CAFE Standards Beyond 2021 - Latest Analysis and Next Step

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Sandia National Laboratories, Livermore, CA

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Presentation Overview

- About Volpe
- Corporate Average Fuel Economy - a very brief history
- Recent publications and ongoing activity
- US DOT analysis framework
- Summary of “Draft Technology Assessment Report” findings
About Volpe

Background:
- Volpe established in 1970
- Part of U.S. Department of Transportation (DOT) Office of Research and Technology
- Located in Cambridge, MA

Our Purpose:
- Advancing transportation innovation for the public good

Our Work Force:
- Multimodal, world-class resource with cross-disciplinary expertise
- Over 570 federal employees and 400 on-site contractors
Examples of work at Volpe

- Maritime Safety and Security Information System (MSSIS) – DoD
- Small Business Innovation Research Program – DOT
- Aircraft wake turbulence and aircraft separation – FAA
- Improving grade crossing safety – FRA
- **Fuel economy research, analysis, and modeling (CAFE)** – NHTSA
- Connected vehicles evaluation and safety assessment – ITS JPO, NHTSA
- Intelligent Transportation Systems policy and planning – ITS JPO
- Remotely piloted aircraft technology assessments – FAA
- Aviation Environmental Design Tool (AEDT) – FAA, NASA
- Implementation of Strategic Highway Research Program (SHRP2) initiatives – FHWA
NHTSA has rule making authority for CAFE, and Volpe supports with analysis
Examples of work at Volpe
A very brief history of Corporate Average Fuel Economy

- Originated in 1975 as part of the (Energy Policy and Conservation Act - EPCA).

- Long history of bi-partisan support from many Congresses and Presidents.


- Requires Corporate Average Fuel Economy (CAFE) standards.

- Requires DOT to set standards at maximum feasible levels for each fleet in each model year.

- Requires DOT to enforce standards.
CAFE increases have helped the U.S. conserve a trillion gallons of gasoline.*

*From long run analysis conducted in 2012.

Each billion gallons of fuel consumption corresponds to approximately 11 million metric tons of carbon dioxide emissions.
DOT has not yet proposed standards beyond 2021

- Per EISA (2007), each CAFE rulemaking may cover at most 5 model years.

- To establish final standards for model years 2022 and beyond, DOT must undertake a new rulemaking. The MY2017-2021 light duty rule is final.

- A July 2016 technical assessment (joint DOT, EPA, and CARB) began the process for 2022 and beyond.

- DOT must consider a range of regulatory alternatives and cannot give any alternative special consideration.
The Light-Duty CAFE standards up through 2021 increase in stringency...
But Light-Duty CAFE standards are more complicated than one number...
Recent CAFE activity (2016)


- Late September, 2016 - Public comment period for Light Duty “Draft TAR” closed.

- September 22, 2016 - Congressional hearing for Light Duty CAFE.

- August 16, 2016 – Medium duty / Heavy duty rule signed.
Let’s Talk Tech
DOT leverages best available information to inform analysis

- Technology characterizations (engine maps, transmission efficiency maps, etc.)
- Full vehicle simulations for more than 100,000 combinations of technologies and equipment.
- Projected year-by-year application of technology as the observed fleet evolves in response to standards (projected response includes practical factors like refresh/redesign cycles, shared platforms, manufacturer product portfolio, etc.)
- Technology costs (including R&D spending, tooling amortization, etc.)
NHTSA analysis relies on modeling and simulation tools from DOE and VOLPE

**Full Vehicle Simulations**
- Argonne National Labs “Autonomie”
- Widely used tool in both industry and academia

**Fleet Evolution**
- Volpe Model
- Model incorporates feedback received during more than a decade of ongoing public review
The DOT analysis evaluates many (combinations of) technologies

Advanced internal combustion engine technologies
- Turbo-downsizing
- Cylinder deactivation
- Atkinson Cycle
- Diesel
- And in time will include other emerging technologies (variable compression ratio, electronic valve control, etc.)

Advanced powertrain technologies
- Advanced transmissions
- Belt integrated starter-generator
- Hybrids and alternative fuel vehicles

Vehicle technologies
- Mass reduction
- Rolling resistance
- Aerodynamic drag
Turbo engines, Hybrids, or Cylinder Deac. will be effective pathways for many cars
Light Trucks may increasingly rely on Turbo-downsizing or cylinder deactivation

Draft TAR Analysis, Augural Standards - Light Truck Engine Systems

- FCV/CNG
- Electric Vehicle
- PHEV
- Strong Hybrid
- Diesel
- Atkinson Cycle
- Turbo
- Cylinder Deactivation
- Naturally Aspirated Engine
Belt Integrated Starter Generators (BISG) could be widely adopted by cars

Draft TAR, Augural Standards - BISG/CISG Penetration Rates

- Cars
- Light Trucks
Transmissions will add gears and reduce parasitic losses

*Non-HEV transmissions*
Transmissions will add gears and reduce parasitic losses

* Non-HEV transmissions
Additional levels of mass reduction are likely in Cars and Light Trucks

Draft TAR, Augural - PC Mass Reduction

Draft TAR, Augural - LT Mass Reduction
Additional aerodynamic improvements are likely in Cars and Light Trucks
Summary of MY2015 Draft TAR analysis

Draft TAR, Augural Standards - Average Cost of Compliance

Per Vehicle Compliance Cost vs. MY2015 baseline

Model Year


$-  $500  $1,000  $1,500  $2,000  $2,500

Passenger Car  Light Truck
DOT continues to align our analysis with observations of the fleet
Summary of pending DOT updates

- MY2016 fleet
- Improved “baseline” vehicle classifications
- Re-run engine maps with regular fuel
- Additional advanced transmissions (10-speed, for example)
- Adjustments to final drive ratio for performance neutrality
- Updated technology costs
- Ongoing stakeholder engagement...
Thanks, and stay tuned!

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