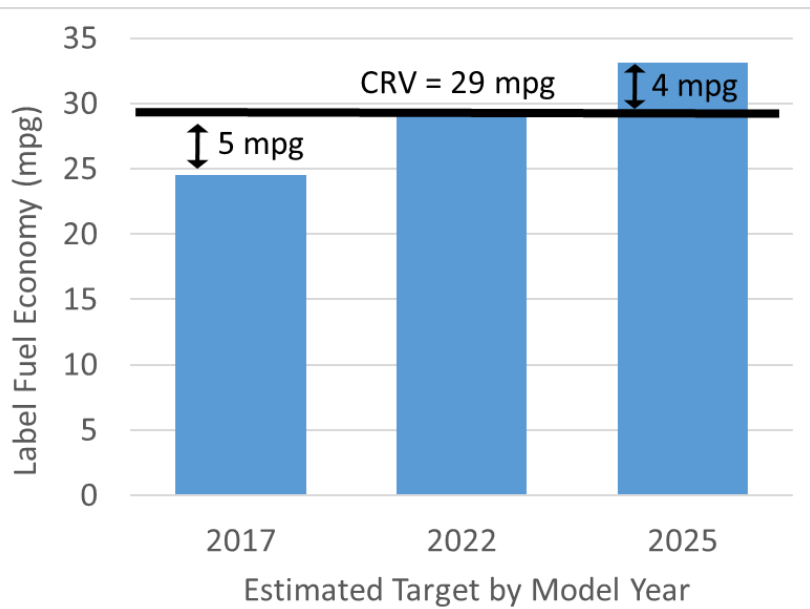
Advanced Gasoline Vehicles can Take the Industry Much Further ... many vehicles already meet future targets

Vehicle Production that Meets or Exceeds MY2020 CO₂ Targets



With fleet averaging, in any given model year, only about 50% of vehicles would need to meet/exceed their target, depending on sales volumes.

Case Study: 2017 Honda CRV 1.5 liter AWD



**Illustrative example only. EPA estimated real-world fuel economy targets from CO₂ compliance targets, assuming A/C credits and 5 g/mi off-cycle credits*

- Best-selling SUV in U.S.
- AWD versions make up 2/3 of sales
- Advanced Gasoline Technology:
 - Turbocharged GDI 1.5 liter I4 engine
 - Continuously variable transmission
 - No electrification
- Could already meet* 2022 target
 - 5 years ahead
- Within 4 mpg of 2025 target
 - *With 8 years to go*



**WHAT MIGHT 2025 LOOK LIKE –
EPA TECHNICAL ASSESSMENT
(THUS FAR)**

EPA's Assessments are Informed by a Wide Range of Information

➤ **Technical research performed by EPA**

- Benchmarking testing of **30 vehicles** across wide range of powertrains & segments (with more to come)
- Published more than **30 peer-reviewed papers and technical reports**
- Vehicle simulation modeling, cost teardown studies, mass reduction feasibility/cost studies, manufacturer “learning by doing” costs, research on consumer issues, economic inputs, others

➤ **Extensive reviews of the literature**

- **100's of reports/papers** from the literature published since 2012, including major studies such as the 2015 National Academy of Sciences report

➤ **Stakeholder outreach & collaboration**

- Hundreds of meetings with automakers, suppliers, NGOs, consumer groups, labor, states/local governments, others
- Collaboration with NHTSA, CARB, DOE, Transport & Environment Canada

