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The Economic Implications of Potential NHTSA and EPA Regulatory Revisions on U.S. Light Truck Sales and Manufacturing

CENTER FOR AUTOMOTIVE RESEARCH

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Kristin Dziczek, Director, Industry, Labor & Economics Group

Brett Smith, Assistant Director, Manufacturing, Engineering & Technology Group

Yen Chen, Senior Industry Economist, Industry, Labor & Economics Group

Michael Schultz, Industry Economist, Industry, Labor & Economics Group

David Andrea, Executive Vice President of Research

CAR
CENTER FOR AUTOMOTIVE RESEARCH

3005 Boardwalk, Suite 200
Ann Arbor, MI 48108
www.cargroup.org

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EXECUTIVE SUMMARY

U.S. production and sales of vehicles classified as light trucks are very important to the U.S. economy and to the profitability of the automakers making pickup trucks, vans, sport utility vehicles (SUVs), and compact utility vehicles (CUVs). Many consumers prefer light trucks because they are versatile, spacious, possess unique performance features versus passenger cars and have a perceived safety advantage. An additional driver of light truck sales is the near-historic low, real fuel prices. The U.S. Energy Information Administration projects fuel prices to stay low through 2025, which may mean consumers will continue to prefer vehicles classified as light trucks going forward.

Three out of every five vehicles sold in the United States in 2015 were light trucks, and nearly two out of every three vehicles manufactured in the United States by all of the automakers were light trucks. In 2015, more than 155,000 U.S. workers were employed in the manufacture of light trucks and engines and transmissions used by light trucks at BMW, Daimler, Fiat Chrysler Automobiles (FCA), Ford, General Motors (GM), Honda, Hyundai-Kia, Renault/Nissan, Subaru, Tesla, and Toyota.

Unit for unit, U.S. light truck production has a larger impact on the U.S. economy than production of passenger cars.[1] Not only is U.S. light vehicle production heavily concentrated in pickups, vans, SUVs, and CUVs, but these production activities have an even greater effect on the U.S. economy than passenger car production since many light trucks are designed and manufactured solely for the North American market. These single-market vehicles are supported by a concentrated supply chain in the North American region, as well. Across all manufacturers, light trucks averaged 48 percent U.S. and Canadian content—this is 6 points greater than the average for all passenger cars at 42 percent. Body-on-frame (BOF) light trucks have even higher average U.S. and Canadian content at 57 percent.

The concentration of economic activity can also be seen when looking only at U.S. production of traditional BOF trucks. These full-frame light trucks are currently manufactured in the United States by Daimler, FCA, Ford, GM, Renault/Nissan, and Toyota, and have a combined total direct employment of 84,200. CAR's economic contribution modeling produces a 15.9 employment multiplier for U.S. BOF truck and related engine and transmission production. This means every job in a U.S. BOF assembly and related engine or transmission manufacturing facility supports an estimated 14.9 jobs elsewhere in the economy. These indirect (supplier) and spin-off jobs are in many sectors of the economy, but are primarily concentrated in manufacturing, construction, administrative, retail trade, and professional and technical services. U.S. BOF light truck production produces $71.9 billion in private disposable income, and a net gain to the federal, state, and local governments of $26.6 billion. These economic contributions are conservative estimates, as they are calculated only on BOF truck and associated engine and transmission employment; including all light trucks would yield higher employment, personal income, personal income and social insurance taxes paid, and government transfer payment impacts.

Vehicles that are classified as light trucks—including pickup trucks, vans, SUVs, and CUVs—are very profitable, and automakers' overall operating profits move up or down depending on how well these

[1] American Automobile Labeling Act (AALA) vehicle content data was weighted using Q3 2015-Q2 2016 U.S. light vehicle sales (IHS, 2016); (U.S. National Highway Traffic Safety Administration, 2015-2016).

vehicles are selling. For example, every one percent increase in sales of light trucks at Ford and GM is estimated to increase the companies' combined quarterly North American operating profits by over $110 million ($442 million on an annualized basis). On a per vehicle level, every incremental unit of light truck sales brings in an average of $6,000 in profits for Ford and GM across the entire light truck segment. This per vehicle estimate includes large SUVs and pickup trucks that are among the most profitable vehicles sold in the United States; profits on pickup trucks can be as high as $13,000 (Bunkley, 2015) (Naughton, 2016). Light truck profits support research and development activities, lower corporate borrowing costs, and can provide the cash cushion necessary to weather industry downturns.

In 2012, the U.S. National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) set standards for fuel economy and greenhouse gas emissions for model years 2017-2025. Based on expected vehicle footprints (wheelbase times vehicle width), the fleet average for light trucks will need to be 39.5 mpg by 2025.[2] However, each manufacturer will have a different target based on their vehicles' footprints and sales volumes. The EPA compliance standards require light trucks to reduce CO_2 emissions by 3 percent per year through model year (MY) 2021, and then by 5 percent per year from MY2022 through MY2025. For larger light trucks—those with a footprint greater than 65 square feet—the compliance standards are less steep in 2021 through 2025.

There are five main areas of concern with regard to the ability of light truck manufacturers to meet future fuel economy and emissions standards:

- Accounting for some CUVs as passenger cars instead of light trucks negatively impacts both passenger car and light duty truck fuel economy standards, and puts further pressure on each company's portfolio of products.
- Credits and technology incentives may not provide sufficient inducement for consumer demand.
- Technology costs to meet BOF duty cycle required may be excessive.
- Mid-sized pickup trucks will be challenged to meet standards throughout the regulations time period.
- Stranded capital is a concern for manufacturers and suppliers, but may be more severe for BOF pickup trucks.
- Unintended outcomes from regulatory standards may lead to economic disruption for companies and communities.

NHTSA and EPA are currently undertaking a Midterm Evaluation (MTE) to set the CAFE and GHG standards set for MY2022-2025. While there are regulatory provisions that offer some compliance flexibility through credits, credit banking and trading, and technology incentives, it will be a challenge for vehicle manufacturers to meet the regulatory targets for light trucks. As such, U.S. regulators must take economic impact and industry factors into account during the ongoing MTE to set realistic and achievable standards for light trucks.

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[2] Assumes full use of air conditioning credits; based upon assumed footprint averages for cars and trucks (separately), and assumed car/truck split in the market.

THE IMPORTANCE OF LIGHT TRUCK SALES AND MANUFACTURING IN THE UNITED STATES

Vehicles that are classified as trucks (pickups, vans, SUVs and CUVs) represent a majority of light vehicles sold and manufactured by all automakers in the United States. In 2015, over 155,000 workers were employed by 11 U.S. vehicle manufacturers in the production of light trucks, and engines and transmissions for light trucks. Light truck sales and production are essential to U.S. automotive assembly and parts supplier employment, the economies of the 13 states and numerous communities that host truck assembly and supplier plants, and the financial health of the automakers.

Light truck production activities have a concentrated effect on the overall U.S. economy. Unlike passenger cars, light trucks typically are designed and manufactured primarily for the North American market, and the primary design responsibility for these vehicles is centered in the United States. Whereas supply chains for passenger cars are global in scope, this single-market focus of light trucks results in a condensed, localized supply chain that is heavily concentrated within the United States. Evidence of this concentration can be found by analyzing American Automobile Labeling Act domestic content figures. Across all manufacturers selling vehicles in the United States, 2015-2016 model year passenger cars averaged 42 percent U.S. and Canadian content, and light trucks averaged 48 percent—with BOF trucks averaging 57 percent.[3] Due to the high level of local sourcing, unit for unit, the production of light trucks supports more U.S. employment than does production of passenger cars.

U.S. Light Truck Sales

In 2015, light trucks accounted for 57.4 percent of all U.S. light vehicle sales, and vehicles that use traditional body-on-frame (BOF) architecture accounted for 20.4 percent (IHS, 2016). Pickup trucks and large SUVs commonly use BOF construction, while smaller SUVs, CUVs and vans tend to use unibody architecture. The U.S. sales share for light trucks is forecast to remain relatively flat through 2023 (IHS, 2016).

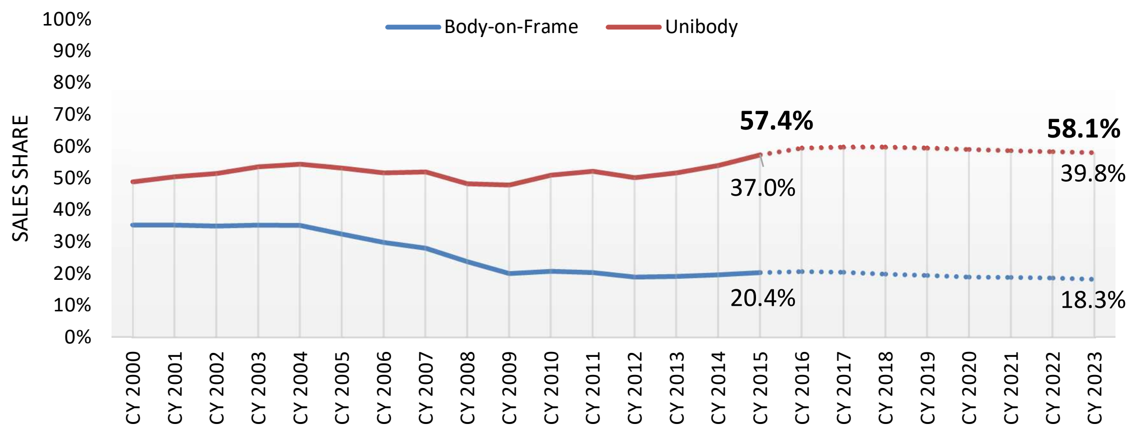
Figure 1 shows that U.S. light truck sales have, historically, remained surprisingly strong—even in the face of challenging market conditions. When gas prices reached record-highs in 2008, and throughout the Great Recession in 2009, light truck sales remained roughly half of the new vehicle market—accounting for 48.3 percent of sales in 2008, and 47.9 percent of sales in 2009 (IHS, 2016). However, sales of BOF vehicles have been declining over the past decade. From 2000 through 2004, the share of BOF vehicles remained near 37 percent of all new light vehicle sales in the United States, but from 2005 to 2009, BOF market share steadily declined—falling to 20.9 percent in 2009, and stabilizing around 20 percent of sales thereafter (IHS, 2016). This trend is driven by vehicle manufacturers changing some models from BOF to unibody construction, as well as new unibody vehicle models being introduced. Work trucks that require stringent utility attributes for payload and towing will remain BOF.

