October 26, 2018

Environmental Protection Agency
EPA Docket Center (EPA/DC)
Air and Radiation Docket
Mail Code 28221T
1200 Pennsylvania Avenue NW
Washington, DC 20460
Attention Docket ID No. EPA-HQ-OAR-2018-0283

National Highway Traffic Safety Administration
Docket Management Facility, M-30
U.S. Department of Transportation
West Building, Ground Floor, Room W12-140
1200 New Jersey Avenue SE
Washington, DC 20590
Attention Docket ID No. NHTSA-2018-0067

Re: The American Iron and Steel Institute’s (AISI) Comments on the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks

Dear Sir/Madam:

Thank you for the opportunity to comment on the U.S. Environmental Protection Agency’s (EPA) and the National Highway Traffic Safety Administration’s (NHTSA) Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 (83 FR 42986) (August 24, 2018). AISI serves as the voice of the North American steel industry in the public policy arena and advances the case for steel in the marketplace as the preferred material of choice. AISI also plays a lead role in the development and application of new steels and steelmaking technology. AISI is comprised of 21 producer member companies, including
integrated and electric furnace steelmakers, located in 41 states, Canada and Mexico, as well as 120 associate members that are suppliers to or customers of the steel industry. The American steel industry employs more than 387,000 people and indirectly supports nearly two million jobs. Steel contributes more than $520 billion to the economy when considering the direct, indirect and related impacts. Approximately 27 percent of total U.S. steel shipments in 2017 were for the automotive industry. One of the key focuses of the industry’s work with automakers over the past several decades has been to collaborate on innovative steel grades that result in increased safety and lower mass that are cost-effective for the consumer.

Overview of Comments

We have reviewed the SAFE proposal and greatly appreciate the work that NHTSA and EPA have put into this rulemaking. We favor the general direction taken in the SAFE proposal, including the preferred option for fuel economy and greenhouse gas (GHG) emissions standards. We are also strong advocates of a One National Program approach, as we believe this is best for automakers, for the automotive supply chain including the steel industry, consumers, and for the economy as a whole, and we look forward to working with stakeholders to those ends. We believe that steel will continue to be a critical component for automakers to meet the final rule requirements.

An overly stringent standard that optimizes tailpipe-only GHG emissions and fuel economy enhancements to the exclusion of other necessary and important design factors would result in a host of negative outcomes. Under such a stringent regulatory standard, the compliance approaches that automakers are forced to apply in order to achieve marginal improvements in fuel economy/GHG reductions come with increasingly costly tradeoffs. Previous fuel economy/GHG regulatory actions have not always addressed these tradeoffs. However, a number of these tradeoffs, such as increased costs to consumers, safety design issues, and potential impacts on employment were discussed by EPA in the April 13, 2018 FR notice (Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles, 83 FR 16077). Further, the current SAFE proposal has benefited from a more complete consideration of the program’s goals and the tradeoffs associated with overly stringent fuel economy standards/GHG standards.

We oppose any standard that forces material substitutions for the purpose of lightweighting without a clear understanding of the tradeoffs or unintended consequences. We support the continuation and expansion of the existing flexibilities, in particular off-cycle credits which help to fully acknowledge the benefits of technologies and approaches that improve efficiency beyond what is measured in laboratory testing. The current SAFE proposal would scale back the stringency of the standards compared to those issued on January 12, 2017, based
upon the recognition that "(t)here remains no single technology that the majority of vehicles made by the majority of manufacturers can implement at low cost without affecting other vehicle attributes that consumers value more than fuel economy and CO2 emissions" (83 FR 42991). Further, there are a wide range of materials available right now for use by automakers for their given design purposes. We believe that any final SAFE regulation should be developed with full consideration of the potential tradeoffs associated with fuel economy/GHG requirements.

Therefore, EPA/NHTSA should:

1. Design the SAFE final rule understanding auto manufacturers' business models, such as component proliferation strategies, vehicle model mix, manufacturing infrastructure changeover time and global platform sharing;
2. Account for cost of ownership considerations in framing the SAFE final rule;
3. Account for safety design considerations in framing the SAFE final rule;
4. Account for potential employment considerations in framing the SAFE final rule; and
5. Consider the potential impacts of material substitution lightweighting on total GHG emissions in framing the SAFE final rule.

We respectfully submit the following comments addressing the iron and steel industry's specific interests with respect to the proposal.

1. EPA/NHTSA should design the SAFE rule final understanding auto manufacturers' business models, such as component proliferation strategies, vehicle model mix, manufacturing infrastructure changeover time and global platform sharing

The SAFE proposal details fuel economy/GHG standards for model years 2021-2026 light-duty vehicles that will fundamentally impact vehicle design choices generally, and specifically lightweighting options. Material selection is important in helping automakers achieve their performance goals ranging from the driver's experience to passenger safety to overall durability. These choices must all be balanced to meet the needs of the consumer at an affordable cost while protecting the environment. AISI would like to emphasize a few key points in its comments below that are critical to balancing the government's safety and environmental goals; the automakers' business and employment interests; and consumers' need for affordable personal transportation.