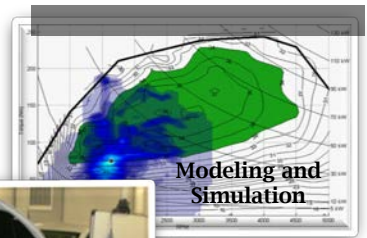
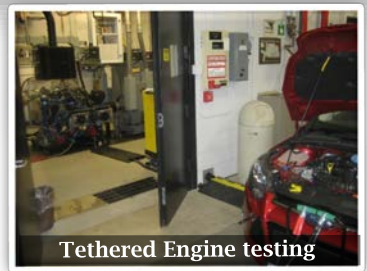
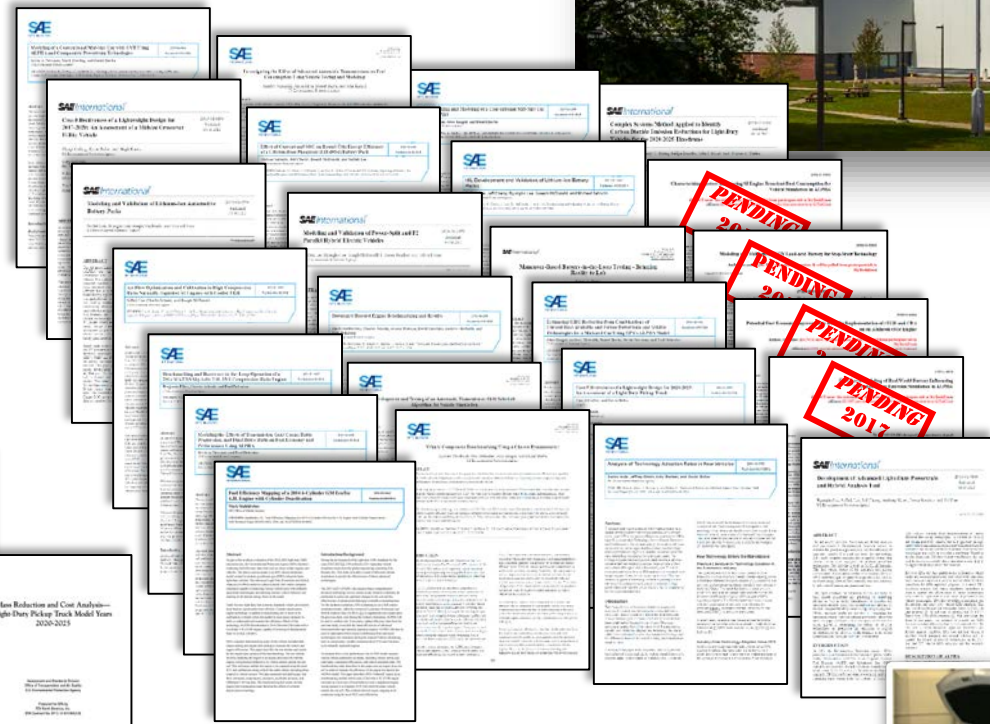
EPA technical information available to all stakeholders/public

EPA's National Vehicle and Fuel Emissions Laboratory
Ann Arbor, MI



Wide range of peer-reviewed publications and presentations:

- Technical papers, including SAE papers and EPA reports
- Conference presentations
- Modeling workshop



+ more ...

EPA Most Recent Assessment –

Standards can be Met Mostly with Advanced Gasoline Technologies

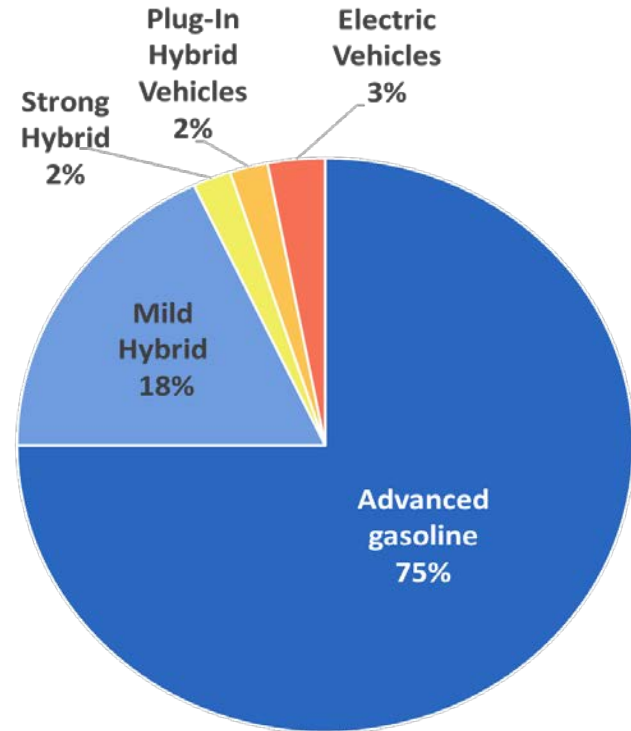
Cost estimate of \$875/vehicle

- ✓ Advanced engines and transmissions
- ✓ Vehicle light-weighting
- ✓ Improved aerodynamics
- ✓ More efficient accessories
- ✓ Low rolling resistance tires
- ✓ Stop-start technology
- ✓ Mild hybrid (e.g., 48 volt systems)
- ✓ Small levels of strong HEV, EV, PHEV