Since 2009, total U.S. light truck market share has been trending upward, and the projection is for light trucks to reach 60 percent share of U.S. new light vehicle sales in 2016, and remain at that level through

[3] Center for Automotive Research calculations using Q3 2015-Q2 2016 U.S. light vehicle sales (IHS, 2016) to weight U.S. and Canadian content figures by vehicle; content data taken from NHTSA American Automobile Labeling Act (AALA) annual reports (U.S. National Highway Traffic Safety Administration, 2015-2016).

2019 (IHS, 2016). Amidst toughening fuel economy and greenhouse gas emissions regulations, light truck market share is projected to fall to 58 percent by 2023. For BOF light vehicles specifically, U.S. market share is expected to remain near 20 percent through 2019, and thereafter decline to 18 percent by 2023 (IHS, 2016).

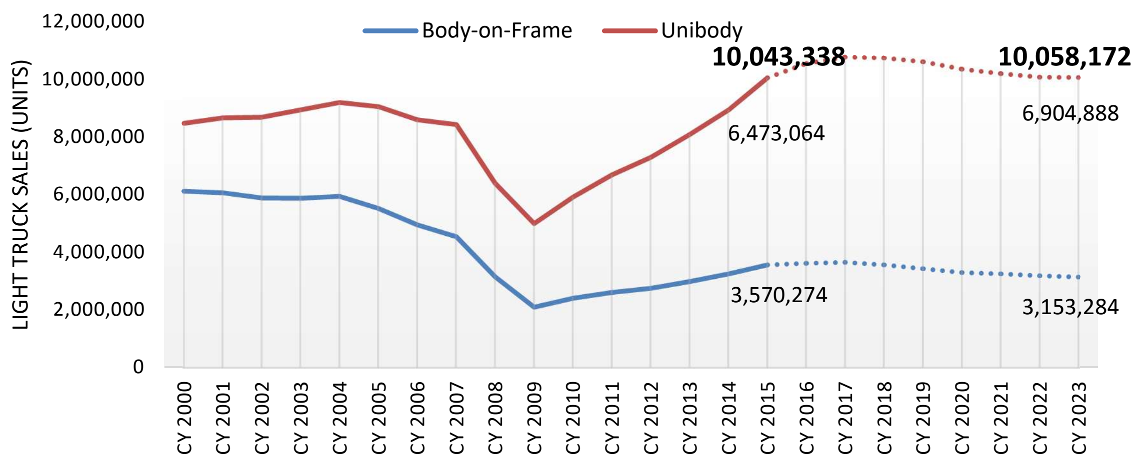
Figure 1: U.S. Sales Share of Light Trucks by Body-on-Frame and Unibody Construction, 2000-2023



Source: (IHS, 2016); Dotted lines represent forecast values for CY2016-2023

The forecast changes in the light truck share of the U.S. vehicle sales market described above are accompanied by overall declines in overall U.S. light truck sales. U.S. light truck sales are expected to peak at 10.7 million units in 2017, and then steadily decline, leveling off around 10 million sales by the early 2020s (IHS, 2016). The mix between unibody and BOF light trucks is forecast to shift from 65 percent unibody light trucks/35 percent BOF to 69 percent unibody/31 percent BOF, respectively.[4]

Figure 2: U.S. Sales of Light Trucks by Body-on-Frame and Unibody Construction, 2000-2023

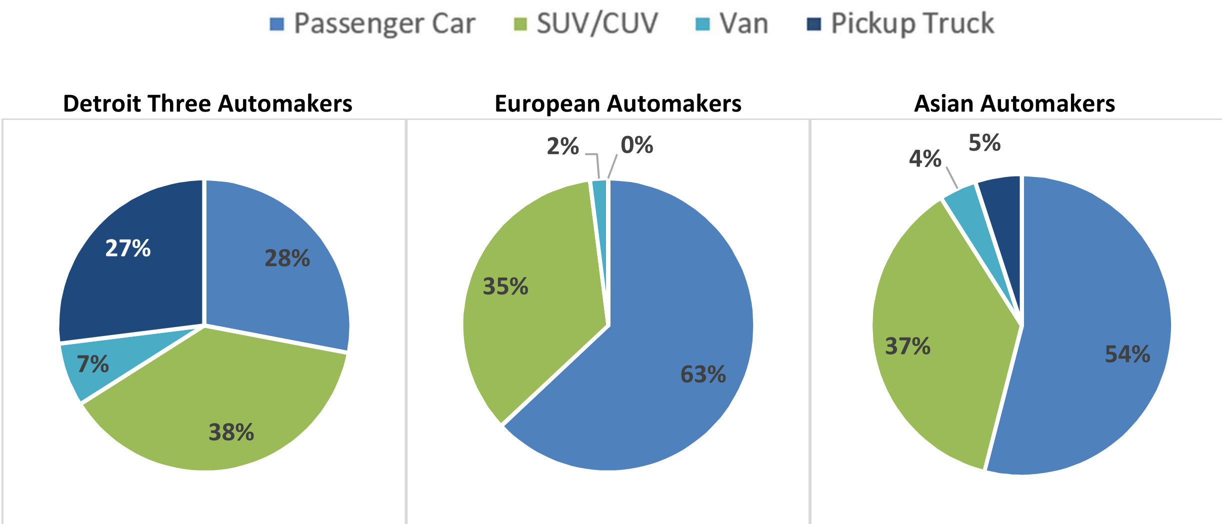


Source: (IHS, 2016); Dotted lines represent forecast values for CY2016-2023

4 IHS assumes "Lowered fuel prices in the near-term forecast horizon should keep light truck sales strong through at least 2019, which is when fuel prices are projected to ratchet up again and fuel economy standards become increasingly stringent, which should put pressure on the sector moving through the end of the forecast horizon."

Sales of light trucks are not evenly distributed across the vehicle manufacturers selling in the United States, and this segment is of particular importance to the traditional Detroit Three automakers—FCA, Ford, and General Motors. These manufacturers are more dependent on U.S. light truck sales as a whole than are European or Asian automakers. Nearly 72 percent of the Detroit Three automakers' U.S. sales in 2015 were pickup trucks, vans, SUVs, and CUVs (IHS, 2016). By contrast, European automakers' 2015 U.S. sales were just over 37 percent vans, SUVs, and CUVs (no pickups); and Asian automakers' U.S. sales were made up of 46 percent pickups, vans, SUVs, and CUVs (IHS, 2016). Sales segmentation data for each group of automakers is displayed in Figure 3.

Figure 3: Share of U.S. Light Vehicle Sales by Segment for Detroit Three, European, and Asian Manufacturers in the United States, 2015



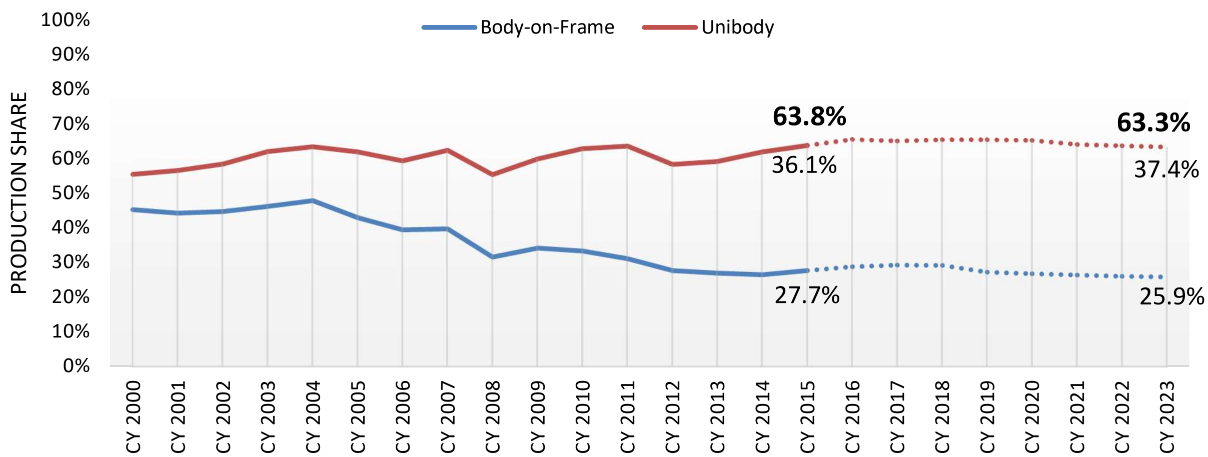
Source: *(Ward's Automotive, 2016)*

For FCA, light trucks accounted for 77 percent of U.S. sales in 2015, and for Ford and General Motors, light trucks represented 70 percent of total U.S. sales (IHS, 2016). BOF vehicles accounted for 30 percent of FCA U.S. sales in 2015, 38 percent at Ford, and 41 percent at GM (IHS, 2016). Consequently, any changes in share or level of light truck sales broadly, or BOF trucks specifically, would have a disproportionate impact on FCA, Ford, and GM.

U.S. Light Truck Production and Employment

Total U.S. light vehicle manufacturing is heavily weighted toward production of vehicles that are classified as light trucks. Light trucks represented 63.8 percent of all vehicles manufactured in the United States in 2015 (by all manufacturers), and 27.7 percent of the market was sales of BOF trucks. As is the case with sales, the overall U.S. production share for light trucks is also forecast to remain relatively flat through 2023, while the BOF share is expected to continue to decline slowly (IHS, 2016). Figure 4 shows the historical trend and forecast to 2023.

