Assessment of Vehicle Mass Reduction Feasibility, Cost and Safety Effects for CAFE and GHG Rulemaking

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Topics

- 2017 and Beyond CAFE & GHG Rulemaking
- Mid-term Evaluation and NHTSA MYs 2022-2025 Full Rulemaking
- Assessment of Mass Reduction Feasibility and Cost for Rulemaking
- Assessment of Effects of Mass Reduction on Safety for Rulemaking
MY 2017+ CAFE & GHG Emission Rulemaking

- NHTSA and EPA joint federal rulemaking
  - NHTSA - Fuel Economy standards.
  - CARB – Accept EPA standards as compliance with California standards.

- Extensive technical, economic and environmental analyses.

- The standards are performance-based
  - Manufacturers will choose the technologies they will use for compliance.
Mid Term Evaluation

2017 - 2021 Final

2022-2025 Augural

Final unless changed by rulemaking

Joint Technical Assessment Report
“No Later Than” Timeline for 2022-2025 NHTSA Rulemaking and Midterm Evaluation

Key time frame to prepare underlying technical work for the Mid-Term Evaluation

2017 and Beyond Final Rule

No Later Than Date
Draft Technical Assessment Report
EPA/NHTSA/CARB

No Later Than Date
NHTSA and EPA coordinate on final action
Either
NHTSA Final Rule with EPA Decision not to reopen
OR
Joint EPA/NHTSA Rule
Fuel Economy Improving Technologies

**Engine:**
- Low friction lubricants
- Engine friction reduction
- Camshaft phasing control (VVT)
- Valve lift control (VVL)
- Cylinder deactivation
- Stoichiometric Gasoline Direct Injection
- Combustion restart
- Turbocharging and downsizing
- Cooled EGR
- Advanced Diesel

**Transmission:**
- 6-speed manual
- Improved automatic trans control
- High efficiency gears
- 6-, 7-, and 8-speed automatic
- 6- and 8-speed Dual clutch transmission
- Shift optimization

**Electrification and Accessories:**
- Electric power steering
- Improved accessories

**Hybrid Technologies:**
- 12v micro hybrid (start-stop)
- Belt mounted integrated starter generator
- Plug-in hybrid
- EV

**Vehicle Technologies:**
- **MASS REDUCTION**
- Low drag brakes
- Low rolling resistance tires
- Secondary axle disconnect
- Aerodynamic drag reduction
Engineering Studies for Mass Reduction Feasibility and Cost
Agency Holistic Vehicle Studies

CARB - 2010
Lotus Engineering, Toyota Venza

- Low Dev 20% MR
- High Dev >30% MR
- Hybrid PT

EPA – 2012
Toyota Venza (FEV/EDAG)

CARB – 2012
Toyota Venza (Lotus)

NHTSA – 2012
Honda Accord (Electricore, EDAG, GWU)

Future Work:

- EPA – 2011-2014
  Light Duty Truck (FEV/EDAG)

NHTSA Potential Light Duty Truck

CARB: Lotus Engineering
Toyota Venza (Phase 1)
Glider only

EPA/ICCT: FEV & EDAG
Venza low development vehicle (Phase 2) – Full vehicle

CARB/ICCT: Lotus Engineering
Venza high development vehicle (Phase 2) – Body Structure and Closures

NHTSA: Electricore, EDAG & GWU
Honda Accord – Full vehicle

EPA Truck study in progress
NHTSA potential truck study
Assessment of Effects of Mass Reduction on Societal Safety
NHTSA has long considered the potential safety effects in determining maximum feasible CAFE standards.

If OEMs will reduce vehicle mass or build smaller vehicles in response to future CAFE standards, we want to anticipate:
  1. Whether there will be safety implications
  2. If so, what are those safety implications

CAFE standards should be designed to encourage manufacturers to pursue a path toward compliance that is both safe and cost-effective.
Assessment of Societal Safety

NHTSA is assessing societal safety using two approaches:

- **Backward Looking:**
  - Statistical analysis of historical crash data
  - Study the effects of vehicle mass reduction and vehicle size on safety

- **Forward Looking:**
  - Engineering design and analysis approach
  - Crash simulation using CAE models
  - Use holistic light-weighted vehicle designs
Safety Assessment: Statistical Analysis of Historical Crash Data
Analyze historical crash data to assess the impact of vehicle mass and/or size changes on societal safety

Why is statistical analysis of historical crash data useful to NHTSA’s consideration of potential safety effects of CAFE standards?

◦ It shows real-world trends in crash incidence and severity for smaller versus larger and lighter versus heavier vehicles – this information is not available elsewhere

◦ It provides the agency with a substantial pool of data to analyze, which enables the agency to study various crash scenarios and exposures.

However, there are some drawbacks to using historical crash data:

◦ Data is historical – are we confident that it’s representative of future trends?

◦ Data are mixed from various crash scenarios/exposure. Sometimes there is not enough data to pinpoint the exact root cause.
Peer-Review of 20+ Studies
  ◦ Independent review by UMTRI of the methodologies used in 20+ statistical studies

Creation of Common Database
  ◦ Purpose: Reduce discrepancies among various studies due to use of different input data
  ◦ Contains fatality data from MY 2000-2007 vehicle crashes in CY 2002-2008

Dr. Chuck Kahane’s Updated Report
  ◦ Uses the common database above
  ◦ Responsive to comments from peer-reviews as well as from a NHTSA, DOE and EPA interagency team
  ◦ Report published in August 2012
In MYs 2017+ final rule, the agencies used vehicle weight reduction levels that maintained safety for the analysis. The analysis shows a path that the industry could use to maintain overall fleet safety while meeting the new fuel economy standards.

The following mass reduction levels were used in the analysis:
- All vehicles must, of course, meet all applicable safety standards.
- Relative to 2010 fleet levels

<table>
<thead>
<tr>
<th></th>
<th>Subcompact Car</th>
<th>Compact Car</th>
<th>Midsize Car</th>
<th>Large Car</th>
<th>MiniVan</th>
<th>Small Light Truck</th>
<th>Midsize Light Truck</th>
<th>Large Light Truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Amount of Mass Reduction Allowed</td>
<td>0%</td>
<td>0%</td>
<td>3.5%</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Projected Industry Average Amount of Mass Reduction Applied in MY2025</td>
<td>0%</td>
<td>0%</td>
<td>3.5%</td>
<td>10%</td>
<td>15.3%</td>
<td>12.5%</td>
<td>10.2%</td>
<td>11.3%</td>
</tr>
</tbody>
</table>
Safety Assessment: Crash Simulation Modeling
NHTSA Safety Analysis Using Crash Simulation Modeling

- Sponsored by NHTSA
- Utilize finite element models of concept vehicles and on-road vehicles to evaluate safety of light-weighted vehicles
- Vehicle-to-vehicle and vehicle-to-object crashes
- Beyond crash conditions used for standards
  - Vehicle speed from 15mph – 40 mph;
  - Represents a broader array of crashes
  - Weighted by frequency of occurrence from the National Automotive Sampling System (NASS) database
- Interaction between light-weighted and non-light-weighted vehicles
- Evaluate potential countermeasures
  - Potentially different air-bag deployment timing for light-weighted vehicles
  - Adaptive occupant restraint systems
Next Steps

- Will be covered by other presenters later today and tomorrow.
THANK YOU!