American Chemistry Council
Statement for the Record
House Energy & Commerce Committee
Subcommittee on Consumer Protection and Commerce
Subcommittee on Environment and Climate Change
"Driving in Reverse: The Administration's Rollback of Fuel Economy and Clean Car Standards"
June 20, 2019

The American Chemistry Council (ACC), including its Plastics Division, appreciates the opportunity to comment on the House Energy & Commerce Committee hearing entitled, "*Driving in Reverse: The Administration's Rollback of Fuel Economy and Clean Car Standards.*"

BACKGROUND

ACC is a national trade association representing U.S. companies that manufacture chemistry and plastics. American chemistry is an innovative $768 billion enterprise that plays a critical role in delivering a sustainable future through resource and fuel efficiency, material innovation, and continuous improvement in our products and operations. Last year alone, America's chemistry industry spent approximately $91 billion in research and development to support innovation in a variety of fields, including energy, food, health and water.

The business of chemistry creates over 811,000 U.S. manufacturing and high-tech jobs, and six million related jobs that support families and communities. This includes the manufacturing of lightweight plastics and polymer composites used by the transportation industry. Every day, plastics and polymer composites help deliver cleaner air and water, safer living conditions, efficient and affordable energy sources, lifesaving medical treatments and safe, and innovative lightweight vehicle solutions.

Automotive plastic and composites provide countless innovative lightweight solutions, including reconfigurable flexible interiors for autonomous vehicles, antimicrobial self-cleaning surfaces for fleet and ride share vehicles, interior and exterior lighting and important safety features such as back-up cameras and air-bags. Lightweight plastic and polymer composite auto parts comprise over 50 percent of a vehicle's material volume, but less than 10 percent of its weight. Beyond plastic and composites, chemistry enables a multitude of vital vehicle innovations, including synthetic rubber for improved air retention over the life of the tires, adhesives and sealants for multi-material joining, lubricants for improved engine performance and batteries for vehicle electrification. Virtually every component of a lightweight vehicle, from the front bumper to the rear tail-lights, is made possible through chemistry.

Polymer composites are a combination of tough plastic resins that are reinforced with glass, carbon fibers and other materials. These materials often weigh far less than traditional automobile materials, yet maintain high levels of strength and a high resistance to corrosion. These materials provide an economical way to lightweight vehicles while preserving important safety features and consumer preference through improved design flexibility. Additional properties of plastic and composites, including strength to weight ratio and excellent energy absorption, make these materials especially well-suited for the design and manufacture of light-duty vehicles.

THE ROLE OF PLASTIC AND COMPOSITES IN LIGHT-DUTY VEHICLES

ACC applauds the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) for their efforts to create a harmonized, sustainable and safe highway transportation platform in the United States. However, we strongly disagree with the conclusory statements in the Notice of Proposed Rulemaking (NPRM) "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks" issued on August 24, 2018 that the choice of "relatively cost-effective technology option of vehicle lightweighting…will increase on-road fatalities."[1] These public comments provide the Agencies with feedback and data to support a final rulemaking that reflects the robust scientific governmental and industry research regarding how lightweight plastic and composite auto parts can be used as a tool to improve fuel economy while maintaining safety.

The lightweigting of vehicles by manufacturers has, and will, continue to spur innovation, growth and competition in the U.S. automotive industry to meet consumer demands for stylish and safe vehicles. ACC supports these efforts and the Agencies' recognition of lightweight plastic and polymer composite technologies, as a compliance tool for auto manufacturers to make vehicles more fuel efficient. Among other numerous benefits, automotive plastics and composites play an important role in improved safety, improved design, mass reduction, aerodynamic improvement, electrification and autonomous deployment and optimized component integration.[2] Utilizing plastic and composites within the global automotive industry follows well-documented trends of polymer usage to economically reduce mass and increase efficiency in the civilian and military aerospace industries. Choosing plastic and polymer composites to reduce mass in light-duty vehicles is a decision supported by science that can pay immediate and long term economic and environmental dividends.[3]

In the NPRM, the Agencies propose to maintain the CAFE and CO2 standards applicable in model year (MY) 2020 for MYs 2021-2026. ACC supports a harmonized national standard that continues to recognize vehicle lightweighting as a safe and feasible strategy to achieve improved fuel efficiency, including techniques for improved design, aerodynamic drag improvement, and optimized component integration. This is an area where lightweight plastic polymer composites

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[1] NPRM, 83 Fed. Reg. 42986, 42991 (Aug. 24, 2018).