Comments to support this critical balance are centered on the understanding of the vast range of vehicles available to meet the array of consumer needs. To accomplish this,
automakers have many different strategies for delivering the best vehicle for each category of consumer needs. Automakers should be free to choose which materials support those strategies based on all data available to them as opposed to being directed towards higher-cost materials which may have unintended environmental consequences. A balanced review and presentation of automotive materials data will lead automakers to meet regulatory intent through implementing the best materials for the applications based on sound science and data.

We believe that the SAFE proposal’s options are based on a solid understanding of the nature of automaker vehicle design choices. For example, the mass reduction studies that had been employed in support of the Midterm Evaluation Draft Technical Assessment Report for Model Year 2022–2025 Light Duty Vehicle GHG Emissions and CAFE Standards (TAR) (81 FR 49217, July 26, 2016) were in general a collection of well-known mass reduction initiatives with a bias towards replacing steel with alternative lower-density materials, especially aluminum, as the easier route to achieving significant reduction in vehicle mass. Cost efficiencies derived from optimized material use and recycling and the optimistic projections of secondary mass savings and component resizing were erroneously assumed to offset the cost penalty associated with these materials. A comprehensive business case that includes component proliferation strategies, vehicle model mix, manufacturing infrastructure changeover time and global platform sharing considerations is necessary to understanding industry-wide responses under the fuel economy regulations. These critical aspects should be considered as detailed below to provide an unbiased picture of the materials available to help automakers make sound decisions to achieve the standards.

Since 1970, the steel industry has developed over 200 innovative new grades of steel. From conventional (mild) steel, to high strength, to advanced high-strength and now ultra high-strength steel, many of these innovative steel grades were designed in collaboration with automakers and specifically for the purposes of achieving new vehicle designs that meet regulatory requirements. Vehicle body structures,1 closures2 and chassis subsystems3 represent a considerable percentage of overall vehicle mass (more than 50 percent). It is, therefore, common for all vehicle mass reduction studies to aggressively pursue weight savings in these subsystems as the main source of primary vehicle mass reduction. Although all of the studies cited in the TAR may attempt to be as comprehensive and impartial as possible, it is evident they do not fully address the complexities embedded in auto manufacturers’ business models, such as component proliferation strategies, vehicle model mix, manufacturing infrastructure changeover time and global platform sharing strategies. Were these studies to guide the SAFE rule policy choices, the unintended consequence could be to force automakers into choosing

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1 Also known as body-in-white (BIW)
2 Hood, front fenders, side doors and rear closure (decklids, tailgates, liftgates, hatches)
3 Suspension components, frames and subframes
alternative materials that are both more costly and have the potential to drive overall GHG emissions higher (as discussed in point 5 below).

a. Body structures and closures

The design of vehicle bodies-in-white (BIW) and closures is not a stand-alone activity. Instead it is subject to a number of constraints often conflicting and requiring delicate negotiations across subsystems and organizations to achieve a balanced vehicle solution, including for example:

- The number of model derivatives off of the same platform and global platform sharing/manufacturing footprint including large variations in power trains (i.e., ICE, BEV, HEV);
- Component packaging (especially front motor compartment, such as engine, transmission, exhaust, compressor / radiator front module, battery, front headlamps, washer / wiper system);
- Occupant packaging and interior space;
- Exterior design and expressive styling cues;
- Regional performance targets within the particular vehicle segment (safety, strength, stiffness, durability, corrosion resistance and noise, vibration and harshness (NVH));
- Vehicle driving dynamics (0 – 60 mph, lateral acceleration, center of gravity, etc.); and
- Cargo capacity and towing.

While in one instance NHTSA acknowledges Honda’s manufacturing infrastructure constraints, (see TAR page 5-176), other studies typically use an existing vehicle as a surrogate for a purely technical investigation and disregard the first point regarding real world infrastructure constraints. While this may be in theory a reasonable approach, it does not appropriately address the capital and cost elements that are essential to any decision-making process that automakers face.

Based on a surrogate vehicle architecture and the corresponding performance targets, the approach to BIW and closures lightweighting can typically be categorized as follows:

- Efficient Design Principles (opportunity for mass and cost savings):
  - Vehicle derivative/bandwidth management;
  - Structural load-path optimization;
  - Structural section size and shape optimization;
  - Part consolidation/elimination;
  - Structural joint design efficiency;
o Removal of unstressed material; and
o Harvesting secondary mass savings (*where possible*).