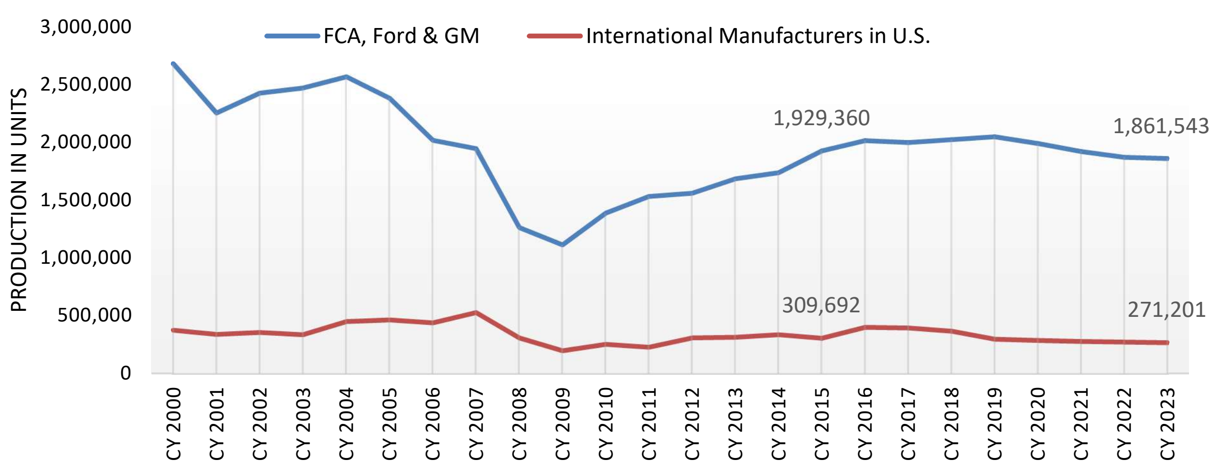
Figure 4: U.S. Production Share of Light Trucks by Body-on-Frame and Unibody Construction, 2000-2023



Source: (IHS, 2016); Dotted lines represent forecast values for CY2016-2023

FCA, Ford, and GM produce the vast majority of BOF pickup trucks manufactured in the United States. Nearly 9 out of every 10 BOF pickups made in the United States are made by these three companies in plants located in Indiana, Kentucky, Michigan, and Missouri. However, the Detroit Three are not the only automakers that produce BOF pickups. Renault/Nissan makes the Nissan Frontier and Titan in its Canton, Mississippi facility; Toyota makes the Toyota Tundra and Tacoma in its plant in San Antonio, Texas. The volume of U.S. BOF pickup truck manufacturing is forecast to fall slightly—by just about 5 percent—between 2015 and 2023.

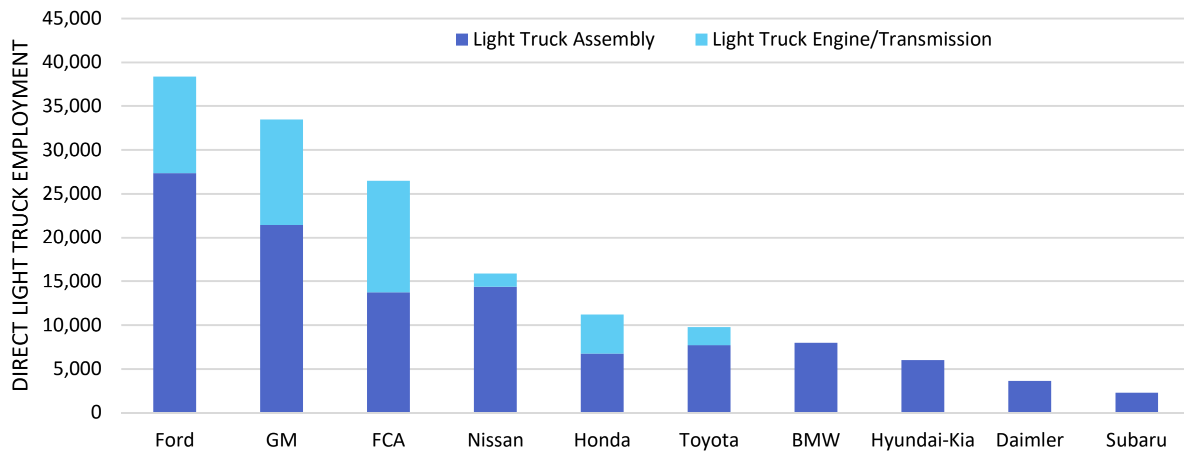
Figure 5: U.S. Production of Body-on-Frame Pickup Trucks, 2000-2023



Source: (IHS, 2016); Dotted lines represent forecast values for CY2016-2023

As previously mentioned, there are 11 automakers that manufacture vehicles—not just pickups—that are classified as light trucks in the United States: FCA, Ford, and GM, of course; but BMW, Daimler, Honda, Hyundai-Kia, Renault/Nissan, Subaru, Tesla, and Toyota also manufacture light trucks in the United States. Together, these companies directly employed 155,200 workers in light truck assembly and light truck engine and transmission manufacturing in 2015, as displayed in Figure 6. Just over 63 percent of those workers were employed by FCA, Ford, and GM.

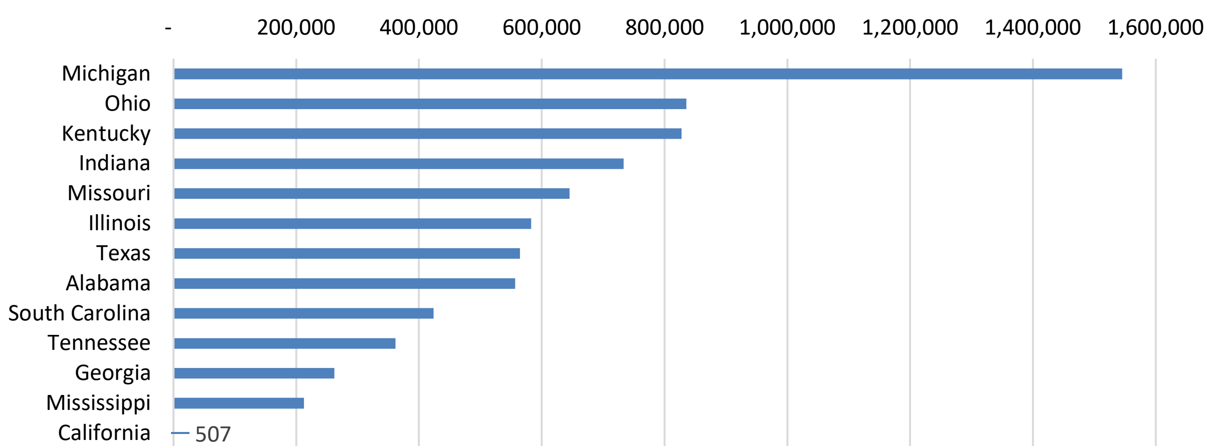
Figure 6: U.S. Light Truck and Related Direct Manufacturing Employment by Automaker, 2015



Source: (Fiat-Chrysler Automobiles, 2016); (General Motors Company, 2016); (Ford Motor Company, 2016); (Toyota USA, 2016); (Honda, 2016); (Center for Automotive Research, 2016)

As illustrated in Figure 7, U.S. light truck manufacturing takes place in 13 states: Alabama, California, Georgia, Illinois, Indiana, Kentucky, Michigan, Mississippi, Missouri, Ohio, South Carolina, Tennessee, and Texas.

Figure 7: U.S. States Ranked by 2015 Light Truck Production Volume



Source: (IHS, 2016)

U.S. Light Truck Profitability

Revenue per vehicle is significantly higher for light trucks than it is for passenger cars, with pickup trucks and full-size SUVs commanding the highest prices. According to data published by the Bureau of Economic Analysis, the average expenditure on new light trucks has continuously been about 40 percent higher than the average expenditure on new passenger cars during 2014, 2015, and through the first half of 2016 (U.S. Bureau of Economic Analysis). Light truck profits are important for a number of reasons: first, these profits fund research and development activities across the manufacturers' product spectrums; second, profitable automakers are less risky to corporate lenders, and therefore receive lower interest rates and increased borrowing power; and finally, profits provide the balance sheet reserves needed to weather the downturns in this highly cyclical industry.

While the focus of this paper is the overall light truck segment, for purposes of modeling segment profitability, CAR researchers utilized the financial data of just two automakers: GM and Ford. Nearly 40 percent of all U.S. light truck sales are vehicles manufactured by Ford and GM; in addition, these two automakers produce 70 percent of all BOF pickup trucks sold in the United States. Due to the sporadic availability of Chrysler financial data stemming from its periodic private ownership, FCA was not included in the analysis. While the statistical model of light truck profitability includes only Ford and GM, it is representative of FCA, as well, given the competitive nature of the light truck segment, and the truck offerings across all three automakers.

Securities and Exchange Commission filings for Ford and GM further emphasize the importance of trucks and other large vehicles to these companies' overall profitability. In their 2015 annual filings, both Ford and GM address the issue of vehicle profitability. Under the heading *Vehicle Profitability* in Ford's 2015 annual filing, the company discusses vehicle contribution margins (the price of each unit less the variable costs of manufacture) relative to the average contribution margin across all vehicles. In 2015, Ford's large vehicle contribution margin was 135 percent of the overall vehicle average (Ford Motor Company, 2016). By comparison, when last reported in 2011, the small vehicle contribution margin was 70 percent of the overall average, while the large vehicle contribution margin was 130 percent that year (Ford Motor Company, 2012). GM reports a similar measure—variable profit (revenue less material cost, freight, variable manufacturing expense, and policy and warranty expense), again benchmarked to the overall fleet average. In 2015, the variable profit of GM trucks, crossovers, and cars were 170 percent, 80 percent, and 30 percent of the overall average variable profit, respectively (General Motors Company, 2016). Since GM began reporting these relative variable profit figures in 2012, trucks have diverged from crossovers and cars. In 2012, these figures were 150 percent of the overall average for trucks, 100 percent for crossovers, and 50 percent for cars (General Motors Company, 2013). With small vehicles and cars yielding significantly below average margins, it is clear that the ability of these companies to generate the capital needed to develop new products and invest in their manufacturing operations is highly affected by the sales of new light trucks—particularly larger pickups and SUVs.