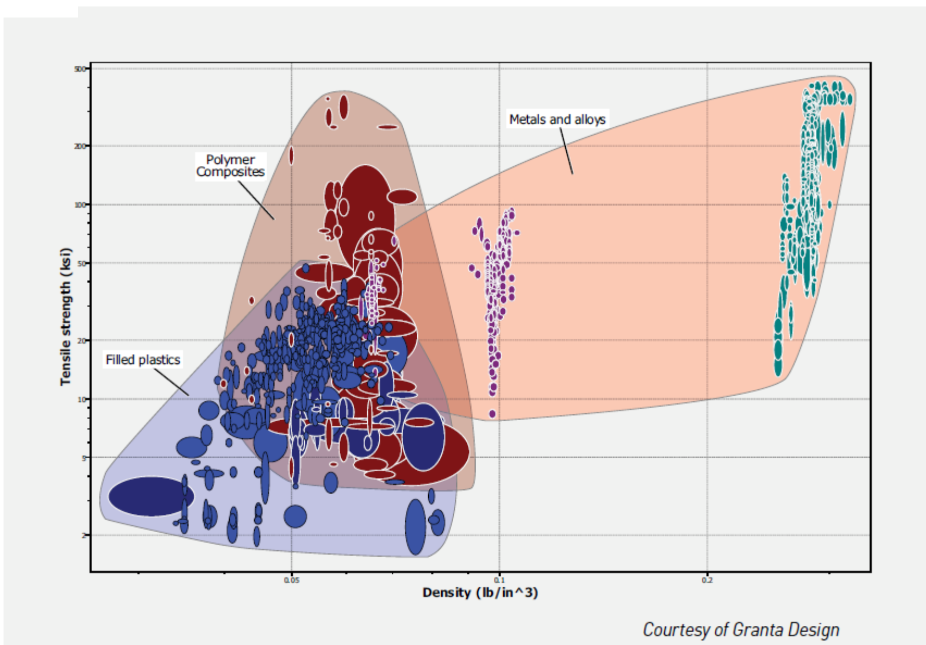
[2] EPA, NHTSA and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025, Appendix", pp. B-46-B-76 (July 2016), *available at* https://nepis.epa.gov/EPA/html/DLwait.htm?url=/Exe/ZyPDF.cgi/P100OYCH.PDF?Dockey=P100OYCH.PDF.

[3] Trucost, "Plastics and Sustainability: A Valuation of Environmental Benefits, Costs and Opportunities for Continuous Improvement" (July 2016), available at https://plastics-car.com/Resources/Resource-Library/A-Valuation-of-Environmental-Benefits-Costs-and-Opportunities.pdf.

can play a significant role in economically reducing vehicle mass of new light-duty vehicles.

The chart labeled “Figure 1” below provides data regarding the tensile strength and density of filled plastics, polymer composites, metals, and alloys. As shown in the chart, there are many plastics and polymer composites that are significantly less dense than most metals and alloys while offering similar tensile strengths. This data illustrates the fundamental physical advantage that many plastics and polymer composites can offer over metallic automotive materials: higher strength-to-weight ratios enable automakers to lightweight while maintaining performance and innovative designs that consumers demand.[4]

Figure 1 Tensile strength versus density for filled plastics, polymer composites, and metals and metal alloys



