Engineering Realities: Structural Crashworthiness, Occupant Injury, and Advanced Vehicle Design

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Top-Tier Issues for Automakers

- Flexible/Adaptable Rulemaking Process Leading to a Single National Fuel Economy Program Post-2016
- Protect the Current Safety “Flight Path”
- Assure That the Studies the Agencies Rely on Reflect Real-World Constraints and Commercial Uncertainties
Process

- Single Coordinated National Program
- Realistic, Practical, Commercially Achievable Standards
- Flexible and Adaptable Rulemaking Process that Periodically Re-Assesses Future Developments Against Today’s Long-Term Predictions

The Degree and Timing of Improvements Being Studied are Unprecedented
Progress Worth Preserving

2009 Fatality and Injury Rates Were the Lowest in U.S. History

From 2008 to 2009, Road Fatalities Dropped 10%
Mass Reduction: Finding the Sweet Spot

- Fuel Economy/GHG Rules Must Contemplate and Balance Design/Safety Effects and Significant Mass Reductions
  - Significant Mass Reduction Requires Comprehensive Vehicle Platform Redesign
  - Potential for Real-World Safety Effects from Significant Fleet and/or Segment Mass Reductions Must be Investigated and Understood
Mass Reduction: Finding the Sweet Spot

- Periodic Review is Needed to Assess
  - Improvements in Design and Material Technology
  - Consumer Affordability/Acceptance
  - Economic Viability
  - Potential Mass Increases Associated With Future Safety Requirements and Voluntarily Provided Equipment
  - Potential Safety Impacts of Significant Mass Reduction
    - Timing and Effectiveness of Advanced Crash Avoidance Technology
    - Potential Further Improvements in Crashworthiness
Design Cycle

- Automakers Typically Implement Many Major Changes at One Time (e.g. 4-6 years with mid-cycle “refresh”); Makes it Difficult to Glean Out Effects of Individual Improvements
- Major Powertrain Components Have an Even Longer Lead-time (8+ years life cycle)
- Since Plant and Process Overhauls Accompany Platform Changes, it is Difficult/Costly to Incorporate Major Improvements Mid-product Cycle
- Depending Upon Degree of Change, Plant/Processes May Take Even Longer
- Model/Platform Replacement is Phased and Does Not Occur For the Entire Product Portfolio at the Same Time
Implementation of Innovation
Managing Uncertainty

Initial Concept

Lab Feasibility

Low Volume Prototype

Low Volume Production

High Volume Pilot

Issue Resolution Loops

Pre-Production Technology Development

Transition from Low to High Volume

Phased Introduction

Years
The Challenges of Advanced Materials

- Manufacturability and Lead-Time for Major Changes in Manufacturing Processes – i.e., Transition from Stamping/Welding to Casting/Bonding
- Implementation of Special Processes to Address Joining and Corrosion Issues
- Increased Demand for New Application of Materials
- NVH, Durability & Vehicle Safety Performance – Ensuring All Important Performance Requirements are Met
- Damage Identification and Reparability
- Potential Unforeseen Consequences
Recommended Lotus Study Improvements

- Examine Multiple Body Types
- Consider the Mass Efficiency of Entire Vehicle
- Address Materials Supply Issues
- Validate New Structural Designs
- Include Capital, Engineering, Development and Tooling Costs for Integration of New Materials
- Consider Manufacturer Design Cycles and Need for Pilot Introduction of New Technology/Manufacturing Processes

Lotus Study Leaves Detailed Safety Analysis to NHTSA
Comparing Lotus Costs to TAR, NAS, and SuperLightCar

NAS Estimate of Cost to Reduce Vehicle Mass (3600 lb vehicle)
1% low $1.28/lb, high $1.54/lb, Ave $1.41/lb
2% low $1.33/lb, high $1.60/lb, Ave $1.46/lb
5% low $1.50/lb, high $1.80/lb, Ave $1.65/lb
10% low $1.80/lb, high $2.16/lb, Ave $1.98/lb

Super Light Car
14% $1.55/lb, 22% $3.07/lb, 41% $6.11/lb

Figure 3.2-1: Mass Reduction Cost Model in Dollars per Pound in Model Year 2020 Compared to the Lotus Results and 2012-2016 Final Rule Cost.
Important Safety Studies

- NHTSA to Track/Study Real-World Safety Trends as More “Mass Reduced” Vehicles Enter the Fleet

- Determine the Best Balance Between the Rate of Mass Reduction and Potential Impact on Real-World Safety

- NHTSA to Conduct the Follow-on Studies Referenced in the 2012-16 Rulemaking and Apply Them to the 2017-2025 Rulemaking
Alliance Members

- BMW Group
- Chrysler
- Ford
- GM
- Jaguar
- Land Rover
- Mazda
- Mercedes-Benz
- Mitsubishi Motors
- Porsche
- Toyota
- Volkswagen
- Volvo