Fuel Savings Offsets Cost increase

- ✓ Net lifetime savings of \$1,650

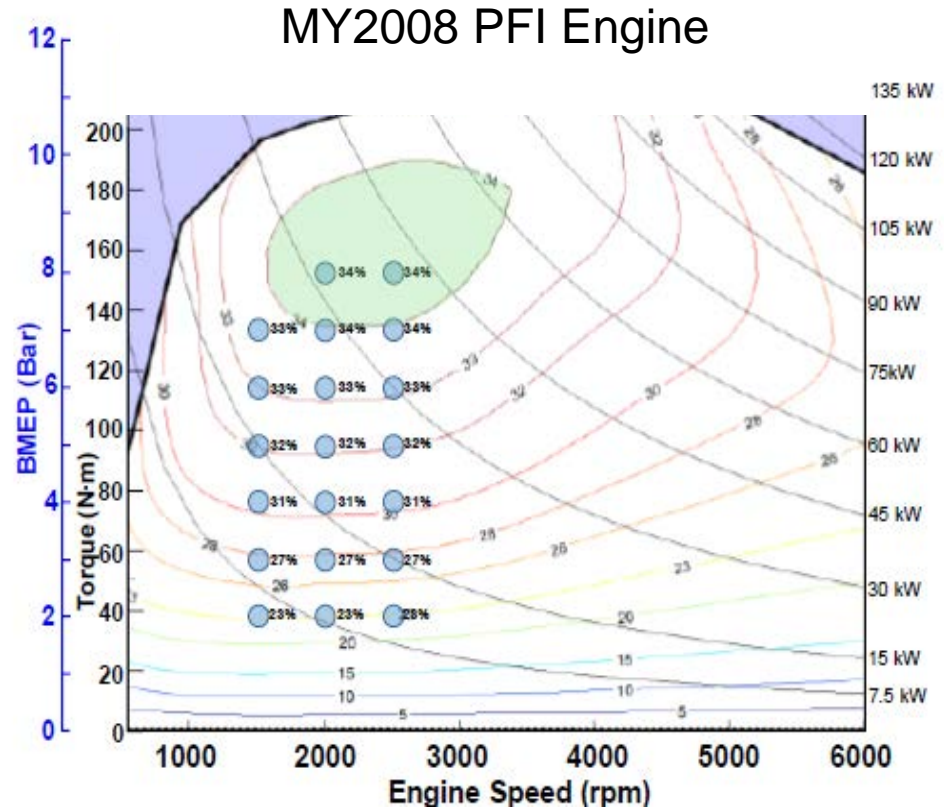
One possible pathway EPA modeled



Progress in Engine Efficiency

MY2008 Actual PFI Engine

- Peak thermal efficiency **34%**
- Narrow efficiency region



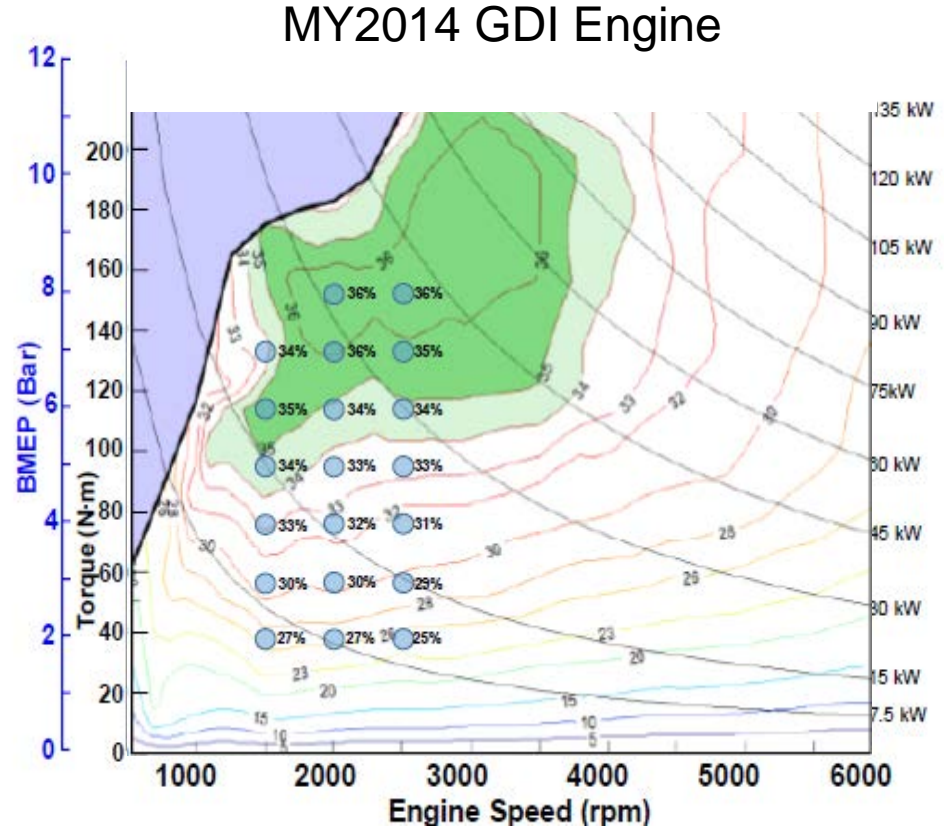
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MY2014 Actual GDI Engine