MASS REDUCTION THROUGH LIGHTWEIGHT PLASTIC AND POLYMER COMPOSITES HAS MAINTAINED OR IMPROVED SAFETY

The NPRM notes that historical data shows that the safest cars are generally heavy and large while the cars with the highest fatal-crash rates have been light and small and asks “whether the past is necessarily a prologue”.[5] Citing recent studies that in turn rely heavily on retrospective statistical studies, the Agencies’ answer their own rhetorical question and conclude that “[b]ecause the analysis discerns a historical relationship between vehicle mass, size, and safety, it is reasonable to assume these relationships will continue in the future.”[6] The Agencies failed to account for the synergism of readily available and emerging technology that will, in

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[4] American Chemistry Council, “Plastics and Polymer Composites for Automotive Markets Technology Roadmap”, pp. 10-12, 36-40 and 58, (March 2014), *available at*: https://plastics-car.com/Tomorrows-Automobiles/Plastics-and-Polymer-Composites-Technology-Roadmap/Plastics-and-Polymer-Composites-Technology-Roadmap-for-Automotive-Markets-Full-Report.pdf.
[5] NPRM, 83 Fed. Reg. 42986, 43108 (Aug. 24, 2018).

[6] *Id.*

combination with mass reduction, maintain and improve safety, such as improved vehicle designs, crashworthiness systems, restraint systems, driver assist systems, and increasing levels of autonomy.

The retrospective statistical studies supporting the NPRM's conclusions regarding fatality increases resulting from vehicle lightweighting are based by definition on how vehicles had been lightweighted in the past. In particular, in earlier studies, such as that by Crandall and Graham[7], automakers focused on decreasing weight by reducing the length of the frontal structures (i.e., the structures located from the firewall forward). At the same time, considerable effort was also expended to retain occupant compartment size for comfort and, more importantly from a safety perspective, to maintain the "safety cage" survival space required for occupants. Such changes shortened the crush zone for crash energy absorption and caused vehicles to experience more severe crash pulses (i.e., higher decelerations over shorter time durations). Due to the higher decelerations and shorter crash pulse durations, restraint systems underwent substantial improvement. These issues, in part, were addressed by changing an engine's inline configuration to a transverse configuration, thereby recouping some of the crush zone space lost before the engine's reconfiguration.

The later studies described in the NPRM analyzed the safety improvements that resulted when some automakers began utilizing designs that lowered the engine during a crash in order to provide an additional increase in the size of the crush zone.[8] However, these more recent statistical studies failed to take into account readily available design practices that have been developed to both lightweight and provide improved safety for a given vehicle. For example, as early as 2013, manufacturers began using lighter and stronger ultra-high strength steels and carbon fiber reinforced plastic composites; and even earlier were using aluminum and high strength steel for lightweighting, as well as improving the crash performance of the body-in-white.[9][10]9,10 Furthermore, restraint systems have continued to improve. More recently, for example, inflatable belts have been made available in production vehicles, providing better occupant protection as the crash loads transferred through the belt are spread out over a larger area of an occupant's thorax. This reduces the mechanical stresses incurred by a person's skeletal structures (in particular, the shoulder, sternum, and rib cage).[11]

The retrospective statistical studies, on which the NPRM heavily relies, placed primary emphasis on a vehicle's change in velocity (delta V) during a crash as the predictor of fatalities and injuries in the analyses. The NPRM even goes so far as to provide the relationship between the

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[7] The NPRM cites to a 2017 study by Bento, A., et al. to support the conclusion that larger vehicles are better able to protect their occupants during accidents. *Id.* at 43016, n. 94. That study, however, relies on heavily on retrospective statistical studies such as Crandall, Robert W. and Graham, John D., "The Effect of Fuel Economy Standards on Automobile Safety," The Journal of Law & Economics, Vol. 32, No. 1, pp. 97-118, April 1989.

[8] Bento, A., Gillingham, K., & Roth, K.m, The Effect of Fuel Economy Standards on Vehicle Weight Dispersion and Accident Fatalities," NBER Working Paper No. 23340 (June, 2018), available at http://www.nber.org/papers/w23340.

