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Washington, DC 20460

Docket Management Facility, M-30
U.S. Department of Transportation
West Building, Ground Floor, Rm. W12-140
1200 New Jersey Avenue, SE
Washington, DC 20590

Attention: Docket ID No. EPA-HQ-OAR-2015-0827
NHTSA-2016-0068

Subject: Request for Comments – Midterm Evaluation Draft Technical Assessment Report for Model Year 2022-2025 Light Duty Vehicle GHG Emissions and CAFE Standards

Ford Motor Company (Ford) appreciates the opportunity to respond to the July 27, 2016 request for comments from the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) on the Midterm Evaluation Draft Technical Assessment Report for Model Year 2022-2025 Light Duty Vehicle GHG Emissions and CAFE Standards.

When, in 2012, requirements for Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) emissions were established for model years (MY) 2017 to 2025, there were concerns about the ability of the Agencies, the regulated community, and society to accurately assess the appropriateness of those standards across such a long time horizon. Therefore, the Midterm Evaluation was set in the regulation to allow a re-evaluation of critical factors such as the state of technology cost and effectiveness, consumer acceptance, fuel prices, and others. We recognize that this Draft Technical Assessment Report (TAR) is a key contributing resource to that evaluation, leading to the final determination of appropriateness of the 2022-2025MY standards.

The unprecedented increase in stringency of the 2017-2025MY regulations provides both opportunities and challenges to the automotive industry. New technologies are being developed, implemented, and improved at an impressive rate. Over the last four years, since the 2012MY standards first took effect, Ford has seen tremendous growth in several of our advanced technologies:

- Ford's EcoBoost® technology uses turbocharging and direct fuel injection to deliver significant fuel-efficiency gains and reduced CO_2 emissions, with engines ranging in size from 1.0-liter to 3.5-liter. We have produced more than 5 million EcoBoost-equipped vehicles globally since 2009, including 1 million EcoBoost F-150 trucks in the U.S. since 2011. EcoBoost engines account for approximately 60 percent of F-150 sales. The technology is now available on 32 different vehicles, including all our North American nameplates.
- Ford is the leader in light weighting as demonstrated by the weight reductions in the 2015 F-150, for which we reduced weight by 12%, and 2017 F-series Super Duty. Over the past several years, Ford transformed F-series—the top-selling vehicle in the U.S.—to reduce weight, improve fuel efficiency, reduce CO_2 emissions, and improve towing and hauling capability. We implemented high-strength, military-grade, aluminum-alloy bodies and high-strength steel frames across our F-series lineup, reducing up to 700 pounds from F-150 and up to 350 pounds from F-series Super Duty compared to the previous generations. Ford is America's truck leader, and we continue investing to improve the efficiency and capability of our products.

And we have plans for continued investment in fuel efficient technologies, as demonstrated in our commitment to investing $4.5 billion in electrification efforts by 2020.

However, the benefits of these improvements will be limited if consumers do not purchase the new-technology vehicles in sufficient numbers. Our ability to support the national goals for fuel economy improvement and GHG reduction rely not only on the development of efficient technologies, but also on consumers' acceptance of those technologies. In our view, this is the most critical of the many issues that need to be addressed in the Midterm Evaluation process. We appreciate the ongoing opportunities to inform the Agencies of the opportunities and concerns facing the industry and Ford Motor Company as we strive to assess the 2022-2025MY requirements.

Ford Motor Company fully supports the comments provided by the Alliance of Automobile Manufacturers ("the Alliance"), and we do not intend to repeat all of the Alliance comments here. Our comments include some additional information, while emphasizing a number of points more specific to Ford's situation. We would like to note that several issues in the Draft TAR have not yet been fully assessed due to the time constraint of the 60-day comment period. Ford will continue to assess the Draft TAR and provide our perspective throughout the Midterm Evaluation process.

Ford's key concerns regarding the Draft TAR and Midterm Evaluation are summarized below and discussed further in the enclosed attachment.

Technology Assumptions and Modeling

Specific concerns are discussed at length in the Alliance comments and summarized in the attachment, and include the following technologies with regard to effectiveness and/or penetration and the method by which they are bundled in the Agency models:

1. Engine technologies: advanced Atkinson engines and downsized turbocharged packages
2. Transmission technologies: overall classifications, wide ratio transmissions, and high efficiency gearbox
3. Electrification issues: penetration, cost, and effectiveness of 48V mild HEVs, strong HEVs, and plug-in electric vehicles

4. Load reduction (mass, tires, aero): baseline assumptions, availability of material and lead time
5. Performance: performance metrics and assumption of maintaining "constant performance"
6. Accelerated product cadence: the inability to benefit from "learning", and the cost of frequent upgrades to maintain fleet compliance
7. Related regulations: impact of Tier 3 and LEV III regulations on fuel consumption and on the effectiveness of key powertrain technologies
8. General modeling concerns: lack of sufficient time and data to assess; overreliance on the Lumped Parameter Model

Additionally, there remains significant uncertainty related to technologies and costs necessary to attain future standards. This is evidenced by the significant changes in technology assumptions made by the Agencies between assumptions in the original 2017-2025MY rulemaking, and those in the recently released draft TAR. In a relatively short 4-year period, there have already proven to be significant differences between the Agencies' original assumptions and the current ones. The very real uncertainty reflected in these differences needs to be accounted for in assessing the feasibility of future standards. Differences between projections and reality can be greatly magnified over the upcoming nine years covering the MY 2025 standards. Given the range of possible outcomes, future standards should be based on projections at the conservative end of the range. Otherwise, the Agencies could end up imposing unrealistic obligations on manufacturers, and billions of dollars of costs on society as a whole.

Consumer Acceptance and Employment

The 2017-2025MY regulations specifically required the Midterm Evaluation to assess these factors in determining the appropriateness of the requirements. Unfortunately, the Draft TAR's coverage of these two critical factors lacks depth and fails to reach essential conclusions. The discussion of these key subjects occupies only 43 pages of the 1,217 page document, in essence concluding that there were insufficient resources to properly assess either factor. In our view, this outcome is not adequate to support a final Midterm Evaluation decision. Consumer acceptance is likely the most important element of a successful regulatory program. There is little doubt that technologies are available to meet the stringent requirements; the real question is whether these technologies can be made available affordably and in a manner that meets consumers' wants and needs. Ford supports the Alliance comments on consumer acceptance and offers some additional insights on the following topics:

1. Consumer expectations and willingness to pay for fuel economy
2. Dealership experience with electric vehicle customers today (selling and service)
3. Estimating the impact of higher standards on vehicle sales

Regulatory Flexibilities

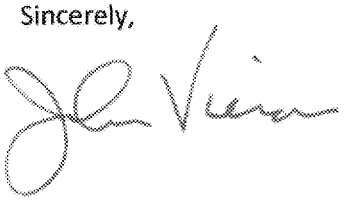
The 2017-2025MY Final Rule recognized need to incorporate a range of compliance mechanisms into the future rules. These include credits for innovations such as off-cycle technologies, improvements in air-conditioning systems designed to minimize refrigerant leakage, and the promotion of advanced technologies that operate on a variety of alternatives to traditional

gasoline. Ford fully supports the Alliance discussion on these items and summarizes the key issues in the attached supplemental comments.

Harmonization
Going forward, the joint CAFE/GHG standards, per the original intent of the rulemaking, should enable manufacturers to comply with both their GHG and CAFE obligations by building one fleet of vehicles that can be sold nationwide. At a miniumum, the degree of coordination between EPA and NHTSA during the Midterm Evaluation needs to be no less than the degree of coordination involved in the original joint rulemaking. The Agencies need to make further efforts to eliminate differences in the GHG and CAFE programs to the maximum extent possible.

Once again, we appreciate the opportunity to provide the attached written comments. We look forward to continued dialogue to further explore these issues. Please feel free to contact Todd Fagerman at Ex. 6 or Nancy Homeister at Ex. 6 if you are so inclined.