- Peak thermal efficiency **36%**
- Broader efficiency region



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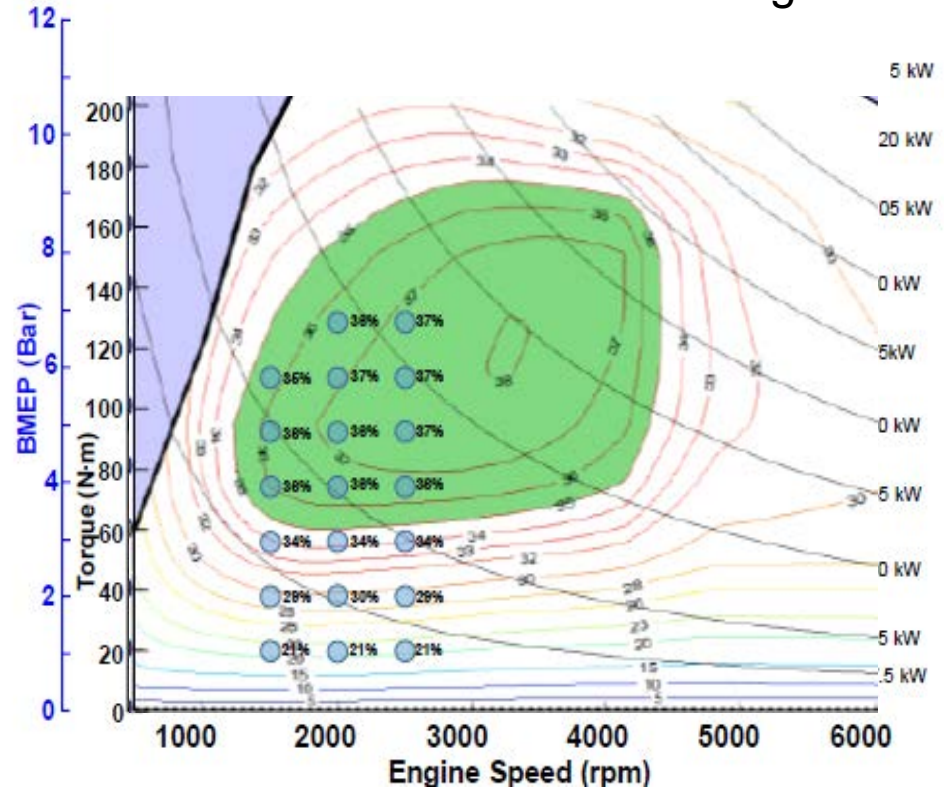
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MY2016 Actual Turbo downsized Engine

- Peak thermal efficiency **38%**
- Very broad efficiency region
- Large overlap with 2-cycle test operation