- **Incremental changes to the manufacturing infrastructure** (*moderate mass savings at a minimum cost*):
  o Alternative joining technologies; and
  o Re-balancing content of body shop sub-assembly stations.

- **Material substitution and manufacturing system redefinition** (*potential for high mass savings with significant increase in capital, material cost and structural cost*):
  o Low-density materials (aluminum, magnesium and carbon fiber reinforced plastic (CFRP)); and
  o Associated changes in existing manufacturing infrastructure to functionally integrate new materials.

b. **Efficient design principles**

The studies included in the TAR adopted efficient design principles, which are independent of material selection, as the cornerstone of BIW lightweighting. This approach has been demonstrated in recent product launches (see General Motors examples, TAR page 5-377) where increases in the use of advanced high-strength steel (AHSS) in the BIW and closures coupled with the efficient design principles enabled significant vehicle mass reduction with no increase in material or structural cost and no appreciable disruption to the existing manufacturing infrastructure.

The FutureSteelVehicle (FSV)* was a three-year program, completed in 2011 by WorldAutoSteel*®, which developed fully engineered, steel-intensive body structure designs for electrified vehicles that reduce mass by more than 35 percent over a 1994 sedan benchmark. With that level of mass reduction and considering that the body structure typically comprises approximately 22-25 percent of the vehicle curb mass, it is clear that an overall vehicle mass reduction of over 7 percent, the target identified in the TAR, from baseline is achievable using AHSS. This is accomplished while meeting a broad list of global crash and durability requirements, enabling five-star safety ratings, while avoiding high-cost penalties for mass reduction and the unintended consequence of driving materials production GHG emissions

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5 WorldAutoSteel is the automotive group of the World Steel Association.
higher. The FSV body structure was constructed using more than 97 percent high-strength steel and AHSS (approximately 50 percent gigapascal (GPa) steels). This translated into a body structure with an average tensile strength of approximately 790 megapascals (MPa). This compares favorably to the 429 MPa average tensile strength of the best-in-class 2013 Cadillac ATS\(^6\) AHSS intensive body structure. As such, there are continued opportunities for AHSS applications to meet and exceed the weight reduction goals spelled out in the TAR.

A recently published study by WorldAutoSteel\(^7\) on statistical mass benchmarking, concludes that there still is considerable opportunity for the application of “Efficient Design Principles” even in current production vehicles to realize mass reduction without resorting to overly costly materials. The study also demonstrates that when compared to efficient steel designs, the aluminum mass savings advantage is reduced considerably. In fact, on a vehicle-level basis, the margin in vehicle-curb weight between vehicles with steel structures and those with aluminum structures was narrow.

The data showed that while aluminum body structures can reduce curb weight by 9.3 percent compared to average steel structures, current efficient steel structures reduce vehicle curb weight by 6.5 percent compared to the same average steel structures, closing the gap with aluminum to just 2.8 percent. It is expected with the introduction of higher strength and ductility third generation steels, this gap will continue to close. The agencies, therefore, should ensure that information employed in regulatory decisions reflects these real world achievements and does not inadvertently steer auto manufacturers towards alternative materials but remain neutral on material selection for achieving the standards.

c. Secondary mass savings

Secondary mass savings are one element of efficient design principles, and studies cited within the TAR rely on it to:

- Offset, at a vehicle level, the cost of considerably more expensive low-density materials; and
- Increase the overall vehicle mass reduction potential.

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While secondary mass savings are theoretically possible and can lead to mass de-compounding,8,9 in reality they are subject to practical limitations such as:

- Availability of the exact desired component size at every percent mass reduction breakpoint; and
- Meeting specific vehicle attributes within its segment.

A better alternative, mentioned briefly in Section 5.2.7.3 of the TAR (see TAR pp. 5-165), would be to start the vehicle program by “right-sizing” vehicle components during the planning phase. This approach works well for clean-sheet vehicle architectures and does not inappropriately drive the use of alternate low-density materials (e.g., 2017 GMC Acadia).

d. Mixed material design solutions

Mixed material BIW design solutions are performance-driven aggressive optimization studies drawing on a full material palette10 to place the right material in the right location for optimum mass reduction (TAR Section 5.2.7.4.5 pp. 5-187, Department of Energy/Ford/Magna MMLMV research project). Manufacturing infrastructure complications and the related capital investment increases are often mentioned with little detail in the TAR.

One cannot underestimate the practical challenges associated with such solutions specifically from a dissimilar material joining and isolation perspective. One additional issue that is seldom addressed is repair procedures (in-plant or aftermarket). To avoid the aforementioned difficulties, the majority of auto manufacturers historically have opted to use alternate low-density materials for mass reduction only in bolt-on subsystems (e.g., chassis and closures).