Sincerely,



Midterm Evaluation Draft Technical Assessment Report for Model Year 2022-2025 Light Duty Vehicle GHG Emissions and CAFE Standards

Docket ID No. EPA-HQ-OAR-2015-0827
NHTSA-2016-0068

Supplemental Comments of Ford Motor Company

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I. Introduction

Ford appreciates this opportunity to comment on the joint Draft Technical Assessment Report (TAR) that is a key component of the Midterm Evaluation to assess the appropriateness of the 2022-2025MY standards. Ford supports the comments submitted by the Alliance of Automobile Manufacturers ("Alliance"). These comments intend to supplement Alliance comments and in no way disagree with any of their input or conclusions.

The efforts that started in 2010 and culminated in the 2017-2025MY CAFE and GHG Final Rule in 2012 were largely unprecedented in the automotive industry both in stringency and the extended timeframe of established regulatory standards. However, continued alignment between the three Agencies (NHTSA, EPA and CARB) and assurance of a known program into the future was of considerable interest to the industry and Ford. A robust Midterm Evaluation was and remains critical to ensure that the assumptions made in those early years regarding projected developments in fuel economy technology, anticipated improvements in infrastructure to support new kinds of powertrains, the willingness of consumers to accept new technologies, and other factors were appropriate.

The 2017-2025 Final Rule laid out several factors that specifically need to be assessed and addressed in the Midterm Evaluation:

- "The availability and effectiveness of technology, and the appropriate lead time for introduction of technology;
- The cost on the producers or purchasers of new motor vehicles or new motor vehicle engines;
- The feasibility and practicability of the standards;
- The impact of the standards on reduction of emissions, oil conservation, energy security, and fuel savings by consumers;
- The impact of the standards on the automobile industry;
- The impacts of the standards on automobile safety;
- The impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program; and
- The impact of the standards on other relevant factors."[1]

Although the Agencies have noted, in their response to the Congressional requests for an extension to the comment period, that the Draft TAR has been under development over the last four years, we believe that several key elements of the regulatory-required study require further assessment:

- Technology assumptions regarding cost and effectiveness, as well as the ability to reach the penetration levels assumed by the Agencies by 2025MY
- The assessment of consumer acceptance of technologies that are key to compliance strategy, as well as the impact on the economy and employment if vehicle sales are adversely impacted by consumers' unwillingness, or inability, to purchase products that may not meet their needs of affordability or utility
- The ongoing commitment to program flexibilities
- Increased harmonization between the CAFE and GHG programs moving forward.

[1] Code of Federal Regulations, Title 40, Part 86, Subpart S. §86.1818-12(h)(1)

Each of these issues will be discussed in greater detail below, and we look forward to continued discussions with the Agencies to ensure these issues are adequately addressed in the Midterm Evaluation.

II. Technology Cost and Effectiveness/Modeling

Realistic technology cost and effectiveness assumptions are central to assessing the feasibility of the 2017-2025MY CAFE/GHG regulations. The CO_2 reduction effectiveness attributed to specific technologies will determine the degree of advanced technology penetration needed to ensure a compliant fleet, and the resulting technology density will determine the direct and indirect manufacturing costs needed to comply. As fundamental as this process is, however, this picture does not fully describe the cost of compliance for manufacturers. Manufacturing costs encompass only the costs associated with building and *making available for sale* the vehicles needed to comply, but they do not include the cost of *selling a compliant fleet to customers*, whose needs and preferences include attributes other than fuel economy, such as affordability, safety, utility, performance, and styling.

Ford recognizes and appreciates the Agencies' efforts to develop sophisticated modeling frameworks to estimate the technology needed to achieve a compliant fleet. However, given the severe stringency of the 2022-2025MY standards and the extended timeframe under consideration, we agree with the Alliance recommendations that further refinements are needed to ensure more accurate and robust modeling results.

Additionally, like all modeling efforts, the outputs are only as good as the inputs. Many of the technology assumptions in the Draft TAR are questionable, for reasons discussed in the Alliance comments.. In general, we find that the assumptions tend to be taken from the higher end of the effectiveness spectrum, while technology costs tend to be taken from the lower range of estimates. The compounding effect of these choices—when considered across the fleet and over time, skews the outcome of the analysis in a— significant way. We will continue to work with the Agencies to further illustrate their importance.

Certain assumptions warrant particular scrutiny, including, 1) the Agencies' key engine and transmission assumptions, and, 2) the Agencies' across-the -board vehicle-level assumptions around issues such as light-weighting, aerodynamic drag reduction and low rolling resistance tires. Projections for vehicle-level improvements are particularly important because these assumptions affect the entire fleet across all powertrain pathways, yet we find that the TAR assumptions in these areas tend to be more nebulous and arbitrary than the component-level or powertrain assumptions. These concerns are thoroughly detailed in the Alliance comments.

In summary, Ford agrees with the Alliance conclusion that the overall result of these many variances in technical effectiveness and modeling—some large, some small—is that achieving a compliant fleet in 2025MY will require a much higher penetration of CO_2 reducing powertrain technologies than assumed in the Draft TAR. In particular, Ford believes that such a fleet will require much higher levels of strong electrification (HEV, PHEV, and BEV) in order to comply with the standards, resulting in proportionally higher compliance costs.

Ford has regularly met with the Agencies over the past four years and has provided detailed information on our internal modeling results, future vehicle technology pathways, estimated compliance costs, the impact of the Tier 3 / LEV III regulations (91RON E10 test fuel, SULEV/Bin 30 emissions, and 3

mg/mi and 1 mg/mi PM standards), and the need for higher levels of electrification to comply with the 2022-2025MY standards. The 60-day comment period does not allow for a comprehensive summary of these and many other issues, so Ford will continue to meet with the Agencies after the comment period and provide additional supporting data.

Ford supports the comments on the Draft TAR submitted by the Alliance on technology cost and effectiveness. Key specific issues are summarized below:

A. Engine Technologies

Advanced Atkinson Engines Technology Package (ATK2) – EPA's effectiveness assumptions and future penetration levels for the ATK2 pathway are significantly overestimated:

- 44% fleet-wide penetration of ATK2 in 2025MY is unrealistic given the limited number of powertrain refresh cycles available before 2025MY. Additionally, it is unreasonable to assume that OEMs already heavily invested in different high-efficiency powertrain pathways (e.g., turbo-downsizing) would be able to commit the immense resources needed to reach these high ATK2 penetration levels in such a short time.
- The effectiveness values for the "futured" ATK2 package - projected at 40% penetration in 2025MY and includes cooled exhaust gas recirculation (CEGR) and cylinder deactivation (DEAC) - are too high, primarily due to overtly-optimistic efficiencies in the base engine map, insufficient accounting of CEGR and DEAC integration losses, and no accounting of the impact of 91RON Tier 3 test fuel.

Turbo Downsized Engine Packages (TDS) – While changes to the TDS assumptions contained in the Draft TAR have resulted in values that are now closer to industry estimates (e.g., removal of TDS27), the effectiveness values are still optimistic:

- The projected efficiency of the engine maps used as EPA's basis for turbocharged engines is too high due to use of high octane fuel, optimistic friction reduction assumptions, and failure to fully account for the effect of higher boost pressures on crevice losses, friction, and compression ratio.
- The effectiveness assumptions are biased upward due to the use of 96+ RON test fuel instead of the fuel that will be used for CAFE/GHG in the 20MY+ timeframe (91RON Tier 3 / LEV III fuel).NHTSA's acknowledgement that any subsequent testing will use fuel with the appropriate octane level is appreciated, the impact of this change needs to be reflected in future analyses.
- The degree of downsizing assumed by the Agencies is too aggressive. These assumptions appear to be based primarily on maximizing the fuel efficiency on the city and highway test cycles while satisfying only rudimentary performance requirements. This approach overestimates the optimal degree of downsizing by ignoring the adverse effect that an "under-sized" engine can have on customer acceptance, drivability, and high speed/high load fuel efficiency. Regular grade octane fuel - like the default Tier 3 test fuel - exacerbates this effect.

B. Transmission Technologies

Transmission Classification – EPA's grouping of different transmission types (planetary, CVT, and DCT) into the same efficiency bins ignores the unique effectiveness and cost implications of

these vastly different technologies and is inconsistent with the methodology applied to other technologies (e.g., separate treatment of TDS and ATK2).

Wide Ratio Transmissions – The effectiveness attributed to 8, 9, and 10 speed transmissions is too high when compared to the actual gains realized on similar transmissions recently introduced to the market.