MY2016 Turbo downsized Engine



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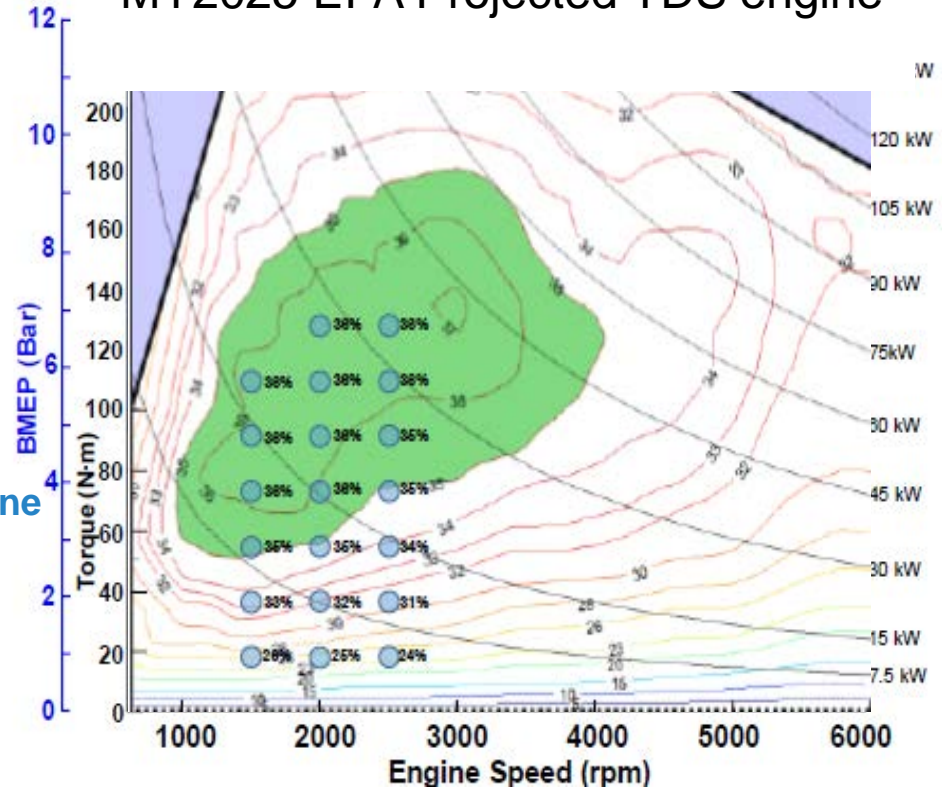
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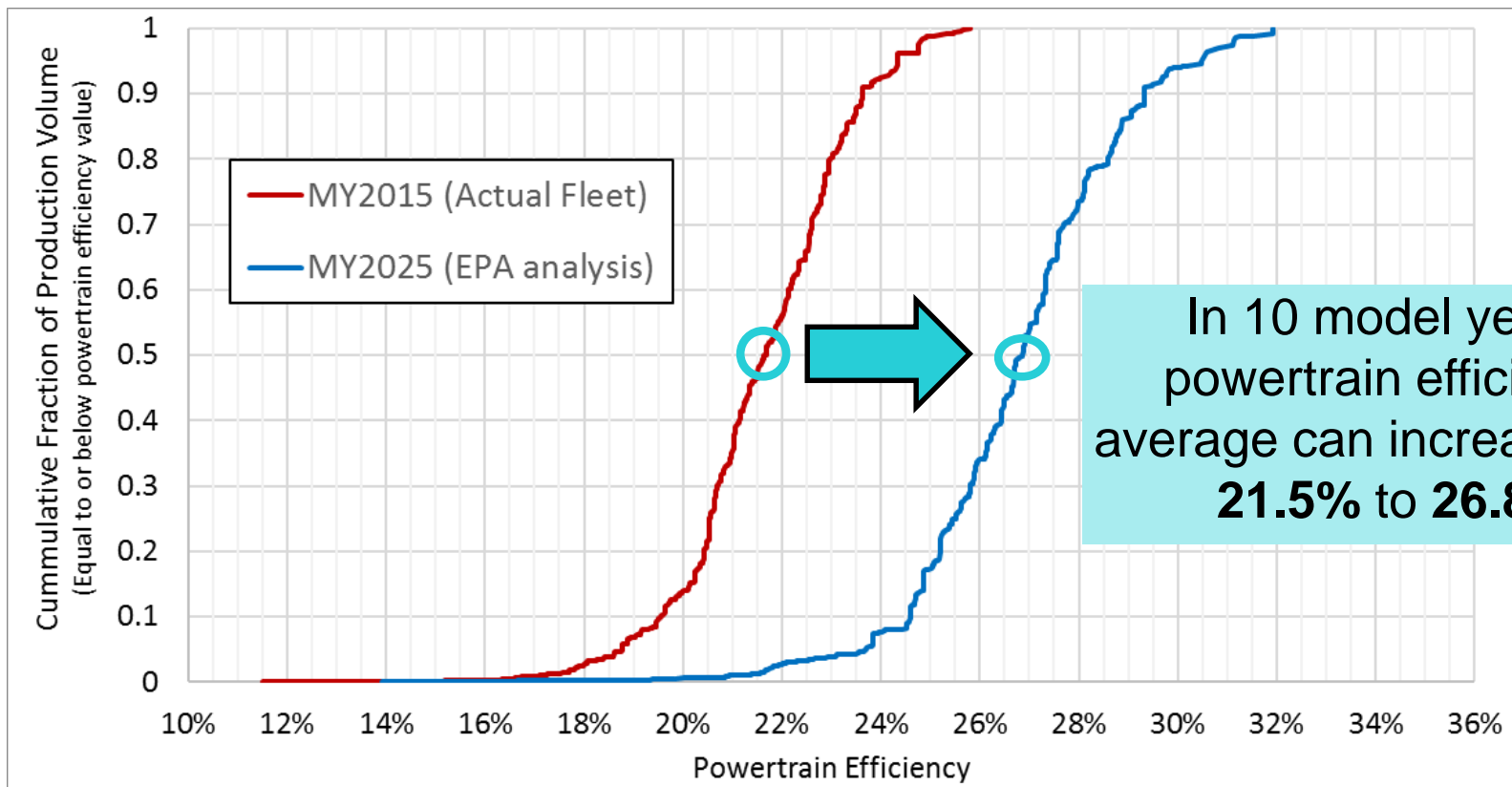
MY2025 EPA projected turbo downsized engine