The TAR does not cover auto manufacturers’ infrastructures and time to change over manufacturing, body shops and paint shops (which would entail a significant cost to upgrade). The costs in the TAR are process-driven technical cost models and do not represent a comprehensive business case. AISI believes a more comprehensive review of these costs and implications is necessary to adequately inform the final standards.

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10 E.g., mild steel, high-strength steel, AHSS, ultra-high-strength steel, aluminum, magnesium and carbon fiber reinforced plastic.
2. EPA/NHTSA should carefully account for cost of ownership considerations in framing the SAFE final rule

In the SAFE proposal, EPA/NHTSA expresses a strong preference for establishing a final fuel economy/GHG requirement that considers costs to consumers. “Even when used in combination, technologies that can improve fuel economy and reduce CO2 emissions still need to (1) actually work together and (2) be acceptable to consumers and avoid sacrificing other vehicle attributes while also avoiding undue increases in vehicle cost.” (83 FR 42991) The impact of fuel economy/GHG standards on the cost of vehicles impacts automakers’ choices and consumers’ purchasing decisions. “Automakers, who must nonetheless continue adding technology to improve fuel economy and reduce CO2 emissions, will either sacrifice other performance attributes or raise the price of vehicles—neither of which is attractive to most consumers.” (83 FR 42992)

Significant lightweighting with aluminum and other alternate materials results in increased costs to consumers throughout the life of the vehicle and does not return commensurate benefits. This includes higher costs on average for the vehicle at the point of purchase, higher auto insurance rates, and higher repair costs. Expectations are that insurance premiums for trucks will increase as they do for sedans when comparing aluminum- to steel-intensive bodies based on increased purchase and repair costs.

a. Consumer costs: purchase price

The Steel Market Development Institute (SMDI), a business unit of AISI, adapted data from an analysis performed by NHTSA on mass reduction for a midsize sedan for light-duty vehicles for Model Years 2017-2025, issued in Aug 2012. The results of that work, displayed in Table 1 below, show that while use of aluminum, magnesium and carbon fiber could decrease average vehicle weight by 137 kg and increase fuel economy by 0.6 mpg over design with advanced high strength steel, it came at an increased manufacturing cost of $2,680 per vehicle. Based on an average of 15,000 miles per year and gas price of $3.89 per gallon (highest rate in US in October 2018), it would take 18, 35 and 76 years respectively to make up for material cost differences in each of the lightweighting scenarios. This is, obviously, much longer than the average life of a vehicle, which is approximately 12 years on average.
Lightweighting with steel provides the highest value to the auto manufacturers and therefore to the consumer. This point is highlighted in the cost analysis in the updated EDAG study on the 2011MY Honda Accord\textsuperscript{11} (baseline, see Exhibit 1 below). As shown in the figure, Option 1 maximizes use of AHSS in the body structure and closures to achieve a 19 percent lighter vehicle for 0.39 $/kg. Options 2, 3 and 4, which involve increasing amounts of aluminum and other alternative materials, show a much less effective and more costly $/kg for the percent mass reduction achieved.

b. Consumer costs: maintenance, repair and insurance

On insurance costs, data indicate that insurance premiums for trucks will increase in a manner similar to premium costs for sedans when comparing aluminum- to steel-intensive bodies based on increased purchase and repair costs. According to a report from the Insurance Institute for Highway Safety (IIHS) (July 30, 2015), total repair costs were 26 percent higher for the aluminum F-150 pickup, in line with claims for other vehicles with high-aluminum content. The report indicated that extra time and higher part costs contributed to higher costs. As noted in the report, aluminum body repair requires a separate bay and tools to avoid cross-contamination that leads to corrosion, an investment of approximately $100,000. Additional training also is needed to perform proper repair. Data indicate that fewer than five percent of shops were certified for aluminum body repair in 2016.

Forcing material substitution in vehicle design harms automakers by negatively influencing consumer attitudes toward lightweighted vehicles. A 2018 study performed by Lab42, a quantitative market research firm, found that overwhelming majorities of consumers do not believe that aluminum is as durable (87 percent), strong (90 percent) or safe (91 percent)
as steel. Additionally, more than half of consumers in the study say that replacing steel with aluminum will negatively impact their opinion of an automotive brand. In total, 43 percent said that they are less likely to purchase or lease from an automaker replacing steel with aluminum in vehicles. Findings like these place automakers in a very difficult position: when the standard is overly stringent, they are forced to comply through all means available, and yet when material substitution is the only approach available, it goes against consumer preferences and thus will likely negatively impact sales.

In Chapter 10 of the TAR, the agencies address the Economic and Other Key inputs. In section 10.11, the impact to maintenance, repair and insurance was reviewed.