[9] Dr. Dirk Lukaszewicx, Design Drivers for Enhanced Crash Performance of Automotive CFRP Structures, Twenty-Third International Technical Conference on the Enhanced Safety of Vehicles, Seoul, South Korea (May 2013).

[10] SAE, "Pros and Cons of Advanced Lightweighting Materials," SAE International Tech Briefs, Vol 42, No. 3, pp. 14-17 (March 2018).

[11] Personal knowledge of ACC consultant and retired Director for Safety Research at NHTSA, Dr. William Thomas Hollowell, from his research at NHTSA and his personal communications with researchers at the OEMs.

mass ratios of the vehicles involved in vehicle-to-vehicle crashes and each vehicle's resulting delta Vs. However, the studies failed to take into account that, while the mass ratio of the vehicles involved in a given vehicle-to-vehicle crash dictates the delta V of each vehicle, readily available design techniques can manage the time duration over which a vehicle's delta V occurs.

In providing for occupant safety, engineers break down the crash into two impacts during which the designer has some control: the first being the impact of the vehicle to another vehicle or a stationary object, and the second being the impact of the occupant to surfaces within the interior of the vehicle. Managing the crash time duration during the first impact is critical as this provides the opportunity to further optimize the performance of the occupant restraint systems during the second impact. That is, the longer the crash pulse duration can be increased, the lower the impact speed of the occupant to interior components will be and the better the opportunity to properly deploy the restraint system. This in turn defines the design of the optimal interior components—including required component performance (e.g., padded dashboard and pillars) and strength (e.g., the structural members of the safety cage, such as the pillars), as well as the accompanying proper restraint system characteristics, which provide very effective system performance. Such improved performance derives in part from designs incorporating the use of materials which have high specific energy absorption (i.e., high energy absorption per kilogram of material). For example, carbon fiber reinforced plastic (CFRP) composites can be engineered to provide far more energy absorption per unit mass of material (as depicted in Figure 2 below) providing a designer the potential to reduce vehicle mass while improving a vehicle's safety performance.

The Agencies' own Draft Technical Assessment Report included the following conclusion regarding carbon fiber auto parts:

> Carbon fiber reinforced polymer composites are of particular interest for automotive applications because they can be designed to have mechanical properties that are comparable to steel, but have a significantly lower density. Furthermore, they can have good energy absorbing characteristics in a crash which can improve vehicle safety.[12]

In an ongoing study[13] utilizing finite element modeling, George Mason University (GMU) has been incorporating CFRP composites to provide the equivalent performance provided in a NHTSA research project[14] undertaken to improve the crash performance of a Toyota Corolla subjected to the frontal oblique offset test procedure being developed for the New Car Assessment Program. In NHTSA's project, high strength steels were utilized resulting in a 17 kg increase in the baseline vehicle weight. In the GMU project, the use of CFRP composites provided the equivalent safety performance, while also providing a reduction of 7 kg in the

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[12] *See supra* note 2, p. B-52.

[13] Chung-Kyu Park, Cing-Dao (Steve) Kan, William Thomas Hollowell, and Rudolf Reichert, "Evaluation of the Safety Performance and Weight Reduction Using CFRP Modified Automotive Structures in NHTSA's Frontal Oblique Impact Test," National Crash Analysis Center, George Washington University, *available at* http://indexsmart.mirasmart.com/26esv/PDFfiles/26ESV-000169.pdf

[14] Awaiting publication of NHTSA final report, anticipated by year-end, per NHTSA approved draft report has been submitted for formal publication and is currently undergoing necessary edits to satisfy American Disabilities Act requirements, https://www.nhtsa.gov/research-data.

baseline vehicle weight. Both studies resulted in substantially improved crash performance with respect to compartment intrusion while providing essentially equivalent crash pulses.