- Peak thermal efficiency **38%**
- Similar efficiency region as MY2016 actual engine
- Hardware improvements provide some improved low-load efficiency

MY2025 EPA Projected TDS engine

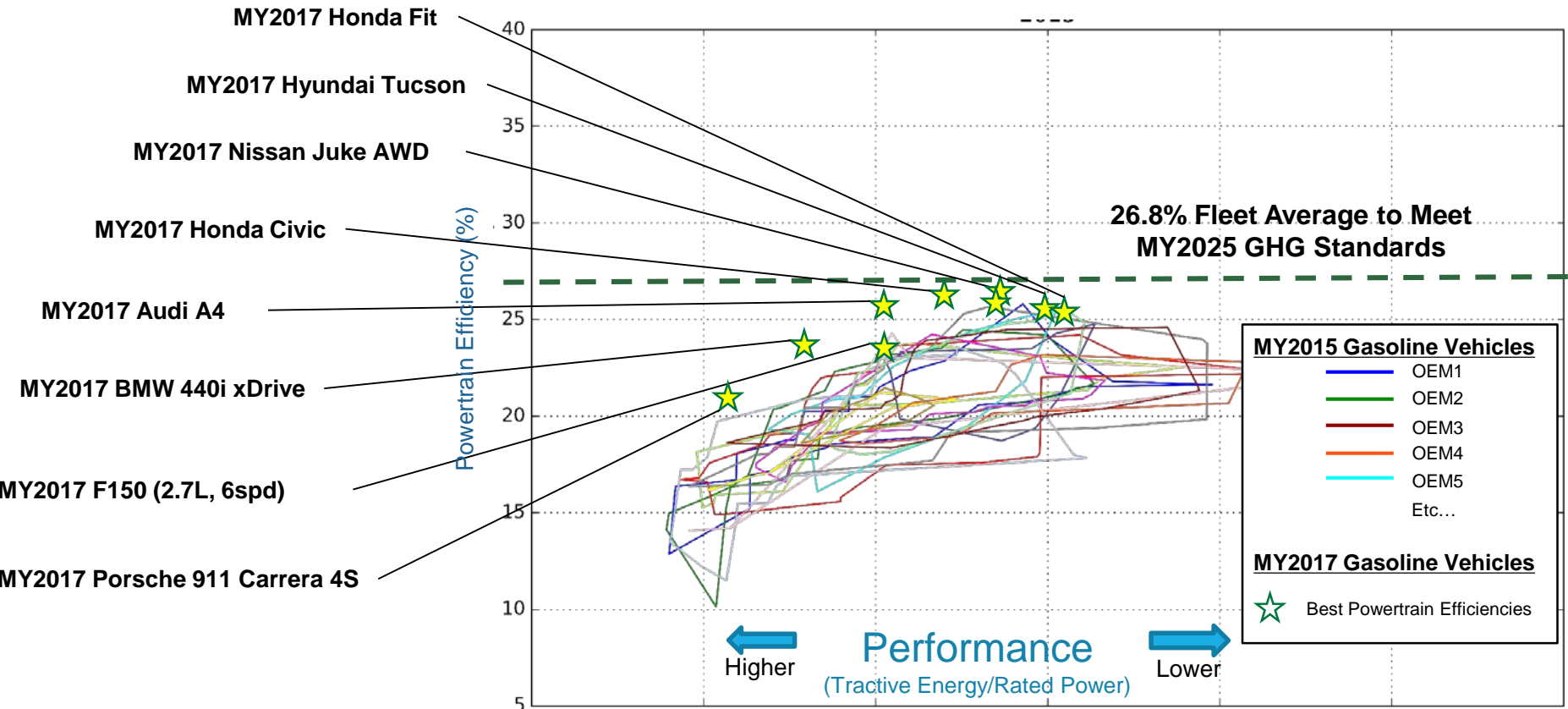


Current vs. Future Gasoline Powertrain Efficiencies



In 10 model years, powertrain efficiency average can increase from **21.5%** to **26.8%**