Repair costs are those costs that are unexpected and, as such, occur randomly and uniquely for every driver, if at all. Examples of repair costs would be parts replacement following a crash or a mechanical failure, etc. (See TAR page 10-55)

In fact, the average collision repair costs will have an impact on the yearly vehicle insurance costs, with an initial cost estimate of $396 in 2010 dollars (TAR page 10-56). Analysis of a report by NHTSA\textsuperscript{13} that compares insurance costs across vehicle types indicates there is a substantial difference in insurances costs for a steel-intensive versus an aluminum-intensive vehicle.

Using available data and comparing values to 100, which represent the average of the entire U.S. vehicle population within the report, the following calculations were completed.

\textbf{i. Large luxury car}

Average costs for the entire segment are 46 percent higher than the average at a value of 146. The aluminum-intensive vehicles within the class, however, have an average value of 228 (56 percent higher than the entire class).

\textbf{ii. Very large luxury car}

Average costs for the entire segment are 89 percent higher than the average at a value of 189. The aluminum-intensive vehicles within the class, however, have an average value of 298 (35 percent higher than the entire class).

\textsuperscript{13} NHTSA, Comparison of Differences in Insurance Costs for Passenger Cars, Station Wagons, Passenger Vans, Pickups and Utility Vehicles on the Basis of Damage Susceptibility, June 2014.
c. Cost of mass reduction in the RIA

As discussed, the cost to consumers of new vehicles plays a key role in the overall structure of the SAFE proposal. Additionally, mass reduction plays an important part in automakers compliance strategy in meeting the fuel economy/GHG requirements set out in the rule. EPA/NHTSA’s analysis of the costs of mass reduction is therefore worth careful review. If the costs for mass reduction are underestimated in the analysis, it would result in an overly optimistic picture of the role of material substitution lightweighting in meeting the standards. These points argue for a final SAFE rule that considers costs accurately in establishing a standard balanced with the other objectives of the program.

AISI believes the approach to assessing mass reduction costs, as described in Sec. 6.3.10.1.1 (Page 385) of the Preliminary Regulatory Impact Analysis (RIA)\textsuperscript{14}, results in an underestimation of these costs. The approach is much improved over the original linear relationship (especially with 20 percent mass reduction at less than $1.00/kg saved in the original study) (see page 390 of the RIA). However, for a number of reasons, the analysis approach is still not realistic.

- Generally, a teardown study (i.e. Honda Accord or Chevy Silverado) should not be generalized across all passenger car or all light duty truck segments, respectively.
  The 2015 NAS study\textsuperscript{15} in Finding 6.9 states:
    - “… the committee recognizes the limitations of vehicle-specific studies when used to estimate costs across the entire fleet, or even across a vehicle class. The vehicle model selected for the analyses will have a large impact on the opportunities for mass reduction. Factors such as the substantial differences in the starting point of vehicle models, the varied materials in current designs, and individual business considerations—such as global platforms and maintaining vehicle NVH—mean that such studies must be supplemented with other analysis. There is high potential for misinterpretation of the cost estimates resulting from these vehicle specific studies if they are applied to other vehicle designs in a general fashion, and this potential is much greater for mass reduction techniques than it is for other types of technologies.” pg. 242


Figure 1, below, from a September 2016 Center for Automotive Research (CAR) report\(^{16}\) graphically depicts the same finding. This chart shows the increasingly steep costs for mass reduction as the reduction percentage goals increase.

- The aluminum cost per kg saved for body structure and closure components (except for hoods) is an underestimate. Underestimation of these costs usually results from:
  - Overestimating mass reduction (e.g., RIA, Table 6-37, Page 393, 52 percent mass reduction for a decklid and 44 percent for side closures is ambitious, and likely not with added trim for acoustics), and/or,
  - Underestimating material & manufacturing costs.

- As a general rule, the assumptions employed in the RIA for a clean sheet approach of a completely new architecture using current infrastructure are not realistic.

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3. EPA/NHTSA should carefully account for safety design considerations in framing the SAFE final rule

A strict fuel economy/ GHG standard that forces lightweighting through material substitution also has impacts on vehicle design with respect to overall vehicle safety. The steel industry’s collaboration with automakers over the years has resulted in a sizeable number of advanced high-strength steels that aid auto design, allowing for safety as well as mass reduction. Steel provides more efficient designs through thinner sheet and section geometry as a result of its high strength and modulus (which is a measure of the material resistance to deformation). The higher strength of steel allows for thinner sheet and smaller geometry section of steel designs over competing aluminum designs.

Two such examples (Figures 2 and 3 below) are the Honda Accord A-pillar and B-pillar, which are 20 percent thinner than the previous steel model, increasing driver sightlines by 7.9 degrees; an aluminum section would need to be larger by comparison.17 These design factors fit nicely into the SAFE proposal’s strong focus on improved safety at lower cost in order to see increased fleet turnover.