CAR constructed two linear regression models to estimate the impact of Ford and GM U.S. light truck sales on the companies' North American operating profits—one using total light truck unit sales as an independent variable, and another using year-over-year percent change in light truck sales. As noted earlier, a similar analysis for FCA was not possible due to the lack of financial data. North American operating profits are dependent upon the real gasoline price, and either total light truck unit sales or year-over-year percent change in light truck sales, depending on the model. In both models, CAR included a control variable to account for the step-function difference created by the level of pre- and post-recession light vehicle sales trends. Another control variable was needed to account for a very large one-time accounting charge in Q3 2007 at GM.

The econometric models used combined data for Ford and GM to estimate the impact of a combined change in light truck sales.

Equation 1: North American Quarterly Operating Profit Linear Regression Specification Using U.S. Unit Sales of Light Trucks and Passenger Cars as Dependent Variables

North American
Quarterly Profits = f(Real Gasoline Price, U.S. Light Truck Sales Level, U.S. Passenger Car Sales Level, Recovery Control Variable, Q3 2007 Control Variable)

The regression results indicate, while all other variables remain constant, for every dollar increase in real gasoline price, Ford and GM's combined quarterly North American operating profit would decrease by near $1.1 billion. On the other hand, for every additional light truck sold, Ford and GM's average profit is estimated to rise by $6,000. The model explains 82 percent of the variation in Ford and GM's combined North American operating profits. The estimation proved statistically insignificant for the passenger car variable, and so a similar relationship between car sales and profits cannot be stated.

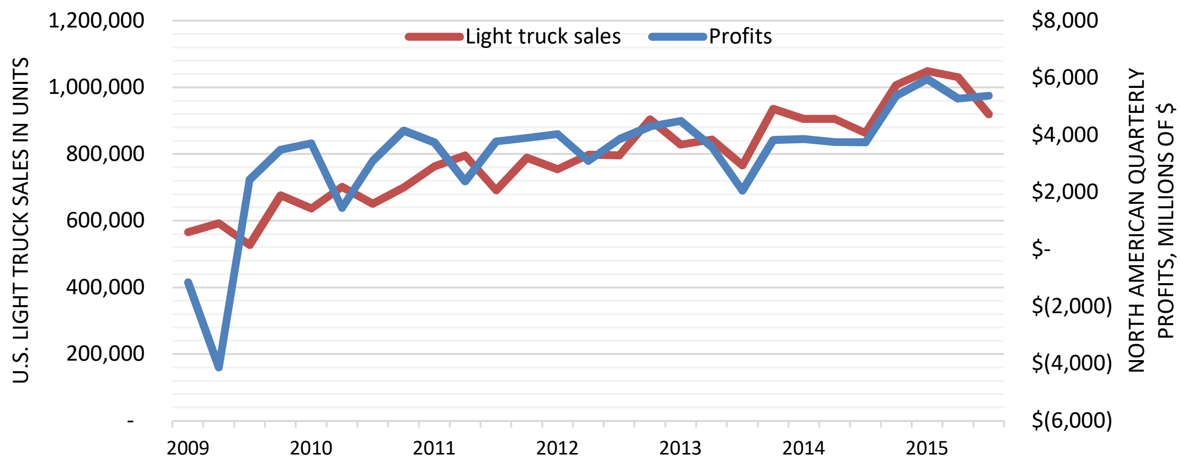
Equation 2: North American Quarterly Operating Profit Linear Regression Specification Using Year-Over-Year Percent Change (YOY PCT Δ) in U.S. Light Truck and Passenger Car Sales as Dependent Variables

North American
Quarterly Profits = f(Real Gasoline Price, YOY PCT Δ U.S. Light Truck Sales, YOY PCT Δ U.S. Passenger Car Sales, Recovery Control Variable, Q3 2007Control Variable)

The regression results indicate, while all other variables remain constant, for every one percent increase in U.S. light truck sales, there is a corresponding increase of $110.5 million in Ford and GM's combined quarterly North American operating profit ($442 million on an annualized basis). This model explains over 84 percent of the variation in Ford and GM's combined North American operating profits. This estimation also proved statistically insignificant for the passenger car variable, and so a similar relationship between car sales and profits cannot be inferred.

On average, Ford lost $654 million per quarter from 2001 to 2007, lost $869 million per quarter during the 2008-2009 recession, and made a quarterly profit of $1.92 billion from 2010 to 2016. Similarly, from Q1 2001 to Q2 2007, GM on average lost $262 million per quarter. The automaker lost $3.5 billion per quarter during Q3 2007-Q4 2009 recession (excluding Q3 2007, when GM took a one-time negative accounting charge of $35 billion), and has produced an average quarterly North American operating profit of $1.87 billion from 2010 to 2016. Both Ford's and GM's profitability track closely to the fluctuations in the company's light truck sales volumes in the United States, as shown in Figure 8.

Figure 8: Ford and GM Combined North American Profits and Combined U.S. Light Truck Sales, Q3 2009 – Q1 2016



Source: (Ford Motor Company, 2016) (General Motors Company, 2016) (LMC, 2016)

U.S. Fuel Economy and Greenhouse Gas Regulations and Trucks

During the first nine months of 2016, U.S. vehicle sales have increased by only 0.3 percent over 2015. However, sales of light trucks have increased by 7.8 percent year-over-year, compared to a decline of 9.0 percent for U.S. passenger car sales. The share of the overall U.S. light vehicle market for light trucks is currently at an all-time high of 59.7 percent and is expected to climb for the remainder of the year and into calendar year 2017. This segment shift reflects strong consumer preferences for vehicles classified as light trucks over cars, and can be at least partially attributed to low fuel prices and an improving economy over the last several years.

U.S. sales of traditional BOF trucks have shared in the segment shift for light trucks. Sales of BOF pickups and SUVs now account for 14.7 percent and 7.4 percent of the overall market year-to-date (YTD) through September 2016, with sales increases year-over-year of 5.7 percent and 5.2 percent, respectively (Automotive News, 2016). For FCA, Ford, and GM, light trucks provide a disproportionate share of both revenues and profits; for other automakers, light trucks are a source of profits, but do not comprise a majority of sales.

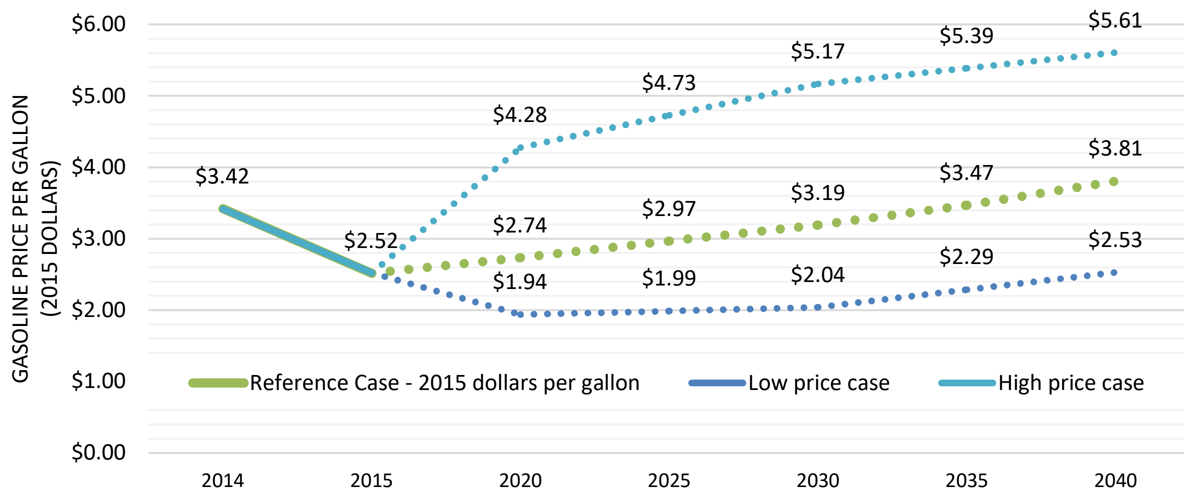
Light Truck Sales and Fuel Economy

Consumers value light trucks for their versatility, interior space, and performance compared to cars as well as a perceived safety advantage. BOF trucks can carry more passengers with three row configurations, tow large loads, carry large payloads, have off-road travel capabilities, may have better harsh weather performance, and due to higher ride height and seating position, provide superior visibility compared to passenger cars. However, light trucks typically lag in fuel economy compared to passenger cars.

Certainly, fuel economy is valued by consumers; however, fuel economy is not likely to be the primary purchase attribute. Rather, fuel economy enters into the purchase decision after a specific vehicle class–such as sedan, crossover, or pickup–has been selected, and serves as one among many traits which differentiate specific models on a buyer's shopping list (Fuels Institute, 2014). Real fuel prices are now at or approaching historic lows—a market reality that is not likely to change much through 2025, or even 2035, according to the 2016 reference case forecast by the Energy Information Agency as shown in Figure 9.[5] Therefore, fuel economy may not have much of an impact in consumers' preferences for vehicles overall, and specifically for those classified as light trucks.

[5] The high price case assumes higher demand for crude oil in non-Organization for Economic Cooperation and Development (OECD) countries and lower supply of Organization of the Petroleum Exporting Countries (OPEC) crude oil; the low price case assumes lower non-OECD demand and higher OPEC supply.

Figure 9: Motor Gasoline Prices and Forecast, 2014-2040 (In Constant 2015 Dollars)



Note: Prices are transformed from 2015 dollars per million Btu
Source: (U.S. Energy Information Administration, 2016)

The Regulatory Challenge

Since MY2012, light vehicles sold in the U.S. market have been subject to new national Corporate Average Fuel Economy (CAFE) standards from the U.S. National Highway Traffic Safety Administration (NHTSA), and greenhouse gas emissions (or GHG, primarily CO_2) from the U.S. Environmental Protection Agency (EPA).[6] The CAFE and GHG standards differ for light trucks and cars, and, in addition, are not completely aligned with each other.