Powertrain Efficiency: Current Levels and Projected Improvement Needed



National Academies of Science 2015 Study

- ✓ In 2015 an NAS Committee published a comprehensive assessment of the light-duty CAFE & GHG technologies
- ✓ NAS included a detailed review of the 2012 EPA/NHTSA Assessment:
 - “The committee found the analysis conducted by NHTSA and EPA in their development of the 2017-2025 standards to be thorough and of high caliber on the whole.”*
- ✓ The NAS also concluded that the 2025 standards could largely be met with advanced gasoline vehicle technology:
 - “Spark ignition engines are dominant in light-duty vehicles today and are expected to remain dominant, with further reductions in fuel consumption beyond 2025.” [Finding 2.1]*



Can GHG standards be good for the U.S. auto industry, and the overall U.S. job market?

- Sept. 2016 – Center for Auto Research issued a sales & employment assessment
- CAR's report showed potentially large negative impacts on employment and vehicle sales
 - assumes range of high vehicle costs all higher than EPA estimate (\$2,000-\$6,000)
 - assumes vehicle buy considers only first 3 years of fuel savings in buying decision
- Though EPA has concerns with the methodology used in this report, if we use the CAR approach **but with EPA's cost estimates**, the CAR model projects positive sales and employment with \$3/gal gasoline prices
- If we assume that consumers consider 5-years of fuel savings (instead of CAR's assumption of 3-years), the vehicle sales change grows to **+585,000** and national employment change grows to **+206,000**

EPA assessment of CAR study, using \$1,324 (2015\$) technology cost to go from 2016 to 2025 standards

Sales change	+234,000 more vehicles sold
Employment change in auto production	+9,300 more auto jobs
Employment change nationally	+84,700 more total U.S. jobs

WHAT COMES NEXT?

EPA's Reconsideration of the MTE Final Determination

March 15, 2017 - EPA Administrator Pruitt issued a Notice announcing he will reconsider the EPA Final Determination published in January 2017:

*“ ... EPA has concluded that it is appropriate to **reconsider its Final Determination** in order to **allow additional consultation and coordination with NHTSA in support of a national harmonized program.**”*

*“In accord with the schedule set forth in EPA's regulations, the **EPA intends to make a new Final Determination** regarding the appropriateness of the MY 2022-2025 GHG standards **no later than April 1, 2018.**”*

EPA Continues its In-depth Evaluation of Advanced Powertrains

EPA's National Vehicle and Fuel Emissions Laboratory
Ann Arbor, MI



Component benchmarking efficiency maps:

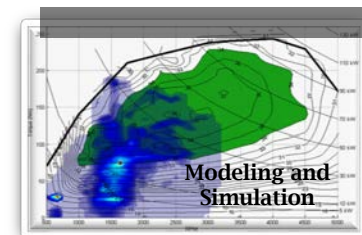
- MY2016 Mazda CX-9 2.5 liter GDI-turbo-charged w/ 6-speed AT
- MY2016 Honda Civic 1.5 liter GDI-turbo-charged 10.6:1 w/ CVT

Vehicle level benchmarking:

- MY2016 Acura ILX w/dual-clutch transmission with torque converter
- MY2017 Ford F150 w/10 speed AT
- MY2016 Chevy Malibu w/1.5 liter GDI-turbo-charged w/ 6-speed AT

Demonstration and Modeling:

- Demonstration of cooled EGR on a modified European Mazda 2.0 liter GDI-naturally-aspirated 14:1 CR engine
- GTPower modeling of a MY2012 PSA 1.6 liter GDI-turbo-charged engine with cooled EGR and an advanced turbo
- GTPower modeling of a MY2016 Honda Civic 1.5 liter GDI-turbo-charged 10.6:1 CR engine
- ALPHA model comparison of several CVTs
- ALPHA modeling of all vehicles included in above component and vehicle benchmarking