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4. EPA/NHTSA should carefully account for potential employment considerations in framing the SAFE final rule

A regulatory standard that forced increased use of aluminum over steel as a compliance approach would likely have significant negative impacts on employment. Steel production is largely U.S.-based, while primary aluminum production has shifted outside the U.S. to a significant extent (more than 80 percent\textsuperscript{18}). Thus, under such a regulatory scenario, there likely would be secondary impacts on employment in the U.S. The lower demand for automotive steel resulting from the regulatory requirements would mean lower U.S. employment in the steel industry. While, the anticipated increase in use of automotive aluminum would be reasonably expected to increase aluminum production, such an increase in aluminum production would largely result in an increase in jobs outside the U.S. where the aluminum production occurs.

The SAFE proposal notes, “The analysis did not consider how direct labor changes may affect the macro economy and possibly change employment in adjacent industries. For instance, the analysis did not consider possible labor changes in vehicle maintenance and repair, nor did it consider changes in labor at retail gas stations. The analysis did not consider possible labor changes due to raw material production, such as production of aluminum, steel, copper and lithium, nor did the agencies consider possible labor impacts due to changes in production of oil and gas, ethanol, and electricity.” (83 FR 43078)

We believe this omission in considering potential impacts could be significant if a stringent standard forced material substitution light weighting. “If the value of fuel savings to the new vehicle buyer falls short of the cost of mandated fuel economy technologies, then U.S. automotive sales, production, and manufacturing employment will fall with serious consequences for the U.S. economy.”\textsuperscript{19} Since consumers cannot recover the extra purchase price in a vehicle by saving at the gas tank, they are less likely to purchase a more expensive vehicle. Therefore, consumers may not replace their vehicle as often, thus lowering annual vehicle sales. A shift from steel to aluminum would surely cause ripple effects in employment throughout the supply chain.

5. **EPA/NHTSA should consider the potential impacts of material substitution lightweighting on total GHG emissions in framing the SAFE final rule**

   a. **Importance of material production emissions**

   The Steel Market Development Institute (SMDI), a business unit of AISI, determined in its peer-reviewed study, “Life Cycle Greenhouse Gas and Energy Study of Automotive Lightweighting” (2017) (hereinafter referred to as the “Auto GHG Study”) that the GHG emissions associated with automotive materials manufacturing are significant, particularly in the context of vehicle lightweighting through material substitution to improve fuel economy/GHG reductions.

   Vehicles today are manufactured using a variety of materials, including steel, aluminum, magnesium, plastics and composites, each having their own documented and verifiable GHG emissions intensity (see Figure 4). The data presented in Figure 4 are for North American primary production through slab for steel and through ingot for aluminum. Such emissions are known, measured and verified, similar to tailpipe emissions.

   ![Figure 4. Cradle-to-Gate GHG Emissions of Primary Material Production (in kg CO₂eq/kg material)

   Note: Steel, aluminum and magnesium values do not include finishing emissions. CFRP automotive parts are formed via an integrated process, which includes both production and finishing.](image)

   Sources:
In both the steel and aluminum industries, the processes used to produce primary metal are mature and well-controlled. While improvements in their energy intensities will continue to occur, the relative difference (between steel and aluminum production) is expected to remain approximately the same. This is seen in two recent U.S. Department of Energy (DOE) studies, *Bandwidth Study on Energy Use and Potential Saving Opportunities in US Iron and Steel Industry (June 2015)* and *Bandwidth Study on Energy Use and Potential Saving Opportunities in the Manufacturing of Aluminum (March 2016)*. These studies conclude that the energy savings potential, on a percentage basis, in each sector is almost the same. While the difference in energy intensity of steel and aluminum production (primary aluminum is seven to eight times more energy-intensive than steel, according to energy intensity values published by The Aluminum Association\textsuperscript{20} and the World Steel Association\textsuperscript{21}) is likely to remain the same, the emissions intensity of primary aluminum used in North American vehicle production is expected to increase as described below.

The Aluminum Association reports primary aluminum production GHG emissions intensity (8.9 kg CO\textsubscript{2}eq/kg) in North America is very good compared to the global average (16.5 kg CO\textsubscript{2}eq/kg from the International Aluminum Institute representing global average emissions, including China) largely due to the proximity of North American smelters to sources of hydropower. Nevertheless, some North American smelters have closed as aluminum companies seek lower cost primary material. This accelerates the increase in GHG emissions, as the likely sources of imported aluminum ingots are regions of the world where smelting is powered by fossil fuel-generated electricity, not hydropower.\textsuperscript{22}