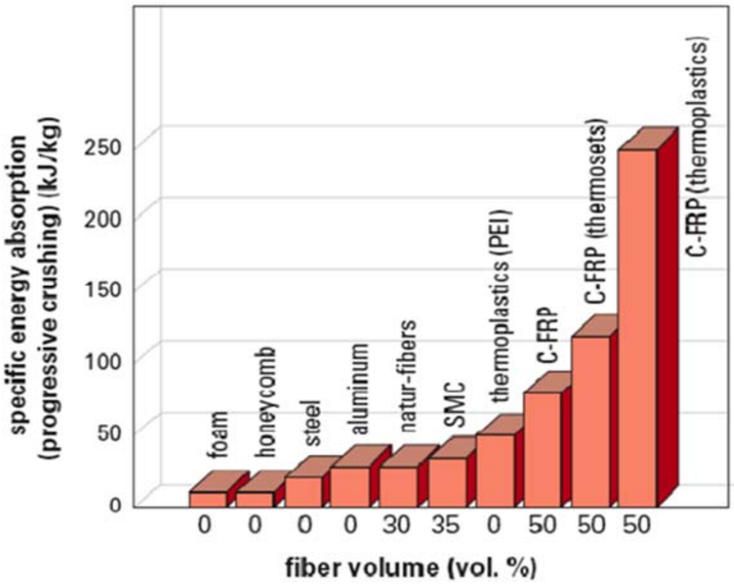

Figure 2. Energy Absorption (Energy/KG of Material) Potential Structural Materials

In another earlier study, researchers at The George Washington University also demonstrated that improved vehicle designs could readily provide equivalent crash protection[15]. This project was a collaborative effort with NHTSA, The George Washington University, and participating member companies of the American Chemistry Council's Plastics Division. The goal of the project was to lightweight a Chevrolet Silverado pickup truck using plastics and composites including the utilization of finite element modeling. In this project, the vehicle size was maintained while achieving a 19 percent weight reduction through lightweighted component replacements using plastics and CFRP composites as well as downsizing of the powertrain and suspension system, made possible by the reduced weight realized from the component lightweighting. The lightweighted vehicle provided equivalent safety performance as the baseline vehicle.

In another project, NHTSA awarded a contract to the National Center for Manufacturing Science and its partners, the University of Delaware's Center for Composite Materials and BMW, to investigate the use of carbon fiber reinforced thermoplastic materials (CFRP) for vehicle side structures.[16] The project team investigated using CFRP materials for these structures, created requirements, and defined assessment strategies. In particular, a B-pillar was designed to meet structural and crash safety requirements specified by BMW and team members using the CFRP

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[15] Chung-Kyu Park, Cing-Dao (Steve) Kan, William Thomas Hollowell, and Susan I. Hill, "Investigation of Opportunities for Lightweight Vehicles Using Advanced Plastics and Composites," National Crash Analysis Center, George Washington University, Report No. DOT HS 811 692 (December 2012), *available at* https://www.nhtsa.gov/DOT/NHTSA/NVS/Crashworthiness/Plastics/811692.pdf

[16] National Center for Manufacturing Sciences, *High-Performance Computing Studies*, Report No. DOT HS 812 404, Washington, DC National Highway Traffic Safety Administration (April 2017), *available at* https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/812404_computingstudiesreport_v2_0.pdf

composites to provide improved side crash performance. In this study, scientists designed, manufactured, and tested CFRP intensive vehicle components, and validated the predicative engineering tools. The design of the B-pillar was followed by the manufacturing and testing of a prototype. This study demonstrated that the designed carbon fiber thermoplastic B-pillar offered 60 percent weight savings over the metallic baseline, and satisfied the specified side impact crash requirements. Also, the dynamic impact and crush response of the B-pillar was adequately modeled using computational tools.