Fuel Economy and Greenhouse Gas Regulations Pertaining to Light Trucks

In many cases the distinction between what is considered a passenger car and what is a light truck is easy to identify; however, for a segment of vehicles such as small CUVs, similar looking vehicles can be classified as either a passenger car or a light truck depending on a few key attributes. In general, a passenger car is a 4-wheeled automobile used primarily on public streets, roads, and highways, rated at less than 10,000 pounds of gross vehicle weight, and transports not more than 10 individuals. A light-duty truck is defined in the regulations by the characteristics in Figure 10.

This figure shows that the non-passenger automobile must either meet one of the criteria in the first column or a combination of one criterion in the second column and four criteria in the third column. A pictorial of the approach, breakover, and departure angles are also provided in Figure 10.

For some small CUVs, the 2-wheel drive version may be considered a passenger car, while the 4-wheel drive vehicle is considered a light-duty truck under the regulations (U.S. Code of Federal Regulations, 2011).

[6] The authors recognize there are nuanced differences between GHG and CAFE regulations. However, for clarity, CAR researchers consider that the regulators have just one national program, and therefore all references will be presented in terms of CAFE/miles per gallon (mpg) equivalents.

Figure 10: U.S. Regulatory Definition of a Truck

At Least One

- Transport more than 10 people
- Temporary living quarters
- Open bed
- Greater cargo-carrying than passenger carrying volume
- 3 row seating with seats that can be removed or stowed to create flat cargo-carrying surface

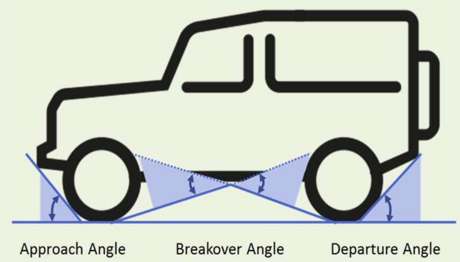
OR

- 4-wheel drive
- Gross vehicle weight greater than 6,000 pounds

AND

At Least Four

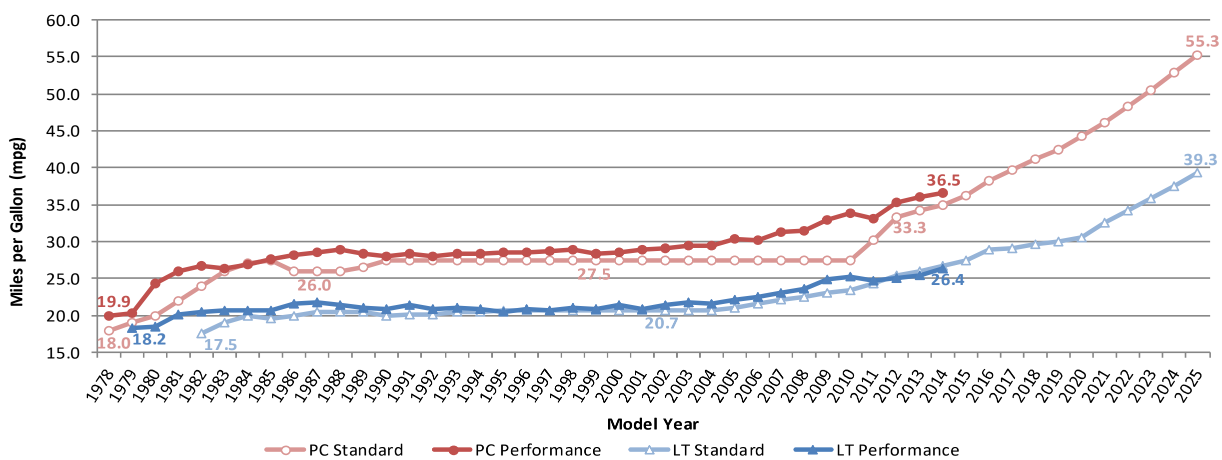
- Approach angle ≥ 28°
- Breakover angle ≥ 14°
- Departure angle ≥ 20°
- Running clearance ≥ 20 cm
- Front and rear axle clearance ≥ 18 cm



Source: (U.S. Code of Federal Regulations, 2011)

Based on the 2012 Final Rule, the fleet average CAFE for light trucks will be 39.5 miles per gallon (mpg) by 2025, compared to a fleet average of 55.3 mpg for cars, as shown in Figure 11.[7] Each manufacturer will have a standard that is representative of its fleet footprint—which may be larger or smaller than the broad fleet average upon which the 2025 standards are based.

Figure 11: CAFE Summary by Year (Actual Performance & Regulatory Standard) for Passenger Cars (PC) and Light Trucks (LT), Model Years 1978-2025

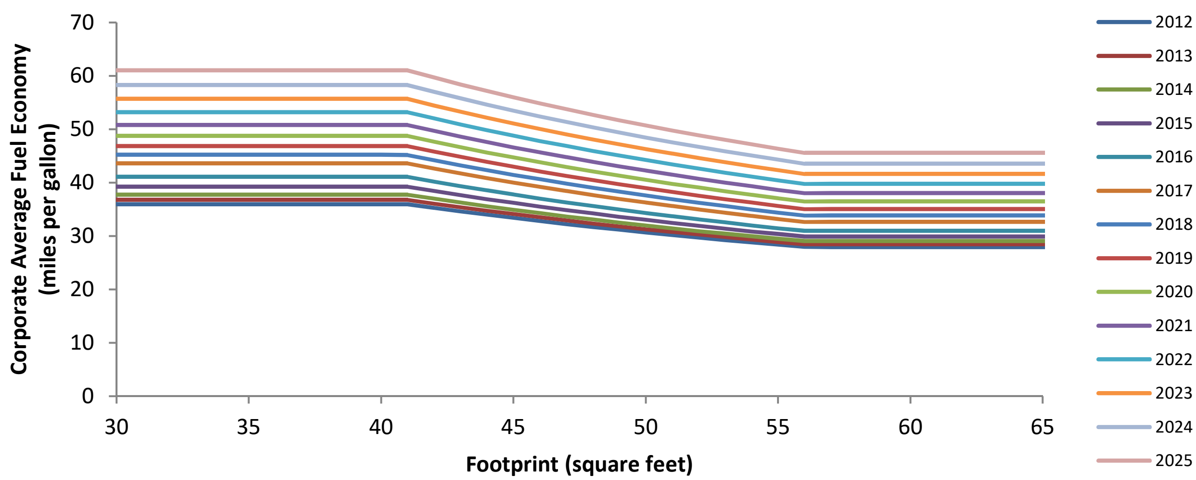


Source: (U.S. National Highway Traffic Safety Administration, 2014)

[7] The 55.5 mpg for passenger cars and 39.3 mpg for light trucks represents a target based on predicted fleet mix and footprint base assumed in the 2012 Final Rule. The actual final standard will likely differ.

The NHTSA compliance standard requires a 3.8 to 3.9 percent annual improvement in fuel economy for passenger cars from 2017 through 2021, and a 4.7 percent improvement from 2022 through 2025.[8] For light trucks, the standard requires a 2.5 to 2.7 percent improvement for 2017 through 2021, and 4.8 to 4.9 percent improvement from 2022 through 2025, as shown in Figures 12 and 13 (U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012).

Figure 12: U.S. CAFE Standards for Passenger Cars, 2012-2025

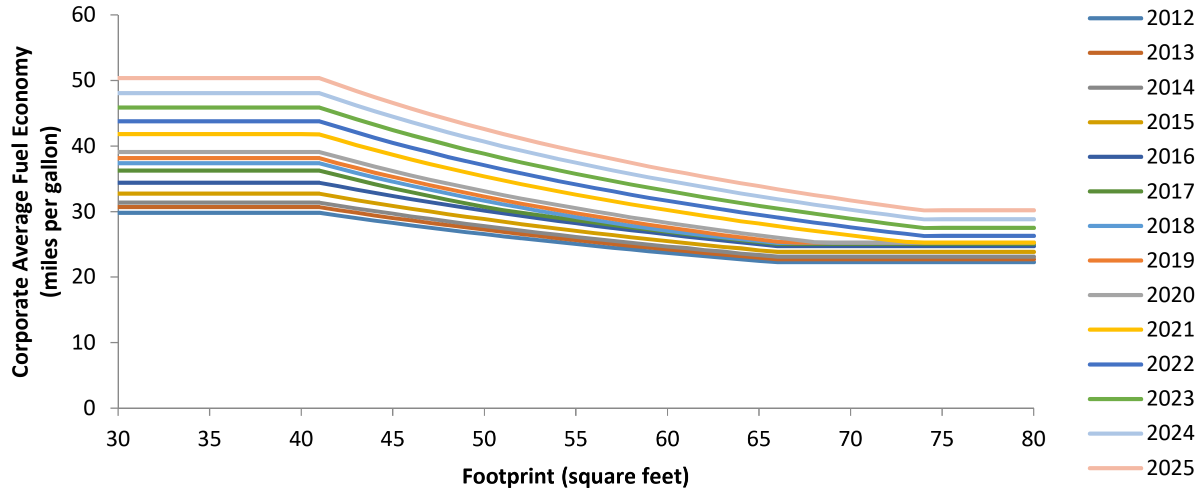


Source: (U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012)

The truck footprint curves in Figure 13 represent at least two important changes: first, the slope of the curve is altered from the 2012-2016 regulation. This change means a relative decrease in standards for larger vehicles, and an increase for smaller trucks when compared to the previous rule. And second; the point where the curves flatten shifts from 67 square feet to 74 square feet for light trucks in 2021. This footprint alteration offers some relief in meeting the standard for larger trucks by increasing the area below the line-shift vis-à-vis holding the inflection point at 67 square feet.

[8] The 2022 -2025 standards are augural due to the statutory provision that NHTSA shall issue regulations prescribing average fuel economy standards for at least one, but not more than five, model years at a time.