High Efficiency Gearbox (HEG2) – The package of improvements for HEG2 is not well defined, but appears to significantly overestimate the efficiency improvements possible given the progress industry has already made in this area—this progress should be appropriately quantified in the baseline fleet.

C. Electrification Issues

Mild Hybrids (MHEVs) – The Agencies should carefully review the assumptions related to cost, effectiveness and penetration for MHEVs. Additionally, input from OEMs should be considered together with supplier projections.

Strong Hybrids (HEV) – EPA assigns the same cost and effectiveness values to both powersplit and P2 hybrids. These technologies are sufficiently different to warrant separate consideration.

Plug-In Electric Vehicles (PEV) – In general, the cost associated with plug-in electric technologies appears to be conservative, but more time is needed to fully understand the basis of the Agencies' assumptions.

D. Load Reduction – Mass, Aerodynamics and Tires

Mass Reduction

The Draft TAR's analysis of the efficacy and costs of lightweight vehicle materials and technologies highlights a number of issues with the data and conclusions. Specifically for Ford Motor Company vehicles, these issues fall into four primary categories:

- Our current fleet utilizes many of the lightweight body technologies such as advanced high strength steel (AHSS) for primary body structure and aluminum for closure panels. Hence, most Ford vehicles are already well along the "cost – technology curves" included in the Draft TAR. The incremental variable and investments costs associated with further lightweight actions are far more expensive than implied in the Draft TAR.
- The absolute costs of including more lightweight materials in our vehicles are three to more than five times greater than the costs stated in the Draft TAR.
- The time and resources (both capital and personnel) required to change material and manufacturing systems, especially for global vehicle platforms, is substantial. This time and cost are not addressed in the Draft TAR.
- The increased application of electrification will add significant battery weight and package volume offsets to the aggressive, simultaneous vehicle weight and aerodynamic reductions being recommended in the Draft TAR. Further, the growth in customer-requested features in our vehicles—including autonomy and driver assistance—along with increasing safety performance requirements, also add weight to our vehicles. The

Draft TAR does not adequately assess the increased weight associated with increasing regulatory and customer requirements.

Ford Vehicle Body Materials

Ford Motor Company body structures have already incorporated advanced high strength steel, and in many cases the aluminum closures, associated with the first presumed 10% to 20% curb weight reductions.[2]

For platform updates from 2010 forward, Ford Motor Company body and closures have utilized advanced high strength steel bodies and selected aluminum closures.

The 2017 Lincoln Continental, our large, unibody sedan, uses advanced high strength steel (AHSS) for more than 45% of the body structure. More than 10% of the steel in the body structure is boron steel. The average yield strength of the steel in the body-in-white (BIW) is approximately 340 MPa. Figure 1 presents the steel distribution of the Continental's BIW materials.

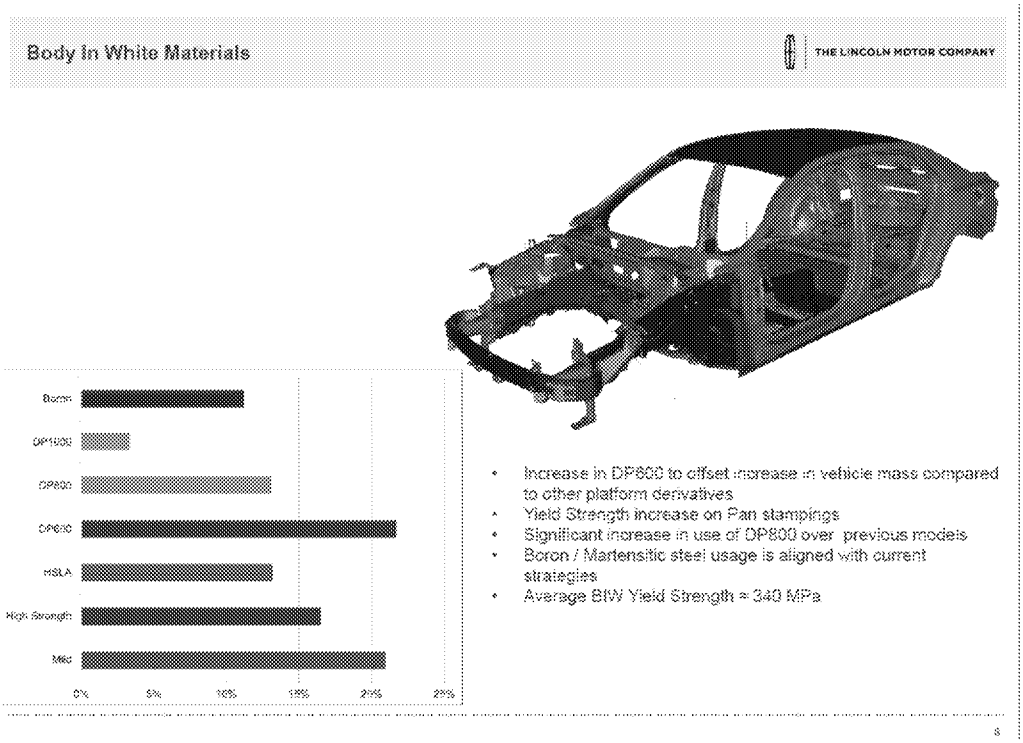

Figure 1. 2017 Lincoln Continental Body-In-White Materials (from Shawn Morgans, Great Designs in Steel 2016 conference)

[2] Draft TAR, Figures 5.55, 5.58, 5.60, 5.61, 5.62, 5.63

The 2017 Lincoln Continental also has an aluminum hood, front fenders, and deck lid. Approximately 25% of the closure material is aluminum and 5% is boron steel (Figure 2).

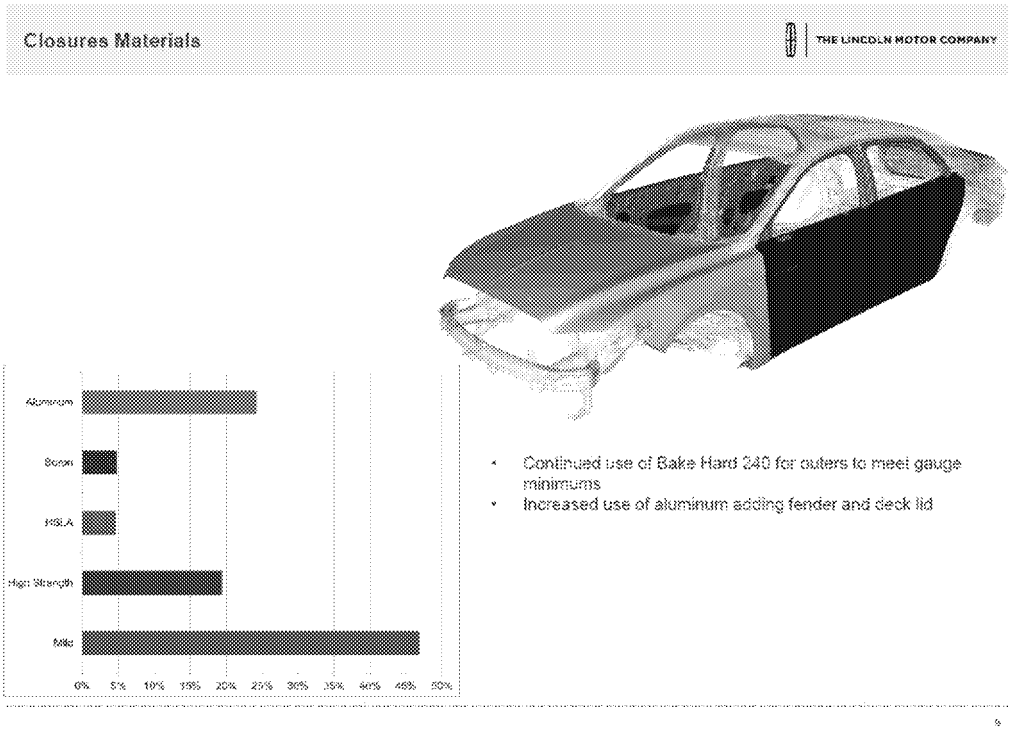

Figure 2. 2017 Lincoln Continental Closure Materials (from Shawn Morgans, Great Designs in Steel 2016 conference)

Similarly for the 2015 Ford Edge, our medium size CD SUV from the global CD platform, the average strength of the body-in-white structural steel is more than 325 MPa. Approximately half the steel in the body structure is DP600 (dual phase advanced high strength steel with strength over 600 MPa) or stronger steel. DP600 makes up 22% of the material used and can be found in the front rails, cowl side, A-pillar and roof rail reinforcements, B-pillar, rear under body cross members, and the back panel structure.