A presentation by Joe Nolan at the 2013 NHTSA Workshop on Mass-Size-Safety further supported the importance of good designs[17]. His research examined crash test data, vehicle technologies, insurance, and NHTSA accident data bases to investigate the relative safety of large and small passenger vehicles. For the future of vehicle design, he noted that: (1) Disparate size and weight vehicles will always exist in the fleet and (2) Smaller and lighter vehicles can have some disadvantage. However, Nolan stated that advanced structural engineering and technology innovations have improved the fleet compatibility and occupant protection across all vehicle sizes. He ended by summarizing the countermeasures that help equalize occupant safety in a mixed-size fleet. These included crashworthiness improvements, especially for the smallest vehicles; strong front, side, and roof structures; head-protecting side airbags with rollover deployment; better light truck compatibility with cars; lowering light truck structures to car levels; electronic stability control; and continued improvement in belt use rates.

The countermeasures advocated by Joe Nolan have been providing positive results. For example, IIHS published in their September 28, 2011 *Status Report* that recent changes in sport utility vehicles (SUVs) and pickup trucks have made crashes involving the two vehicle types less dangerous to car occupants than they used to be.[18] The highlights of this study were presented at the aforementioned 2013 NHTSA Workshop. Shown in Figure 3 are graphs depicting the crash partner deaths for one-to-four year old vehicles per million registered vehicle years. As seen, fatality rates at a given weight decreased substantially between 2000-2001 and 2008-2009. Also note that the death rates were as not as far apart in 2008-2009 for the various vehicle types as they were in 2000-2001. While weight is a contributing factor in the crash outcomes, these graphs also demonstrate that good design can improve those outcomes. The design changes leading to these improvements resulted from a voluntary agreement established out of meetings between NHTSA and automakers to address the issue of compatibility.

[17] Joe Nolan, "The Relative Safety of Large and Small Passenger Vehicles," Insurance Institute for Highway Safety, Presentation to the 2013 NHTSA Workshop on Mass-Size-Safety, Washington, DC, May 2013

[18] IIHS, "Better compatibility has lessened the danger that SUVs and pickups pose to people in cars," IIHS/HLDI Status Report, Vol. 46, No. 8, September 28,2011

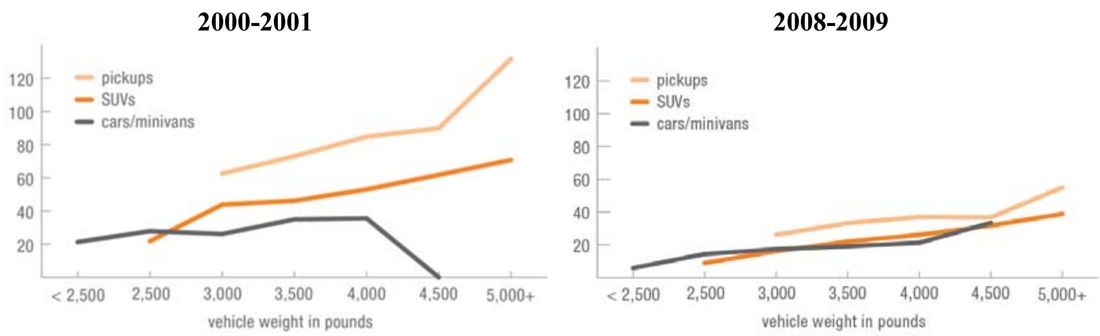

Figure 3. Crash partner deaths, 1-4 yr. old vehicles per million registered vehicle years[19]

We expect safety countermeasures to further improve with the advent of driver assist systems and more recently the high profile work on autonomous vehicles. These are especially significant as such efforts will aid in preventing crashes from taking place at all; or, at a minimum, reducing the severity of crashes that do occur. Such developments include lane keeping systems, blind side information systems, automatic emergency braking systems, drowsy driver alert systems and side sensing systems (that detect and provide warning that objects are coming closer to the side of one's vehicle).