Figure 13: U.S. CAFE Standards for Light Trucks, 2012-2025



Source: *(U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012)*

The Role of Technology Incentives and Credits

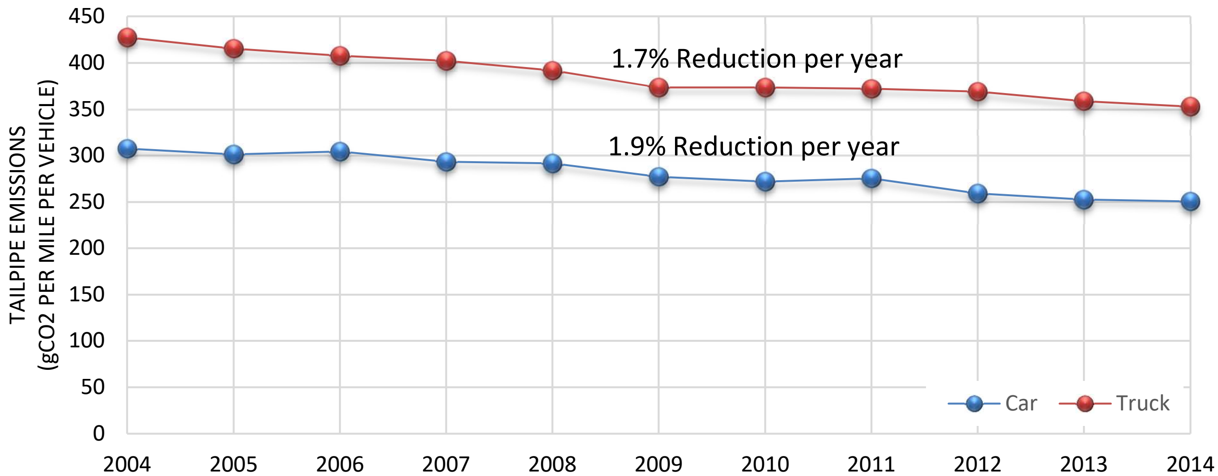
In addition to adjusting the slope and inflection point of the truck curves, NHTSA and EPA also implemented incentives for using advanced "game-changing" technologies. These incentives are in the form of credits under the EPA GHG program, and fuel consumption improvement values—equivalent to EPA's credits under the CAFE program (U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012).

Combined, the altered curves and game-changing technology incentives are intended to offer a pathway for manufacturers to accrue credits in early years, and apply them to meet the more stringent standards in the later years of the regulation. These credits may be earned by over-complying with the CAFE or GHG target for a given model year, implementing air conditioning and other off-cycle technologies that improve fuel efficiency, selling advanced powertrain vehicles such as electric vehicles, and/or offering alternative fuel powertrain options. In reality, the ability to earn adequate credits early in the regulatory timeline may be challenging.

Credits can not only be accrued, but also bought and sold between manufacturers. Attaining compliance through purchased credits requires that other manufacturers over-comply and generate excess credits. Even if a manufacturer generates more credits than it can currently use, there is no mandate to sell them to others; companies may instead keep the credits for strategic or competitive reasons.

In 2015, CAR researchers conducted an analysis of credit accrual and usage for the industry using 2013 credit balances (Schroeder & Smith, 2015). CAR applied a zero, two, and four percent reduction of fuel consumption per year to the entire fleet from 2015 to 2025. The two percent reduction in fuel consumption (or CO_2 emission) is consistent with the reductions achieved between 2004 and 2013 as trucks have had a total CO_2 emission reduction of 1.8 percent per year in that time period, and cars have reduced CO_2 emissions by 2.0 percent per year, as shown in Figure 14. For this report, CAR updated the 2015 study data to include 2014 model year performance.

Figure 14: Industry-Wide Unadjusted Tailpipe CO_2 Emissions for 2004 – 2014



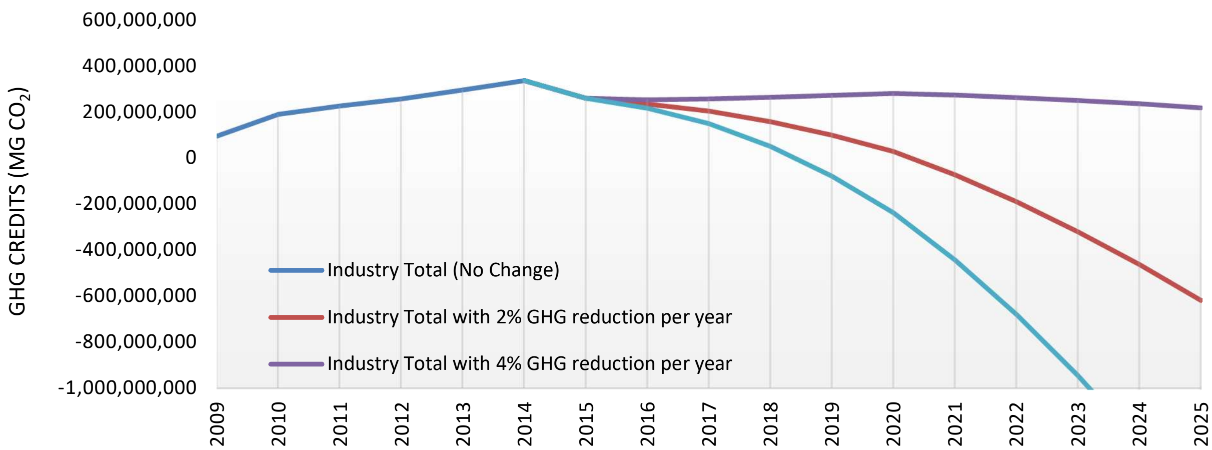
Source: *(U.S. Environmental Protection Agency, 2015)*

In the decade between 2004 and 2014, the industry implemented many fuel savings technologies. In fact, as the EPA states in the draft Technical Assessment Report released in July 2016:

> *"Manufacturers are adopting fuel economy technologies at unprecedented rates. Car makers and suppliers have developed far more innovative technologies to improve fuel economy and reduce GHG emissions than anticipated just a few years ago."* (U.S. Environmental Protection Agency, 2016)

Even at the "unprecedented rate" of innovation between 2004 and 2014, the industry achieved "only" half of the required annual reduction that will be required annually for the next decade. A zero percent reduction of annual fuel consumption results in the industry running out of credits by 2018, as shown in Figure 15. An annual reduction of fuel consumption by 2 percent for the entire industry would move the final year of compliance from model year 2018 to model year 2020. At a 4 percent improvement per year, the industry would be compliant for the foreseeable future; however, starting with model year 2022 the industry would once again begin to burn through its earned credits.

Figure 15: Industry-Wide CO_2 Credits at 2% and 4% GHG Reduction Per Year, 2009-2025



Source: *(Schroeder & Smith, 2015)*

The automotive industry will continue aggressive implementation of fuel economy technologies. But even if the rate of technology implementation continues as it has been, the industry may still be challenged to keep pace with the rate of improvement achieved over the previous ten years. If the rate of improvement matches the previous decade or slows, the industry will quickly burn through all available banked credits. CAR's 2015 fuel economy credit analysis illustrates the difficulty of manufacturers relying on banked credits as a strategy to meet the later years of the standards.

One of the key game-changing technologies for full-size pickup trucks is hybrid technology. The 2012 Final Rule includes incentives for mild and strong hybrids in full sized pickups; however, eligibility for both the mild and strong hybrid credit is dependent on the manufacturer reaching a minimum penetration threshold (U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012).[9]

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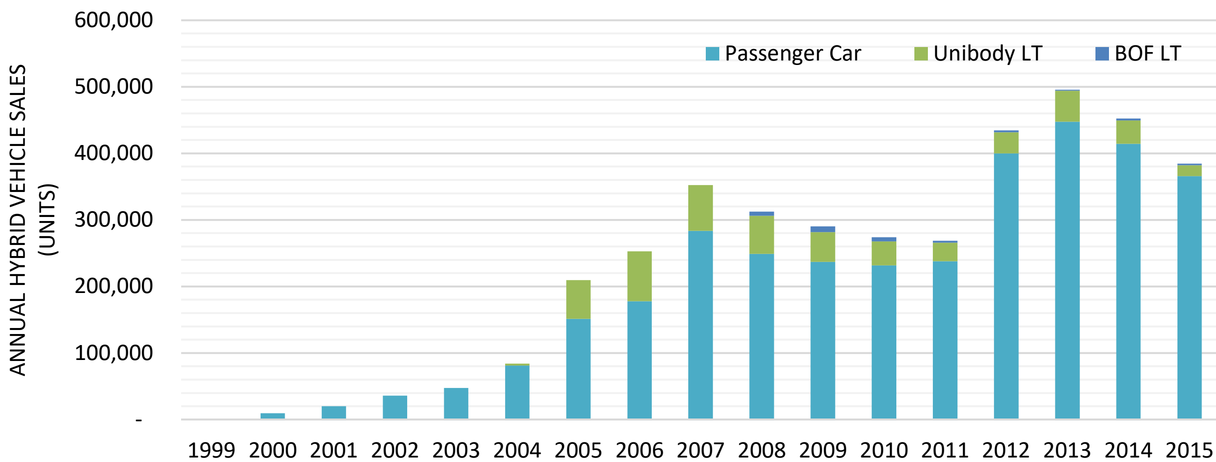
[9] To be eligible [for the credits], a manufacturer would have to show that the mild hybrid technology is utilized in a specified portion of its truck fleet beginning with at least 20 percent of a company's full-size pickup production in MY 2017 and ramping up to at least 80 percent in MY 2021. The final rule specifies a lower level of technology penetration for MYs 2017 and 2018 than the 30 percent and 40 percent penetration rates proposed, based on our [the regulators'] consideration of industry comments that too high a penetration requirement could discourage introduction of the technology. The lower required rates will help factor in the early experience gained with this technology and allow for a more efficient ramp up in manufacturing capacity. As proposed, strong HEV pickup trucks will be eligible for a 20 grams/mile credit (0.0023 gallons/mile) during MYs 2017–2025 if the technology is used on at least 10 percent of a company's full-size pickups in that model year. EPA and NHTSA are adopting specific definitions for mild and strong HEV pickup trucks based on energy flow to the high-voltage battery during testing. These definitions are slightly different from those proposed—reflecting the agencies' consideration of public comments and additional pertinent data. The details of this program are described in Sections II.F.3 and III.C.3, as well as in Chapter 5.3 of the joint Technical Support Document (TSD) (U.S. Environmental Protection

A vast majority of hybrid electric vehicles (HEVs) sold in the United States between 1999-2014 were passenger cars, as seen in Figure 16. HEV trucks—especially BOF hybrid trucks—have not sold well since their introduction in 2004. Even as gasoline prices increased more than 27 percent from 2006 to 2008, and the number of HEV light truck models more than doubled, U.S. sales of HEV light truck declined 12.3 percent. In 2015, just 18,423 hybrid light trucks were sold. While these sales represent 4.8 percent of all U.S. 2015 hybrid vehicle sales, it only represents 0.1 percent of the 2015 U.S. market, with hybrid BOF trucks comprising just 0.01 percent of the total market.