15% of the BIW is made of DP800, including our first use of the material for the rear rails, as well as the B-pillar inner, B-pillar roof bow, and other underbody members. DP1000 is used in the A-pillar and roof rail and added to the rear bumper beam at approximately 5% by weight. Finally, 7% is boron or Martensitic steel, including the front bumper, center hinge pillar, and rocker reinforcement. Figure 3 plots the steel distribution in the 2015 Ford Edge.

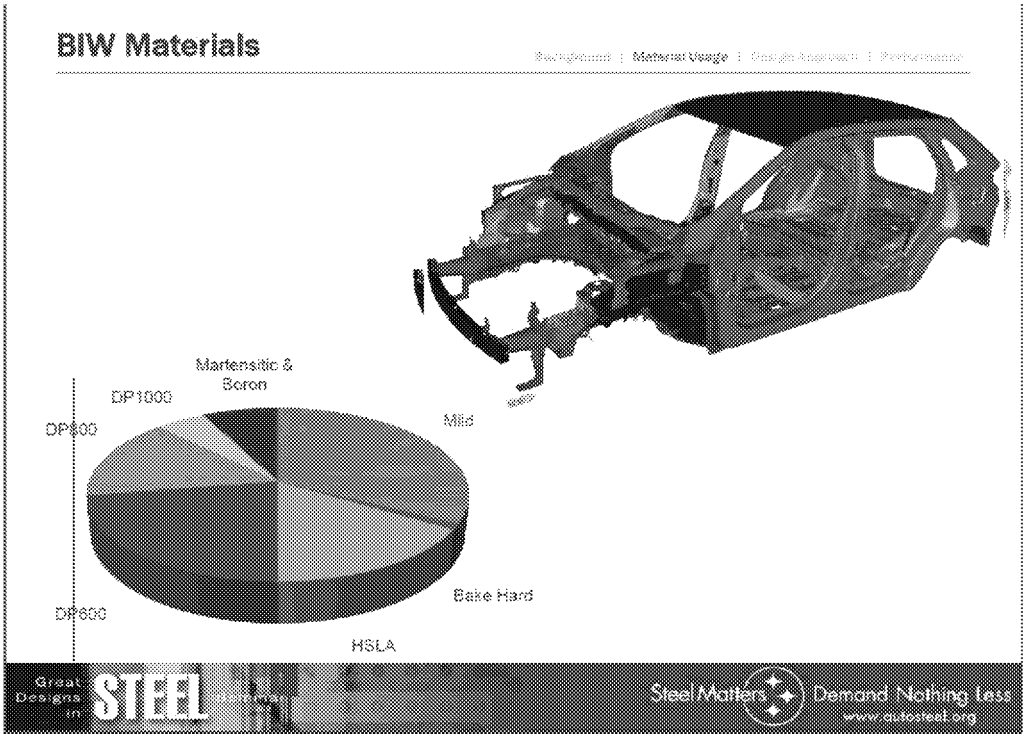

Figure 3. 2015 Ford Edge Body-In-White Materials
(from John Reed, Great Designs in Steel 2015 conference)

More than one-third of the Ford Mustang's body-in-white steel is composed of advanced high strength steel (Figure 4). Also, the Ford Mustang has aluminum hood and front fenders (Figure 5).

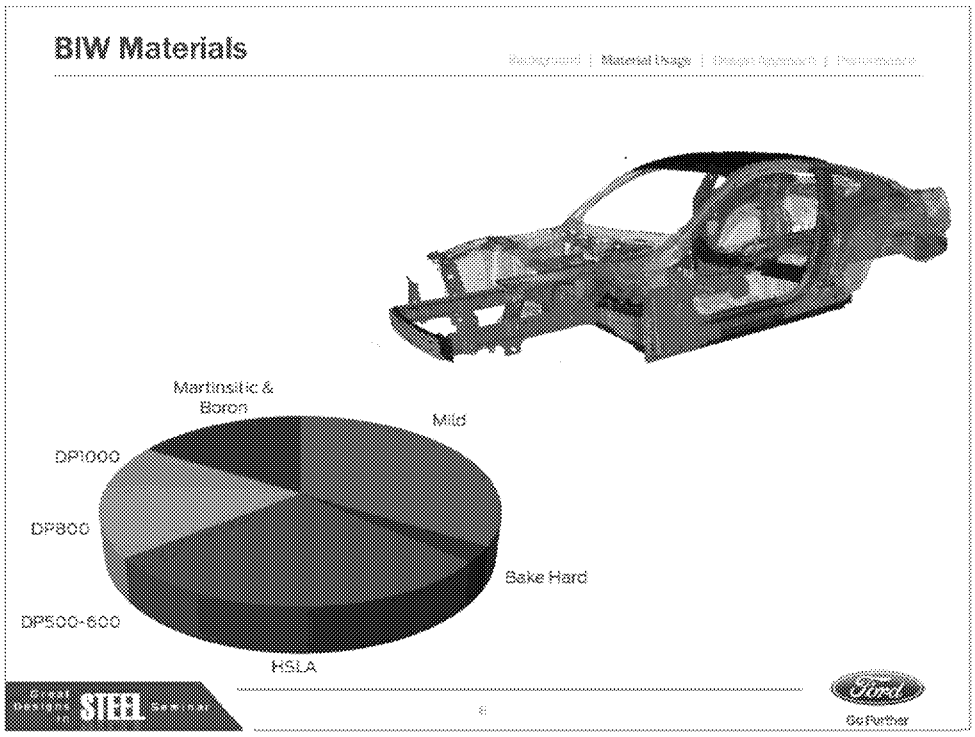

Figure 4. 2014 Ford Mustang Body-In-White Materials
(from Shawn Morgans, Great Designs in Steel 2014 conference)

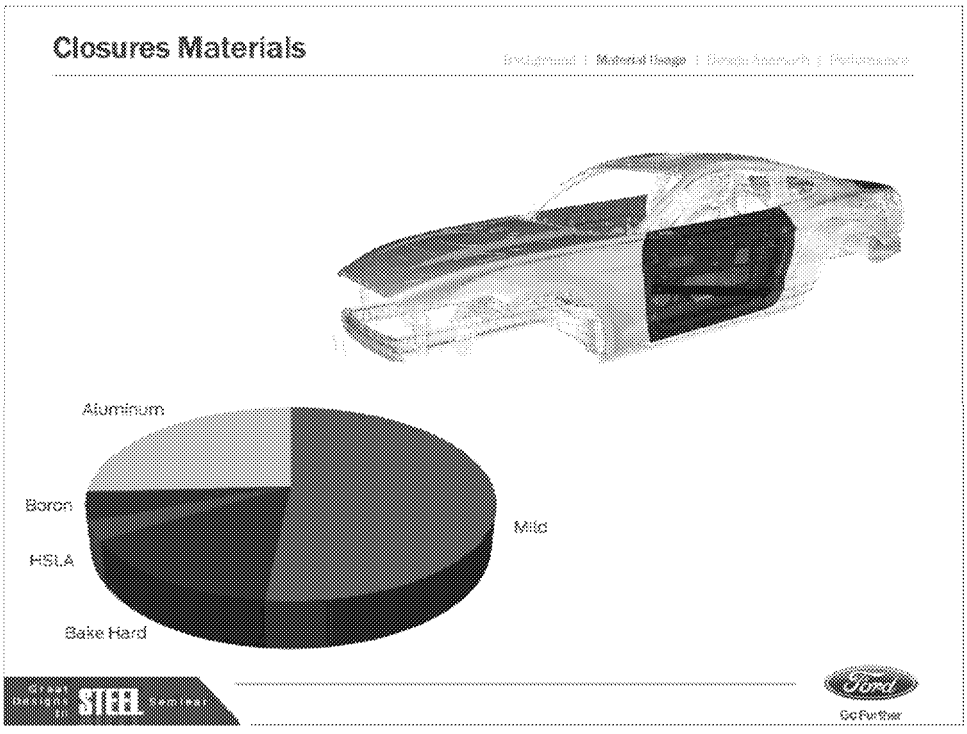

Figure 5. 2014 Ford Mustang Closure Materials
(from Shawn Morgans, Great Designs in Steel 2014 conference)

The current Ford Fusion, released in late 2012 as a 2013 MY vehicle, also employs the advanced high strength steel (AHSS) body with aluminum closure strategy that is identified in the Draft TAR as an intermediate light weighting bundle. The average yield strength of the steel in the Ford Fusion body-in-white is 348 MPa with more than one-third of the steel having strength of 600 MPa or above. Figure 6 presents the materials in the Ford Fusion body-in-white. The Fusion has an aluminum hood to reduce the vehicle mass and improve the weight distribution between the front and rear wheels.