Although one driver assistance study[20] (published in 2007) was noted in the NPRM, that analysis is significantly out of date when considering improvements to such systems made in the decade since its publication. In considering that fatality rates have demonstrated an overall continuous decline since the 1970s, that safety breakthroughs have continued to take place almost every decade, that new advanced technologies are being continually developed or improved and the anticipation these trends will continue; ACC concludes that the projected increase in fatalities in the NPRM due to lightweighting vehicles is unsupported and substantially overstated. Hence, a more robust analysis by the Agencies of the safety impacts of vehicle lightweighting is needed to properly account for the significant design and safety innovations that have occurred in recent years before the Agencies can reasonably use the impacts of lightweighting to justify their policy proposals in the NPRM. Given the speed with which automakers and lightweight plastic and polymer composite manufacturers are innovating to make automobiles simultaneously lighter and safer, the Agencies' conclusion that the past relationship between the size and weight of a vehicle and its safety will continue in the future is not supported by the Agencies' own records.

U.S. ECONOMIC IMPACT OF AUTOMOTIVE PLASTICS AND POLYMER COMPOSITES

Developing technology to lightweight vehicles spurs advanced innovations and creates high-skilled manufacturing jobs in the United States. The $426 billion North American light vehicle industry represents an important sector of economy for the United States and is a large end-use customer market for chemistry. In 2017, the 16.88 million light vehicles assembled in North

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[19] *Id.*

[20] Blincoe, L. & Shankar, U., *The Impact of Safety Standards and Behavioral Trends on Motor Vehicle Fatality Rates*, National Highway Traffic Safety Administration (Jan. 2007), available at https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/810777v3.pdf.

America required some 5.8 billion pounds of plastics and polymer composites valued at $7.0 billion, or $416 in every vehicle.

These automotive plastic and polymer composite products are produced at 1,622 plants located in 45 states. These plants directly employ about 63,080 people and feature a payroll of $3.2 billion. Michigan is the leading state in terms of direct employment (more than 15,275) and is followed by Ohio (about 8,900), Indiana (8,280), Tennessee (nearly 4,120), Minnesota (nearly 3,155), Pennsylvania (more than 2,865), Wisconsin (2,320), Illinois (more than 2,160), North Carolina (nearly 1,720), and New York (nearly 1,515).[21]

Producers of automotive plastics and polymer composites typically purchase plastic resins, additives, other materials, components and services from other parts of the economy. As a result, the contributions of plastics and polymer composites go well beyond their direct economic footprint. The automotive plastics and polymer composites industry fosters economic activity indirectly through supply-chain purchases and through the payrolls paid both by the industry itself and its suppliers. This, in turn, leads to induced economic output as well. As a result, every job in the automotive plastics and polymer composites industry generates an additional job elsewhere in the United States' economy, totaling more than 119,000 jobs.[22]

These U.S. high-skilled manufacturing jobs and the additional jobs they generate elsewhere in the economy will be impacted by this final rulemaking and how the final rule addresses the impact of weight reduction by plastic and composites on safety. This economic impact must be taken into account when calculating the final regulatory impact analysis.

CONCLUSION

ACC appreciates the opportunity to submit this statement for the Committee's consideration. We look forward continuing work with the Committee, Congress, and the Administration on lightweighting vehicles and improving safety and fuel economy through the use of plastics and polymer composites.

Should you have any questions or require additional information, please do not hesitate to contact Booth Jameson at (202) 249-6204 or Booth_Jameson@americanchemistry.com.

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[21] Economic and Statistics Department, American Chemistry Council, "Plastics and Polymer Composites in Light Vehicles", page 1, (September 2018), available at: https://plastics-car.com/Resources/Resource-Library/Plastics-and-Polymer-Composites-in-Light-Vehicles-Report.pdf

[22] *Id.*

https://www.americanchemistry.com/ ACC represents a diverse set of companies engaged in the business of chemistry. An innovative, $553 billion enterprise, we work to solve some of the biggest challenges facing our nation and our world. Our mission is to deliver value to our members through advocacy, using best-in-class member engagement, political advocacy, communications and scientific research. We are committed to fostering progress in our economy, environment and society. The business of chemistry drives innovations that enable a more sustainable future; provides 526,000 skilled good paying jobs—plus over six million related jobs—that support families and communities; and enhances safety through our diverse set of products and investments in R&D.