Figure 16: Annual U.S. Sales of Hybrid Vehicles by Passenger Cars, Unibody Light Trucks, and BOF Trucks, 1999-2015



Source: (HybridCars.com, Various Years) (U.S. Department of Energy, 2016)

Due to the lack of consumer acceptance to date, the ability to meet the federal government's minimum pickup hybrid technology thresholds remains uncertain, if not unlikely—thus making the potential hybrid credit all but unusable for this vehicle segment. It will be difficult to propagate game-changing technologies to meet stringent regulations if consumer demand for such vehicles remains low. By shifting the truck footprint curves and offering incentives for new technologies, the regulators clearly understand that large BOF trucks duty cycles merit unique consideration, but NHTSA and EPA may not have fully accounted for consumer requirements and other market factors that influence light truck demand.

Credits and flexibilities are an important part of the strategy for many companies to meet the NHTSA and EPA standards. The five U.S. manufacturers of BOF pickups use the Flex Fuel Vehicle (FFV) credits as a critical part of their overall CAFE strategy. The current cap for this credit is 1.2 miles per gallon; however, the calculation for this credit is changing (and has already changed for GHG calculation). Starting with MY2016, both the EPA and NHTSA are moving toward a utility weighting factor for FFV

Agency and U.S. National Highway Traffic Safety Administration, 2012) (U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012).

credits based on the real world use of flex fuels. This weighting factor determines the portion of fuel economy or GHG performance that counts towards petroleum and GHG reduction. This change has the direct implication of altering the fuel economy requirement by as much as 1.2 miles per gallon for some vehicle manufacturers' light truck fleets. Table 1 shows a timeline of changes to the petroleum credits that will be available for the CAFE and GHG regulations. Without the benefit of FFV credits as previously offered, pickup truck manufacturers will be further challenged to meet the CAFE standard. Further, credits earned in 2009 and prior years expired at the end of the 2015 model year—further reducing available credits.

Table 1: Timeline of Changes to Petroleum Credits for CAFE and GHG regulations, 2012-2025

		Model Year													
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Petroleum Reduction	EPA														
-85% improvement in flex fuel vehicles fuel economy	NHTSA														
Flex Fuel Vehicle Credit Cap	EPA														
-Maximum total CAFE credit for FFVs	NHTSA	1.2 mpg				0.8	0.6	0.4	0.2						
50 Percent Flex Fuel Utilization	EPA														
-Assumes vehicles operate on flex fuel 50% of the time	NHTSA														
Real World Flex Fuel Utilization	EPA														
-Weighting of flex fuel use based on real world utilization	NHTSA														

Source: *(U.S. Environmental Protection Agency and U.S. National Highway Traffic Safety Administration, 2012)*

Pickup Truck Technology Costs and Performance

These standards present an important challenge for pickup trucks and full-size SUVs that depend on performance, passenger capacity (e.g., third row of seats), and other utility as major sales attributes. In particular, horsepower and low end torque are valued assets for work and many recreational trucks. Since towing and carrying capacities are critical features of such vehicles, powertrain performance is especially important. Meeting stringent CAFE regulation will require improvements in powertrain efficiency that will likely add cost, and may adversely impact towing and drivability characteristics.

Improved aerodynamics and rolling efficiencies will play an important role in meeting efficiency standards for some vehicle segments. However, due to the unique duty requirements for BOF trucks, it will be challenging to substantially improve the coefficient of drag (Cd) or add lower rolling resistance tires to these vehicles. This may lead to an even greater focus on powertrain efficiency and mass reduction for BOF truck compliance.

Powertrain Efficiency

Companies continuously refine their gasoline engines and drivetrains. Further expected and announced additions in fuel economy technologies include advances in gasoline engines, stop-start technology, higher number transmissions (e.g. ten-speed) and possibly 48-volt hybrid systems. These additions improve fuel consumption efficiency, but may add weight, and not insignificantly, increase costs. Further, any potential short term gains in horsepower or torque from these new technologies may be reduced in coming years as engines are likely to be detuned to meet more stringent fuel economy standards.

CAR surveyed nine global automakers to assess expected costs for advance powertrain technologies for light trucks that may be used to meet future regulation (Smith, 2016). The data was provided as direct manufacturing cost, and in order to better reflect the expected current price to consumers of these technologies, CAR utilized a retail price equivalent (RPE) range of 1.5 to 1.84 for the current analysis (U.S. Environmental Protection Agency (EPA), 2016), (McAlinden, Chen, Schultz, & Andrea, 2016).

The additional price to the customer of increasing the fuel efficiency of a light truck gasoline engine from a V8 direct injection engine (representative of current technology) to a more advanced V6 turbocharged engine with 24 bar pressure and cooled exhaust gas recirculation (CEGR) ranges from $2,110 to $2,588 (2016 dollars) depending on RPE used. Further, data collected for the study included manufacturers' estimates for implementing stop/start (RPE of $619 to $760) and 48-volt hybrid systems (RPE of $2,460 to $3,017) into light trucks (Smith, 2016).

Due to cost reductions made possible by learning over time, total costs for each technology may be slightly lower by 2025, but adding these technologies represents significant increases to the purchase price of vehicles, and will make adoption challenging.

Mass Reduction

There are two well-established pathways to reduce mass—or lightweight—a vehicle through intensive use of either aluminum or high strength steel, as well as various permutations of the two (e.g. combining aluminum sub-systems, such as the cab, with steel subsystems, such as the frame). Today's state-of-the-art aluminum and ultra-high strength steel (UHSS) light trucks can be as strong, yet lighter, than previous generations that made use of lower-strength steels.

Even though some components in today's lighter vehicles can be less expensive than previous generations, overall, it is more expensive to produce a lighter weight pickup truck. A study conducted by FEV and funded by the EPA (Caffrey, Bolon, Kolwich, & Johnston, 2015) evaluated strategies to lightweight the 2011 GM Silverado truck. This study found:

1. Intensive use of UHSS could reduce weight by about 18 percent at a direct manufacturing cost of $1,150 per vehicle in 2012 dollars[10]—all by using technologies that are anticipated to be in mass production by 2020.
2. Additional weight could also be eliminated through increased use of aluminum in the cab, closures (hood, doors and tailgate), and bed, while maintaining a UHSS frame. With these additional improvements, the vehicle weight could be reduced by about 21 percent, but at a direct manufacturing cost of $2,200 in 2012 dollars.[11]
3. Even greater weight reduction is possible by adding an aluminum frame, but this option was deemed to be too expensive.

The 2015 Ford F-150 includes an aluminum-intensive cab, closures (doors and hood), and truck bed, with an UHSS frame. This design is similar to option 2 above, but the F-150 weighs just 13 percent less

[10] $1,190 in 2016 dollars.
[11] $2,277 in 2016 dollars.

(700 pounds) than the previous model—which includes a down-sized (and lighter weight) powertrain. FCA and GM have thus far chosen to use the UHSS mass reduction pathway.

Aside from cost, there are other factors to consider in making the transition from UHSS to an aluminum-intensive structure. Although before and after comparisons often take performance into account, the choice of materials can impact both vehicle performance and consumer acceptance. These factors are why FCA, Ford, and GM's redesigned pickup trucks have not achieved the weight savings estimated by the FEV study. Steel and aluminum can differ with regards to dent resistance, strength and corrosion, and these factors must be taken into account when designing for aluminum-intensive vehicles. Although repair costs may be higher, and the lead-time to repair aluminum vehicles could potentially be longer, the insurance industry has not yet responded with significant changes in the policies or rates offered to owners of aluminum-intensive vehicles. Additionally, vibrations transmitted through aluminum require additional cost and weight in the form of more sound package materials, damping and absorption padding to achieve the same interior quietness as steel. These issues were raised by the Honda critique to its light-weighted vehicle (Honda R&D Americas, Inc., 2013).

It is challenging to compare lightweighting technology costs for different vehicles due to different baselines (technology starting points), duty requirements, and other variances. Critiques of the EPA and NHTSA-sponsored studies contend that numerous costs are ignored—such as special development costs, capital costs, driveability impacts (e.g., noise mitigation and sprung-unsprung mass distribution), etc. The critics contend that the government's cost estimates are much lower than real-world costs experienced by the manufacturers (Honda R&D Americas, Inc., 2013). Using adjusted dollars and the RPE range from the previous section, it is conservative to estimate that aggressively light-weighted trucks will have an RPE between $1,785 and $2,190 (UHSS) or $3,415 and $4,190 (aluminum) higher than previous models.

Ford's innovative use of aluminum for body panels and the truck bed is a noteworthy step in mass reduction for the F-150. However, further mass reduction for that vehicle may prove very costly. Any additional move to a greater than 10 percent weight reduction, CAR estimates, will cost a multiple of this initial light-weighting cost (Baron & Modi, 2016).