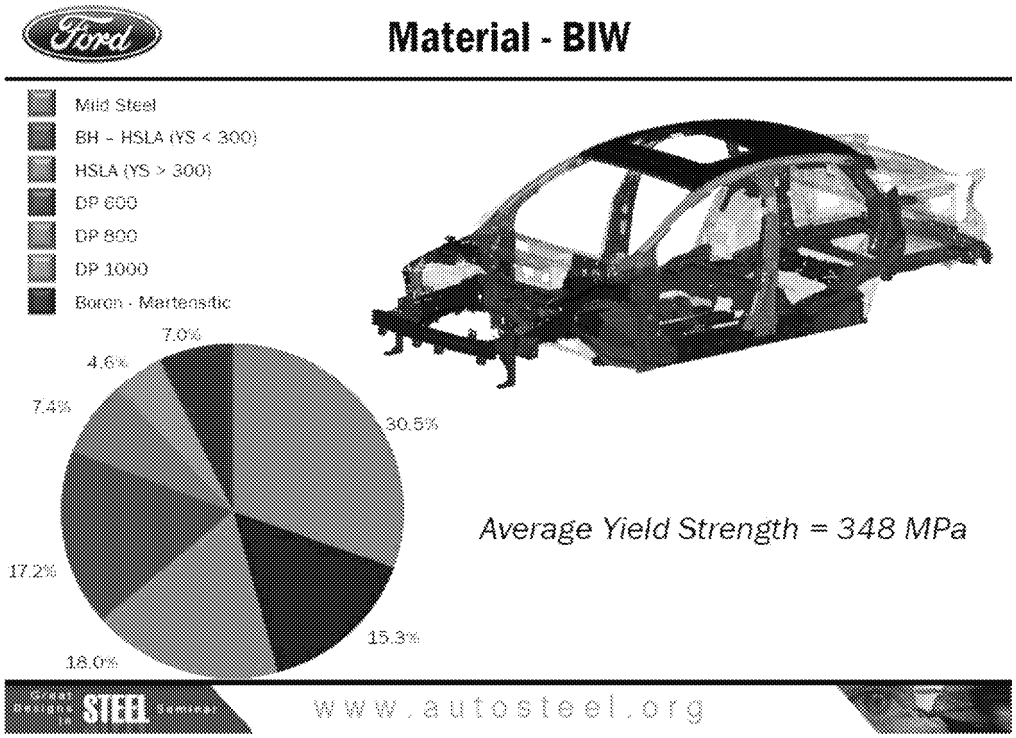

Figure 6. 2013 Ford Fusion Body-In-White Materials
(from Shawn Morgans, Great Designs in Steel 2012 conference)

As these examples demonstrate, Ford Motor Company vehicles have already adopted the advanced high strength steel (AHSS) and aluminum closures strategy. While the Draft TAR suggests that this strategy can yield approximately 15% vehicle mass reduction, the data from our vehicles suggests otherwise. For Ford to use material strategies to further reduce the mass of the body-in-white, closures, and other systems, the incremental costs would begin along the Draft TAR curves from the AHSS + Aluminum point. Therefore, the Draft TAR vastly underestimates the costs of mass reduction in Ford vehicles.

Implementation Time and Complexity

The Draft TAR severely underestimates the time, resources, and complexity of introducing lightweight materials into our global vehicles. For example, Ford Motor Company produces the CD platform vehicles in six assembly plants around the world. The Fusion/Mondeo is produced in five assembly plants: Chongqing, China; Valencia,

Spain; St. Petersburg, Russia; Hermosillo, Mexico; and Flat Rock, Michigan. The Edge is produced in Oakville, Ontario, Canada. Supplying the necessary lightweight materials to these six assembly plants requires a mature, competent supply base that can deliver efficiently all around the globe.

Also, the time required to develop and deliver new lightweight materials is underestimated in the Draft TAR. For the aluminum body and high strength steel frame for the all-new 2015 F-150, engineering efforts began in 2009. While the research and development efforts on aluminum structures and manufacturing changes had been ongoing, in mid-2009 the efforts accelerated to target the F-150. Hundreds of engineers absorbed new assignments beginning in late 2009 to determine if the F-150 could be a successful product with an aluminum body and high strength steel frame.

Figure 7 shows the high level timeline for the prototype development that led to the all-new 2015 F-150.

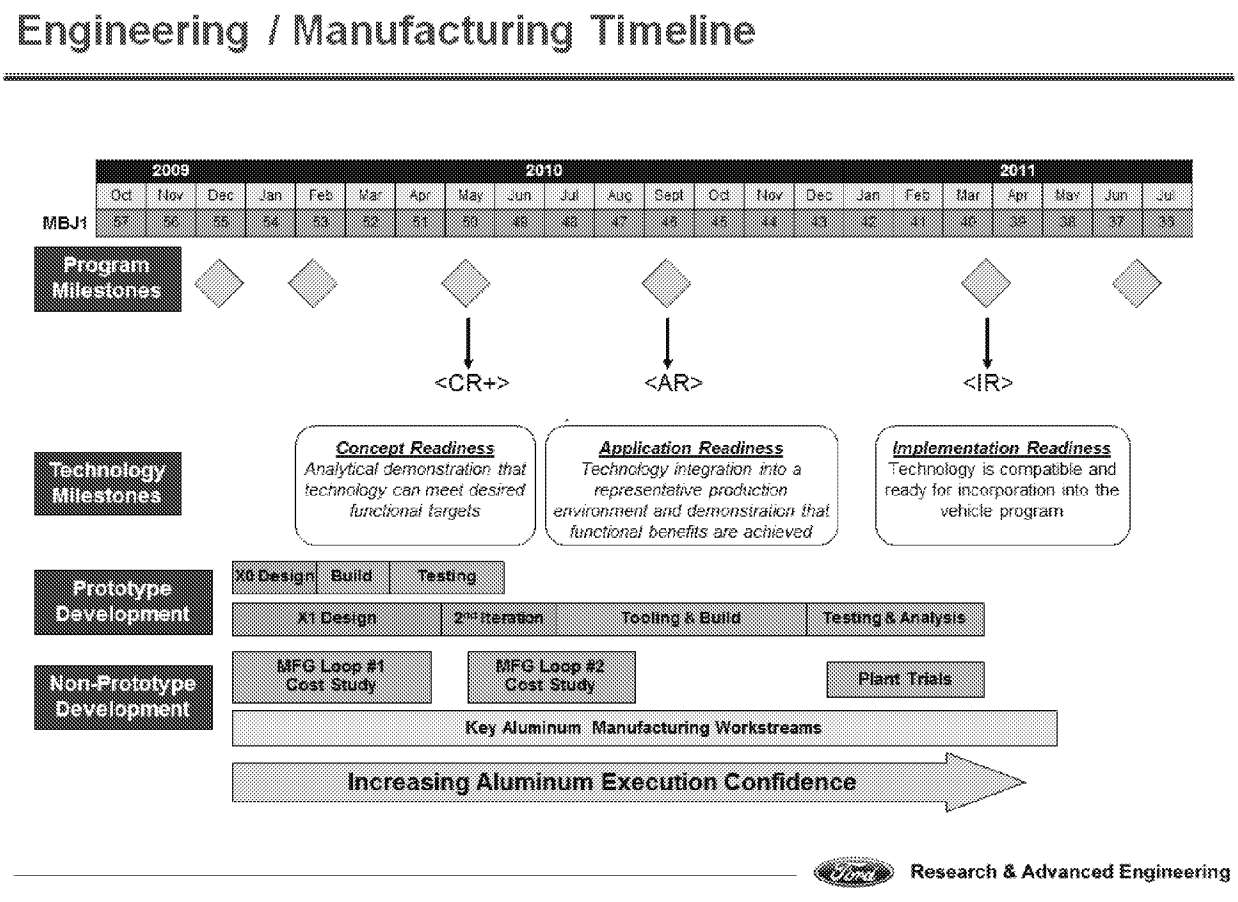

Figure 7. F-150 Engineering and Manufacturing Timeline
(from Pete Friedman, SAE Government – Industry Conference, January 2015)

The time, resources, and costs associated with implementing a new material system are tremendous, and are not adequately addressed in the Draft TAR's assessment of the ability to broadly introduce new materials.