The Auto GHG Study examining GHG emissions for various vehicle types and powertrains found that intensive use of aluminum to lightweight vehicles can result in higher life cycle GHG emissions of up to 9 percent (or up to nearly 18 percent for battery electric vehicles). This use of aluminum also results in higher production-phase GHG emissions of up to 24 percent (or up to 65 percent for battery electric vehicles), with the production emissions occurring before the vehicles are ever driven. Furthermore, as vehicles become increasingly more fuel-efficient and alternative powertrains with zero tailpipe emissions gain higher market share in the future, the importance of the materials from which they are constructed and their influence on total vehicle emissions becomes greater.


b. EPA/NHTSA already considers non-tailpipe GHG sources in other aspects of the light-duty vehicle program

Under the current light-duty vehicle standards, the agencies have already taken into account the impact of GHG emissions from sources other than the vehicle’s tailpipe. In some instances these considerations have allowed auto manufacturers to account for GHG savings such as:

“GHG impacts from several sources including: (a) the impact of the standards on tailpipe CO2 emissions, (b) projected improvements in the efficiency of vehicle air conditioning systems, (c) reductions in direct emissions of the potent greenhouse gas refrigerant HFC-134a from air conditioning systems, (d) ”upstream” emission reductions from gasoline extraction, production and distribution processes as a result of reduced gasoline demand associated with standards...” (See TAR page 12-48)

In other instances the agencies have looked at the “upstream” or non-use phase impacts as potentially increasing emissions:

“’Upstream’ emission increases from power plants as electric powertrain vehicles are projected to increase slightly as a result of the MY2022-2025 standards. EPA additionally accounted for the greenhouse gas impacts of additional vehicle miles traveled (VMT) due to the ’rebound’ effect discussed in Chapter 10.” (See TAR page 12-47)

AISI also submitted comments on the proposed 2012 light-duty vehicle rulemaking highlighting the importance of considering the impact of materials-phase production emissions in the final standard. In its response to comments, EPA recognized that its proposed and ultimately final standard did not incorporate emissions outside the use phase, reasoning that such emissions were relatively small in comparison to those generated in the use phase.

“EPA recognizes that there are GHG emissions associated with vehicles beyond those emitted during vehicle operation or the ‘use’ phase, including emissions from component and vehicle manufacturing and end-of-life disposal. ... The GHG standards we are finalizing for MY2017-MY2025 do not incorporate vehicle manufacturing or end-of-life emissions. We agree with comments by the American Chemistry Council and the Society of the Plastics Industry, Inc. that these emissions are typically small relative to
GHG emissions from vehicle operation, and therefore regulating emissions from the use phase is an effective method for reducing GHG emissions from vehicles."

Since the light-duty vehicle standards went final in 2012, however, AISI has conducted a closer review of how significant these emissions really are in the Auto GHG Study referenced above. As the study demonstrates, the production phase emissions range from 11 percent up to 65 percent of the actual emissions from the tailpipe. The higher range comes from battery electric vehicles, as EPA anticipated in the 2012 rule.

"[W]e acknowledge the point made by other commenters that the relative significance of manufacturing emissions, and other non-use phase emissions, will increase as vehicles’ fuel economy improves over time. Some advanced vehicle technologies and materials designed to reduce GHG emissions at the tailpipe may also be more energy and carbon intensive to manufacture than conventional vehicles and result in vehicle production accounting for a higher fraction of total life-cycle GHG emissions (e.g., electric vehicles powered by a low-carbon grid or certain lightweighting materials)."

Further, EPA did not anticipate a high penetration of carbon-intensive lightweighting materials into the automobile market in its 2012 final rule. However, according to a study conducted by Ducker Worldwide for The Aluminum Association in 2017, the North American annual demand for aluminum sheet used in auto body and closure parts is expected to increase from approximately 500,000 tons in 2015 to nearly 2.4 million tons by 2028. If this aluminum increase occurs as projected by Ducker, consideration of the full vehicle life cycle would likely result in an increase in total vehicle GHG emissions as compared to the reduced total GHG emissions that would result from lightweighting the same vehicle fleet through use of AHSS.

The data produced in the Auto GHG Study demonstrate that despite EPA’s conclusion in the 2012 final standards, production emissions are significant currently, even when compared to actual emissions from vehicle operation. It is also clear from the current regulations that the

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25 See EPA Response to Comments at p. 14-20 (stating “the agencies believe that manufacturers will be able to meet the MY2017-2025 GHG standards through a combination of technologies, without relying on a level of mass reduction that requires a high penetration of these lightweighting materials.”)
agencies have extended consideration of emissions from outside the use phase and could do so here for production emissions. Finally, as demonstrated above, production phase emissions become even more important if vehicle fuel efficiency improves. Therefore, continuing to ignore this phase of a vehicle’s life puts the overall effectiveness of the light-duty vehicle standard in achieving a net reduction of GHGs into question.