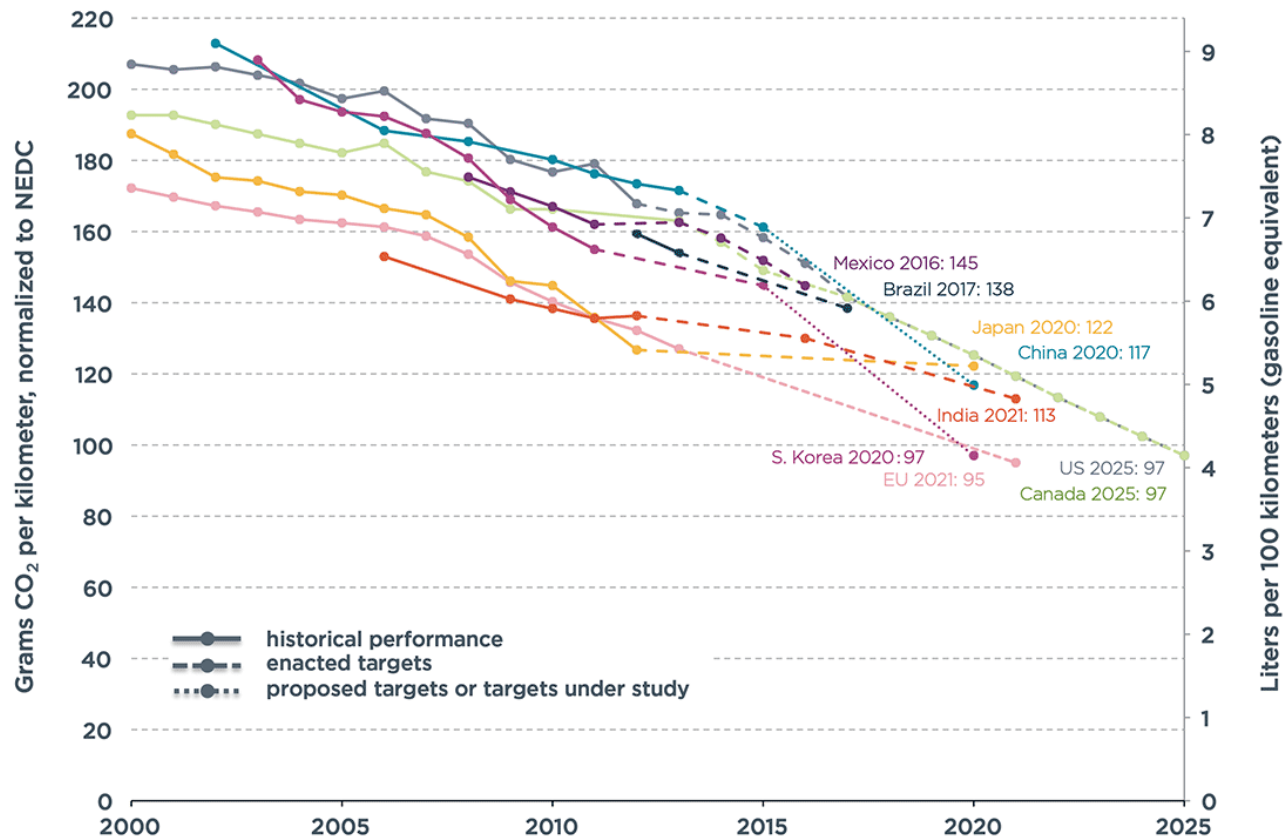


Modeling and Simulation

Additional EPA Work Underway in Many Areas

- **Technology cost teardowns with FEV**: modern GDI turbo-downsized engine, advanced diesel engine, CVT
- Updates to OMEGA **cost-effectiveness optimization model** and ALPHA **full vehicle simulation model**
- Ongoing work to evaluate the **willingness to pay (WTP) for vehicle attributes** (e.g., power, fuel economy, size, etc).
 - Our review of 50+ papers from the last 20 years found very wide variation in these WTP values. Ongoing work evaluates what factors may contribute to this variation.
- **Ongoing evaluation of automotive reviews of MY2015 vehicle fuel efficient technologies**
 - Building upon EPA's study of MY2014 vehicles, we continue to find that positive evaluations for all technologies (70%) exceed negative evaluations of the technologies (18%)
- **Ongoing work to evaluate the vehicle miles traveled (VMT) rebound effect**
- Collaboration with Transport and Environment/Climate Change Canada on **mass reduction** and **aerodynamics**
- Continued evaluation of the vehicle fleet each year to assess technologies, emissions, and compliance
 - supporting EPA's forth-coming **MY2016 Manufacturer GHG Performance Report** and **2017 CO2/Fuel Economy Trends Report**

Global Passenger Car CO2 Standards



Source: International Council for Clean Transportation.

<http://www.theicct.org/blogs/staff/improving-conversions-between-passenger-vehicle-efficiency-standards>