Customer Expectations and Requirements

Although light weighting can provide positive benefits to handling, towing, and hauling, it can also negatively impact noise, vibration, and harshness (NVH). Additionally, new features unrelated to fuel economy and safety regulations are being adopted by consumers, such as driver assistance and connectivity technologies, that add weight to the vehicle. Consumers are unwilling to sacrifice interior quietness in exchange for fuel economy improvements due to light weighting. The Draft TAR does not acknowledge the impact to mass, and therefore incremental mass reduction cost and fuel economy, of these customer-demanded features, the need to preserve NVH, and the drive toward autonomous vehicles.

Ford has aggressively pursued mass reduction opportunities and looks to continue this progress into the future. However, engineering and logistical challenges still remain. This is highlighted by the following:

- In total, the migration of the F-series to aluminum drove the aluminum supply base to add one billion pounds of aluminum sheet capacity to meet Ford's production requirements. Significant lead time and advance planning are required to transition to lightweight materials.
- Global platform sharing continues to be a challenge for managing large-scale light weighting.
- Autonomous and driver assistance technologies have additional weight impacts (note that Ford announced on August 16 our intent to have a high-volume, fully autonomous SAE level 4-capable vehicle in commercial operation in 2021 in a ride-hailing or ride-sharing service).
- And consideration needs to be given to the impact of other regulations, particularly safety, that result in mass additions.

Aerodynamics

Ford supports the Alliance comments on the feasibility of the aerodynamic improvements outlined in the Draft TAR. It is increasingly challenging for the industry to pursue improvements in aerodynamic efficiency. Potential aerodynamic reductions are constrained by many factors such as consumer needs and preferences regarding vehicle styling, vehicle utility, and interior space. These are major factors considered by customers when comparing competing vehicles, and the failure of a manufacturer to deliver in these areas can lead to the production of non-competitive, poor selling vehicles. The Agencies have not fully accounted for these constraints. Additionally, aerodynamic improvements already incorporated into the baseline fleet have not been fully captured in the Draft TAR analysis.

Tires

Ford is aligned with the Alliance comments on the baseline fleet assumptions for low rolling resistance (LRR) tire technology. In particular, although the Agencies acknowledge that LRR tires are increasingly specified by OEMs, this fact does not appear to have been properly included in the baseline fleet assumptions, resulting in an overestimated impact of a fleet-wide rollout of LRR tires.

E. Performance

Ford agrees with the comments submitted by the Alliance regarding the critical importance of appropriately accounting for vehicle performance in the Agencies' analysis. EPA and NHSTA should harmonize on a common set of vehicle performance metrics that comprehensively encompass real-world customer activity beyond 0-30 mph and 0-60 mph times, including metrics such as grade capability, load, and handling. The Agencies should also align on more realistic performance levels for these metrics by considering both the capability of today's fleet and customer expectations.

F. Product Cadence

The fuel economy and greenhouse gas requirements are increasing at an unprecedented annual rate. The year-over-year tightening of the standards results in unintended consequences that impact vehicle cost and overall compliance, which were not assessed in the Draft TAR.

Historically, a newly launched car would not go through a major redesign for 5 to 6 years, while for trucks it is usually longer. However, given that fuel economy needs to increase roughly 4.5% per year, the launched product has to overachieve its footprint target significantly to positively contribute to fleet compliance for at least the first several years. This makes the timing of new vehicle launches significant, and the effort to balance vehicle plans against future targets a challenge. But more importantly, it means the cadence of vehicle redesign has to be much shorter than it has been in the past, resulting in significant investment in programs and reduced time to recoup investments.

Further, the Agencies often refer to the OEM cost saving opportunity from "learning"—after a new technology has been developed and implemented, the Agencies believe additional cost savings can be attained. However, the increased cadence of vehicle redesign prevents this opportunity as engineers must develop the "next new technology" almost immediately after the "current new technology" is launched. This precludes the opportunity for "learning" savings, and significantly increases the risk of stranded investment. The industry's ability to use new stamping or molding equipment over a span of several years is becoming more and and restricted.

However, the challenge to the automotive industry goes beyond fuel economy and GHG programs. We are also simultaneously facing increasingly stringent tailpipe criteria pollutant standards and increasingly challenging safety standards. These standards are not aligned, leading to the need to redesign products on an inconsistent schedule. It should be further noted that the regulations are also often at odds. Reduced engine out emissions and improved catalyst designs often impact the ability to optimize engine calibration for fuel economy, and potentially preclude some fuel efficient vehicle technologies entirely. Safety standards continue to increase vehicle weight, which also offsets fuel economy gains. No manufacturer has unlimited ability to invest, so the conflicting investment requirements can result in a significant impact to a program's ability to meet the regulations while maintaining an acceptable business case.

As the Agencies work toward the Proposed Determination and NPRM, they should properly assess the cost and investment impact of the cadence of year-over-year standards, and misalignment with other automotive requirements.

G. Impact of Tier 3 and LEV III Regulations

The Agencies did not provide an assessment of the impact of the criteria pollutant emission standards that were adopted subsequent to the adoption of the 2017-2025MY Final Rule. These new requirements have increased the challenge of meeting the fuel economy and GHG targets and need to be taken into consideration during the Midterm Evaluation.

Lower Octane Tier 3 Test Fuel: The effectiveness values of key engine technologies in the Draft TAR have been overestimated in part due to the use of 96+RON (e.g., Tier 2) test fuel. These values should be updated to reflect the 91RON fuel that will be used for CAFE/GHG testing in the 20MY+ timeframe.

SULEV30/Bin 30 Emissions: The aggressive cold start emission strategies that are needed to meet 2025MY SULEV30/Bin 30 fleet average emissions will be detrimental to CO_2/FE and should be considered in the Agencies' analysis.

Particulate Matter (PM) Standards: Certain powertrain technology and vehicle combinations may require gasoline particulate filters (GPFs) in order to meet the Tier 3 and LEV III 3 mg/mi PM standards. The CO_2 impacts of these components should be included in the Agencies' assessment. Additionally, the impact of a widespread GPF deployment across the fleet due to a pull-ahead of the LEV III 1 mg/mi standard into the 2022-2025MY timeframe - currently under consideration by CARB - should also be considered.

H. Modeling Methodology

The Draft TAR relies heavily on the modeling conducted separately by EPA and NHTSA. Our concerns are focused on the following issues. We will continue to analyze the models, inputs, and assumptions and provide greater input to the Agencies on our conclusions at a late date.

Accessibility of the Underlying Data: It has been difficult for manufacturers to assess the data underlying the Draft TAR analysis. Assumptions regarding technology effectiveness, technology bundle content, cost, and fleet penetration rates have been challenging to locate for assessment due to the structure of the EPA models. Without being able to clearly identify the inputs to the baseline and the contents of the technology bundles, the industry's ability to fully document all concerns and to provide comprehensive comments on the assumptions is limited at best. We will continue our efforts to obtain and review this data, and we will provide additional comments as appropriate beyond the designated 60-day comment period.