The importance of life cycle thinking in the automotive sector is increasingly acknowledged around the world. Here are some recent examples. On October 3, 2018, the European Parliament recognized need for life cycle thinking in automotive legislation and may formally adopt this position in the near future. In addition, Carla Bailo, President and CEO of the CAR, made comments during her keynote presentation at the Lightweighting World Expo (October 10, 2018) on the importance of Life Cycle Assessment (LCA). As CAR is an independent, non-profit, research organization, and therefore an important unbiased voice within the automotive industry, her comments will reach the OEMs, the supply base, government (federal, state and local), NGOs and academia.

c. Recycling will not significantly reduce the use of primary aluminum

The mechanism of recycling steel and aluminum alloys is different because of the atomic structure of the materials. Steel is magnetic, and in molten form in the presence of oxygen, most alloying elements will separate from iron to bond with oxygen, creating a slag that is easily removed and a molten base material that can be re-alloyed to the same or another steel grade. Aluminum is not magnetic, and its atomic structure is such that alloying elements are not extracted by the introduction of oxygen. As there is no path to return aluminum grades to a “base aluminum” from which they can be re-alloyed to another grade, aluminum grades must be either meticulously recycled to the same grade, diluted by mixing scrap with large amounts of primary aluminum or down-cycled. This is an important consideration in the automotive sector.

There are many steel grades used in automobiles. Scrap steel is collected in the stamping plant when parts are made, known as prompt scrap and also collected at the end of a vehicle’s life when the vehicle arrives at an automotive dismantler. The non-metallic contents (e.g., seats and fluids) are removed and the steel, due to its magnetic properties, is easily separated by magnet and shredded for purchase by scrap dealers and then sold to a steel plant for recycling. A mature recycling infrastructure, operating for decades, accomplishes these tasks.

27 https://www.lightweightingworldexpo.com/
Yield losses in automotive manufacturing are 30-50 percent dependent on part geometry and processing. Therefore, prompt scrap in these amounts is available for both steel and aluminum. For automakers to get the highest value from their aluminum scrap, they must invest in equipment to collect and separate aluminum scrap for it to be recycled into aluminum automotive sheet. Otherwise, aluminum sheet alloys will be mixed along with castings and extrusions and will be downgraded in future applications, whereas steel can be mixed and recycled into any of the automotive steel grades as described above.

The case at the vehicle’s end-of-life is much different and accounts for 65-70 percent of the remaining original body sheet materials since vehicles go to automotive dismantlers at end-of-life and do not return to automakers. Automotive dismantlers are already well-prepared to handle steel due to the ease of separation from other materials resulting from steel’s magnetic nature. It remains to be seen whether automotive dismantlers will invest in the equipment needed to collect and separate aluminum grades for recycling, which cannot be separated with magnetic equipment, or whether automotive aluminum sheet will be simply blended together with aluminum engine and suspension parts and processed together or down-cycled. For this reason, the quantities in which the majority (65-70 percent) of automotive aluminum sheet will be recycled are uncertain. This means the majority of automotive aluminum sheet will be supplied from primary production, which is increasing in its average emissions intensity due to reliance on increased imports, for many years to come.

A more recent study by SMDI titled “Consequential Life Cycle Greenhouse Gas Study of Automotive Lightweighting with AHSS and Aluminum” considers the timing of emissions during the vehicle life cycle. This study demonstrates that the production of aluminum used in vehicles results in significant GHG emissions that occur before the vehicle is ever driven. The science on timing of emissions is well-studied (e.g., Kendall, et al., 2012) with emissions occurring earlier in time (e.g., production emissions) having greater environmental impact. In the TAR, the National Research Council states:

“Because CO₂ in the atmosphere is long-lived, it can effectively lock Earth and future generations into a range of impacts, some of which could become very severe. Therefore, emission reduction choices made today matter in determining impacts experienced not just over the next few decades, but in the coming centuries and millennia.” (TAR page 1-13)
Conclusion

For the reasons stated above, we favor the general direction taken in the SAFE proposal, including the preferred option for fuel economy and GHG emissions standards. We believe a final SAFE rule that balances the priorities of costs to consumers, safety design considerations, employment impacts and total GHG emissions will result in the best outcome. We are strong advocates of a One National Program approach, as we believe this is best for automakers, for the automotive supply chain including the steel industry, consumers, and for the economy as a whole, and we look forward to working with stakeholders to those ends. We hold that steel will continue to be a critical component for automakers to meet the final rule requirements.

Thank you for your consideration of the above comments. AISI and its members are committed to working with EPA and NHTSA to implement sound and effective regulations that are consistent with the goals of the CAFE and GHG standards.

Respectfully submitted,

[Signature]

Thomas J. Gibson
President and CEO