Accuracy of the Technology Assumptions: In the time permitted by the 60-day comment period, we have not been able to conduct the modeling runs needed to provide additional specificity on the overall magnitude of these disconnects on fleet

compliance. We will provide additional analyses and information as soon as it becomes available.

Lumped Parameter Model (LPM): As noted in the Alliance comments, the Agencies should rely on full vehicle simulation–not regression-based tools like the LPM–for their assessments. Quality and plausibility checks should also be applied.

III. Consumer Acceptance, Employment and Other Impacts

Consumer acceptance is a key aspect of the Midterm Evaluation; for the 2022-2025MY fuel economy and greenhouse gas standards to be successful, consumers must be willing to purchase a fleet of vehicles and technologies that will enable OEMs to comply with the standards. Consumers must be willing to pay for increases in vehicle price due to fuel economy technology. To do so, consumers must place value on fuel savings when deciding on their vehicle purchase and consider the benefits from reduced fuel consumption. When automakers do offer for sale a lineup characterized by extensive options for fuel efficient models and powertrains, the vast majority of consumers choose to value other attributes over fuel economy.

While the Agencies addressed consumer acceptance in the Draft TAR, additional analysis is needed to properly evaluate the feasibility of the 2022-2025MY standards. The Agencies concluded that they could not estimate how consumer acceptance would impact vehicle sales:

> *"The National Program light-duty vehicle standards… are likely to have had some effect on vehicle sales. We have not identified, however, any sound way to separately estimate the effect of the standards on sales."*[3]

As a result, the Agencies could not estimate key effects of the standards including a complete estimate of employment impacts; potentially reduced fleet CO_2 improvement due to slower fleet turnover and longer retention of older, inefficient vehicles; and impacts on used vehicle pricing and access to mobility. These unintended consequences may have a significant effect on the economy and on the effectiveness of the standards. Ford supports the Alliance comments on these issues. The Agencies also did not undertake a comprehensive analysis of the impacts of the standards on vehicle credit availability, focusing instead on niche "green loan" products and the ability of some consumers to carry a higher debt-to-income ratio.

Since the 2017-2025MY fuel economy and GHG standards were established in 2012, projections of future gas prices have decreased significantly, reducing the fuel savings available to offset the cost increases resulting from the standards. The Agencies did not adequately address the impact of reduced consumer payback periods, which increased to 5-6½ years relative to the assumptions in 2012. There is a disconnect between the payback periods projected under the 2022-2025MY standards and consumer willingness-to-pay. The Draft TAR notes the National Academy of Sciences' research finding that acceptable payback periods for consumers are in the range of 2-3 years and requested comment on consumer willingness-to-pay for fuel economy.[4] Further, the reduction in gas prices since the standards were established has major implications for consumer willingness-to-pay for fuel economy under the 2022-2025MY standards.

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[3] Draft TAR, p. 6-2
[4] Draft TAR, p. 6-7

Ford supports the comments on the Draft TAR submitted by the Alliance on consumer acceptance and employment. The Alliance addresses key issues related to consumer acceptance and employment including:

- Limitations of equating professional automotive reviews with consumer acceptance
- Further discussion on consumer payback periods
- Comments related to affordability, which evaluate household affordability of new vehicles and the limitations of financing to support additional vehicle price increases due to the standards
- Consumer valuation of fuel economy compared to other attributes of performance and value
- Disconnects between earlier rulemaking projections from the 2012-2016MY fuel economy and GHG standards and actual implementation of technologies across the industry to meet the standards
- Limited growth of electrified vehicle sales despite significant manufacturer incentives and price decreases supplemented by government incentives
- Impacts on employment due to reduction in vehicle sales as a result of higher prices driven by the standards

Ford met with the Agencies in November 2015 to discuss consumer acceptance topics informing the Draft TAR and provided confidential information regarding marketing research and economic impacts, including analyses around market price sensitivity and impact on sales. We will continue dialogue with the Agencies on these issues throughout the Midterm Evaluation process.

Ford offers comments on additional consumer acceptance issues below.

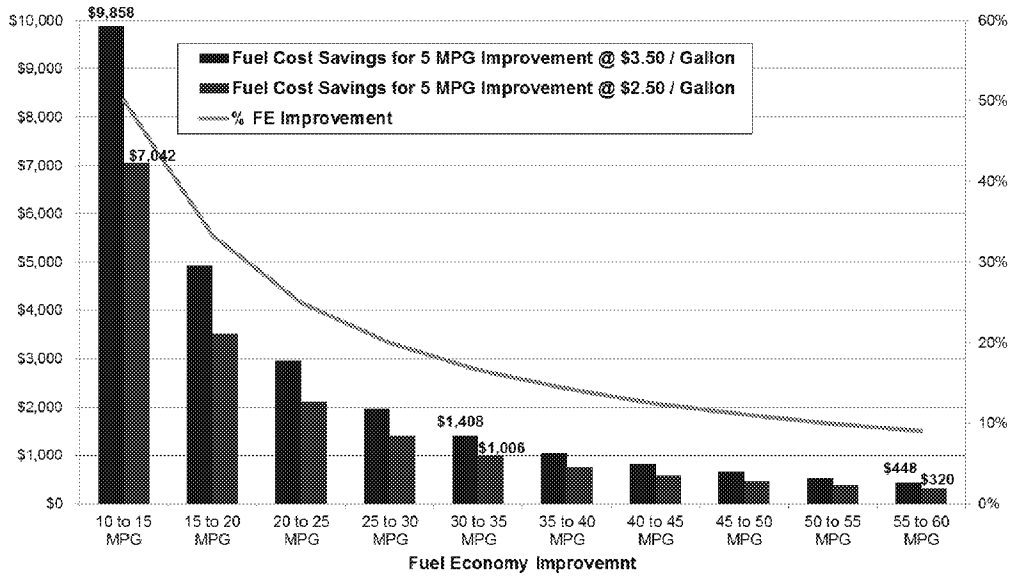
A. Consumer Expectations and Willingness-to-Pay for Fuel Economy

As Ford continues to bring competitive vehicles into the marketplace, we find that consumers are largely unwilling to pay for fuel economy technologies in and of themselves. The additional costs of such technologies must either be subsidized by the OEM, or there must be other incentives to persuade customers to purchase vehicles incorporating these technologies. Increased performance and/or functionality is often necessary to entice consumers to consider vehicles that have unfamiliar characteristics or features. Ford's recent experience bears this out:

- Ford introduced the all-new 2015 F-150 with a high-strength steel frame and high-strength, aluminum alloy body, which provided weight savings of up to 700 pounds compared to the previous generation. To improve competitiveness of the product and increase consumer acceptance of the new technology, Ford offered up to 1,100 pounds of increased towing capability and up to 530 pounds of increased hauling. Without these added benefits in vehicle performance, it is clear that consumers would not have accepted the new and unfamiliar aluminum body to the degree reflected by its strong sales numbers.
- Ford has sold more than 5 million vehicles with EcoBoost engines worldwide, including 1 million EcoBoost F-150 trucks in the U.S. since 2011. EcoBoost uses direct injection and turbocharging to offer improved engine performance and output for a given displacement – in most cases, EcoBoost engines have a smaller displacement than the base engine they

replace, offering both improved fuel efficiency and performance. The performance improvement has been a major factor in the consumer acceptance of this technology.

Ford's commitment to providing fuel efficient options to our customers is clear. However, as detailed more thoroughly in the Alliance comments, limited customer acceptance of advanced technologies – particularly at the lower than expected fuel prices we are experiencing in the United States – has made it challenging to market the more expensive technologies. For electric vehicles in particular, consumer acceptance is a challenge. Most consumers do not perceive that electric vehicles offer a performance or functionality benefit over conventional gasoline-powered vehicles. Factors such as driving range, the availability of charging stations at desired locations, charging times, and interior space, among other things, tend to steer many customers away from electrified vehicles. The potential for fuel cost savings is often not enough to overcome these perceived disadvantages. In addition, many customers may not understand EV technology, tax incentives may appear uncertain because they are not directly paid at the time of purchase, and there is a perception of high transaction prices. Furthermore, as we move to more stringent requirements, compliance costs will increase while at the same time, the value of incremental improvement decreases for the consumer with respect to fuel savings (Figure 8).



Assumes 6.5 years of ownership and 13,000 miles driven per year
Figure 8: Incremental Fuel Savings with Better Fuel Economy

Ford strongly encourages the Agencies to thoroughly assess the impact of the regulations on consumer acceptance, taking into account the multiple resources available assessing consumer interest and willingness-to-pay for fuel efficient technologies.

B. Dealership Experience with Electric Vehicle Customers Today (Sales and Service)

While not specifically referenced in the Draft TAR, concerns have been raised from time to time that manufacturers are not adequately marketing fuel efficient technologies in our dealerships. As this is likely to be a consideration in the Midterm Evaluation, Ford would like to provide the following comments regarding our active efforts to market and sell electrified products through our dealer network.

Ford's commitment to sustainability includes expansion of its certified electric vehicle (EV) dealership network in the U.S. in 2016 through an open enrollment process available to all Ford dealers. Certification includes facilities, trained sales and service personnel, designated EV Team leaders, charging stations, EV demo vehicles and inventory. We recently added a demonstration support program to encourage dealers to have vehicles available to test drive, as well as for customers' use and convenience when their vehicle is in for repair. This effort is another means to encourage potential consumers to appreciate the comfort, engineering, and ease of use of Ford EVs.

Providing online educational resources on EV products and technology aids both dealership personnel and customers in understanding product features and benefits prior to purchase. Ford supports our EV dealers with a full range of training opportunities. Learners can conveniently access all courses and job aids online. Beyond the EV, topics such as "Home Charging Solutions" and "How to Read the EPA Label" are included. Consumer research indicates that consumers interested in electrified vehicle alternatives extensively research online before coming to a dealership. Once they visit a dealership, they seek additional information from an EV-trained sales force. Our certified EV dealership network enables EV personnel to inform customers about our products.

In addition, trained EV staff provides personalized orientation to unique EV driver technologies—such as Smart Gauge and the MyFord Mobile app to enhance driving range, locate charging stations, and assess real-time power usage—which leads to more efficient driving behaviors and a more satisfying ownership experience.

C. Estimating the Impact of Higher Standards on Vehicle Sales

The impact of the standards on vehicle sales is a critical input needed to analyze many other effects of the standards, including impacts to employment, fleet CO_2, and the used vehicle market. To evaluate these impacts, it is important that the Agencies evaluate the impact on vehicle sales during the Midterm Evaluation. However, in the Draft TAR, the Agencies noted that:

> *"...it is difficult, if not impossible, to disentangle the effects of the standards on vehicle sales from the effects of macroeconomic or other conditions on sales."*[5]

[5] Draft TAR, p. 6-1

While it may be true that assessing the effects of the standards on sales is not a simple task, it is nevertheless an essential one in order to support a meaningful Midterm Evaluation process. Simply punting on this question is not an acceptable outcome. We request the Agencies to reassess this critical element, which really lies at the heart of the appropriateness of the standards. The sales effects bear not only on the economic impact of the standards on the automobile industry, but also upon the overall effectiveness of the standards themselves.

In addition to supporting the materials provided by the Alliance, citing from a recent Center for Automotive Research report, Ford is also preparing a data-driven analysis to demonstrate the potential impact of the standards on vehicle sales. We look forward to being able to present our analysis and describe the assumptions and results as we continue working through the Mid-Term Evaluation.

IV. Credits, Incentives, and Flexibilities

The 2017-2025MY Final Rule was designed with a wide range of optional compliance flexibilities to allow manufacturers to maintain consumer choice, spur technology development, and reduce compliance costs, while achieving significant GHG and fuel economy improvements. EPA projected that the standards would be met on a fleet-wide basis through a combination of reductions in tailpipe CO_2 and some use of the additional optional credit and incentive provisions in the regulations.

The current program flexibilities have resulted in increased implementation of technologies that reduce fuel consumption and GHG emissions that are not accounted for on the standard test cycle, and a broader implementation of advanced technology vehicles. The absence of these flexibilities could drive manufacturers to focus solely on improvements captured by the test procedures, resulting in the loss of opportunities for the reduction of on-road fuel consumption and GHG emissions.

Ford believes that these flexibilities need to be maintained and complemented with further actions to support the accelerated adoption of advanced technologies. These flexibilities are more fully detailed in the Alliance comments that we fully support and supplement with specific discussion on the following issues.

A. Air Conditioning System Credits

The Mobile Air Conditioner (MAC) credits are an important source of fuel consumption and GHG emission reduction. The program has proven to be effective by increasing the implementation rate of many MAC efficiency and leakage technologies that result in real world reductions that may otherwise not have been achieved. However, we believe improvements can be made to the implementation of this program, and we intend to continue to work with the Agencies to streamline the MAC efficiency testing requirements.

B. Off-Cycle Technology Credits

EPA has noted the importance of innovative technologies and encouraged the development of the off-cycle program that has resulted in significant on-road reductions of fuel consumption and GHG emissions. Ford supports the continuation of this program and its expansion to include technologies that were not considered in the original rulemaking. In addition, improvements are needed in the Agencies' approval processes to streamline the program and facilitate the rapid development and introduction of efficient technologies.

C. Incentives for Advanced Technology Vehicles

The multipliers for advanced technologies, including battery electric, plug-in hybrid electric, fuel cell, and natural gas vehicles were created as a method to spur the advancements of these technologies. Technology cost, national infrastructure availability, and customer acceptance has inhibited growth in the market share of these advanced technologies. Due to the slow growth in of sales of these technologies, Ford supports the continued application of the multipliers through 2025 to encourage investment and marketing of these vehicles.

D. Advanced Technology Incentives for Large Pickups

The Agencies recognized that the 2017-2025MY standards will be challenging for large vehicles, including full-size pickup trucks that are often used for commercial purposes. EPA and NHTSA included a per-vehicle credit provision for manufacturers that hybridize a significant number of their full-size pickup trucks, or use other technologies that comparably reduce CO_2 emissions and fuel consumption. The Agencies' goal was to incentivize the market penetration of "game changing" technologies for these pickups. Ford supports the continuation of the incentive and additionally requests that the Agencies consider modifying the program to help it more effectively promote advanced technologies. Specifically, Ford requests:

- The minimum penetration thresholds required for this program create a barrier and should be removed as was done with the off-cycle program.
- The credit levels should be updated for all incentives and extended through the 2025MY.

V. Increased Harmonization between CAFE and GHG Programs

Ford's support of the 2012-2016MY, and later the 2017-2025MY, CAFE and GHG standards was largely based on the harmonization of the EPA, NHTSA, and CARB requirements in order to ensure that a single fleet could be produced that was compliant with all regulations in all of our markets. However, there remains disharmony among the programs that has resulted in added complexity and cost in developing a compliant fleet. We therefore encourage the Agencies to support efforts to develop greater alignment within the standards.

The Alliance of Automobile Manufacturers and the Association of Global Automakers jointly petitioned for additional harmonization between the EPA GHG and NHTSA CAFE programs on June 20, 2016, and it is suggested that the Agencies review this petition for additional detail pertaining to the requests made. The actions requested are essentially technical amendments relating to inconsistencies, errors, or procedural issues with respect to the CAFE and GHG programs. They do not impact the stringency of the standards as originally intended, nor are they contrary to the underlying analyses upon which the standards were based. The petitioners requested the following harmonization actions:

- Include off-cycle credits in the CAFE calculation for 2010-2016MY
- Include air conditioning efficiency credits in the CAFE calculations for 2010-2016MY
- Apply the fuel savings adjustment factor across model years
- Apply the harmonized VMT estimates from 2017-2025MY to 2011-2016MY
- Revise NHTSA credit transfer definition to be more consistent with EPA
- Refrain from imposing unnecessary restrictions on the use of credits

- Adjust the CAFE minimum domestic passenger car standard to reflect the final standard applicable to each model year
- Correct the multiplier for BEVs, PHEVs, FCVs, and CNGs
- Provide an improved off-cycle credit approval process

VI. Conclusion

Ford Motor Company appreciates the opportunity to provide these supplemental comments and encourages the Agencies to continue dialogue with industry on key topics related to the Midterm Evaluation including technology cost and effectiveness, modeling, consumer acceptance, credits and flexibilities, and harmonization of the CAFE and GHG programs.