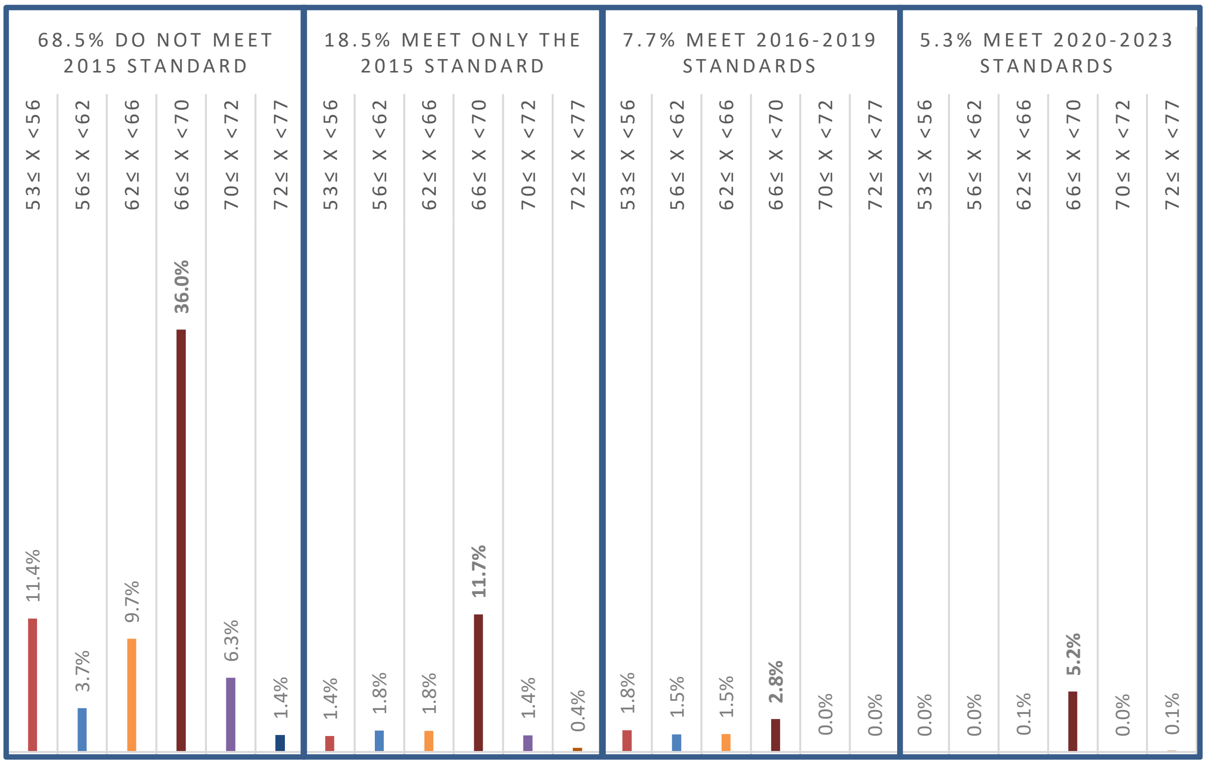
Performance Against the Standards

Figure 17 shows 2015 pickup truck CAFE performance compared to the footprint standards, with groups of individual vehicle configurations represented by colored bars. The figure represents all 2015 pickup models with gasoline engines, including variations for engine configurations, and with either two-wheel drive (2WD) or four-wheel drive (4WD) systems. The data show that without credits (FFV, off-cycle, etc.), nearly one-third of MY2015 pickup trucks with gasoline engines met or exceeded the 2015 CAFE standard, while over two-thirds of MY2015 pickup trucks with gasoline engines did not. All MY2015 pickup trucks with diesel engines met or exceeded the CAFE standard for 2021, but these vehicles struggle to meet EPA's GHG standards.

The figure illustrates several key points: First, the regulation is already a significant challenge for mid-sized pickup trucks due to their smaller footprints (below 56 square feet). Roughly 13 percent of all

MY2015 pickup trucks with gasoline engines exceeded the 2015 regulation. Just 5.3 percent of MY2015 vehicles sold met the 2020-2023 standards, and these are entirely Ford F-150s, which were redesigned as an all-aluminum vehicle for MY2015. The F-150 configurations that do exceed the 2015 standard are those with smaller engine displacements (2.7L SGDI, 3.5L SGDI, and 3.5L MFI) that may be less capable of meeting the duty cycle required for many pickup trucks. Just one in five Ford F-150s sold in the first year of that vehicle's complete redesign met or exceeded the 2020 CAFE standard. It is clear that all BOF pickups will need to make significant improvements in fuel economy in the coming years.

Figure 17: U.S. Light-duty Truck CAFE Targets and 2015 Model Year Pickup Truck Performance Without Credits



Source: (U.S. Environmental Protection Agency, 2016); Center for Automotive Research analysis

A common misconception is that the smaller pickup trucks will help a company's fuel economy position. Historically that may have been the case, however, with the footprint-based strategy in place the smaller pickups are not necessarily a positive contributor to CAFE compliance. Unlike many of the full-size pickup trucks, these mid-sized pickups are not positioned on the flat part of the curve, and thus are more challenged to meet the standards. Advanced diesel engines have been proposed as a possible solution for this segment, but this option adds cost and still faces likely emissions challenges. The current CAFE results reinforce the importance and difficulty in finding technology solutions for this increasingly popular segment.

Clearly, achieving the standard means managing the mix of model variants and options sold. A recent news article pointed out that while overall sales of a popular pickup truck model meet the current CAFE regulation on average, a large share of specific configurations—especially those with smaller footprints—do not meet the current 2016 EPA mandate (Lippert, 2016).

Manufacturers' Portfolio Approach

Meeting CAFE requires manufacturers to take a portfolio approach. A newly-introduced product will likely be CAFE positive (i.e., achieving greater than standard) for the first few years, and then may become CAFE negative (i.e., achieving lower than standard) for the last few years of a product lifecycle. During a product life cycle, a company may add fuel efficiency technologies (stop/stop, diesel engine, etc.). However, even with these additions (and assuming consumers accept these technologies) the product will likely continue fall behind the increasingly stringent fuel economy regulation. At any time, some products within each manufacturers portfolio become CAFE positive while others turn CAFE negative. Manufacturers must manage CAFE and GHG compliance in a portfolio manner, balancing each product in regard to the individual vehicle performance requirements and CAFE targets, along with the impact of other vehicles in the company's line-up.

Vehicle manufacturers have historically built the business case for pickup trucks over a twelve to fifteen-year time horizon in order to meet their internal rate of return (IRR) hurdle rates or a level of return on invested capital (ROIC) requirements. The added cost due to complexity of pickup trucks (numerous cab variations, bed lengths and powertrain options) means it is critical for automakers to spread out engineering, research, design, and tooling costs over higher volumes than most other segments to achieve reasonable per unit allocations. The business case is further pressured by the fact that many of these vehicle cannot gain global scale due to being a U.S. and Canadian focused segment.

Due to the traditionally long life cycles for pickup trucks, companies must consider large technology steps (e.g. the aluminum body for the Ford F150) in the redesign of these vehicles. During a time of rapidly increasing fuel economy standards, these technology advancements must be even larger to remain compliant throughout the life of the vehicle. Although step function changes can bring opportunity for greater differentiation, they also bring far greater risk (customer acceptance, technology readiness, and supplier infrastructure), as well as higher development costs and, ultimately, higher consumer prices.

Alternatively, manufacturers may choose to shorten BOF pickup truck and concomitant powertrain product life cycles. Such a strategy will lower overall unit volumes during the life of the program to allocate investment costs. Thus the engineering, design, testing, and tooling costs—along with the manufacturing plant investments—will increase per unit, and ultimately result in an increased cost to the consumer.

Either strategy will likely lead to higher expenditures to assure platform regulatory compliance, and therefore greater risk for stranded capital. Clearly, as regulatory compliance requirements become more stringent, producers of, and companies that supply components for, BOF pickup trucks are facing an increasing risk of reduced profitability in this critically large segment.

ANALYSIS OF THE ECONOMIC IMPORTANCE OF LIGHT TRUCKS IN THE UNITED STATES

CAR researchers utilized a standard regional economic analysis model to estimate the economic contribution of all U.S. body-on-frame production employment to the overall U.S. economy; this employment includes employees at FCA, Ford, GM, Renault/Nissan, and Toyota.

A Model of the Contribution of U.S. Body-on-Frame Truck Production to the U.S. Economy

Utilizing a regional model of the U.S. economy, CAR estimated the jobs and economic contribution of U.S. BOF truck production and employment in the United States.[12] The model is a computable general equilibrium (CGE) model, which is a computer model that maps how an economy works and how it responds to policy or economic changes. In this economic contribution analysis, the model is used to estimate the number of jobs supported or created by the production of BOF trucks in the United States, as well as the subsequent personal income generated and personal income taxes paid because of the manufacture of these vehicles. The model has been fully documented and peer-reviewed, and was designed for this type of analysis.

The model inputs—direct employment—were drawn from proprietary CAR data files on company employment by plant, and the intermediate and spin-off employment and earnings estimates were generated by the model. The estimated employment contribution is divided into three categories:

- Direct employment is defined as all manufacturing employees from BOF truck assembly and associated engine and transmission employment;
- Intermediate employment is the number of supplier jobs directly related to BOF truck production—in all sectors of the economy;
- Finally, all employment resulting from spending by both direct and indirect employees is referred to as spin-off employment or expenditure-induced employment.

Factors such as personal income generated, tax revenue generated, indirect employment created or supported, and expenditure-induced employment created or supported depicts the economic contribution of BOF truck production and related engine and transmission manufacturing to the U.S. economy as simulated by the regional economic model. CAR's methodology allows for the separation of economic activity influenced by the operations of suppliers, assemblers, and dealers from the aggregate economy, and permits the capture of economic contributions from continued employment in U.S. BOF light truck and related engine and transmission manufacturing.

Note that only direct manufacturing-related employment was used in this analysis. Most automakers—especially FCA, Ford, GM, and Toyota—conduct a majority of the research, design, development, and engineering activities related to light trucks in the United States. However, these expenses and the associated employment are not disclosed at the level of geographic (United States) or product category

[12] The Regional Economics Models, Inc. (REMI) model has been used by CAR and other organizations for over two decades for policy and industrial development analysis.

(light trucks) level. In addition, a substantial portion of corporate sales, general, and administrative expenditures and employment are related to light trucks, but it is difficult to attribute a share of these costs to light trucks, as well.

The results of CAR's analysis in Table 2 show that every one job in U.S. BOF assembly or in manufacturing engines and transmissions for those BOF trucks supports an estimated 14.9 jobs elsewhere in the economy. The supported jobs are primarily within the manufacturing sector, but the impact is seen in many other sectors, as well—including construction, administrative, retail trade, and professional and technical services. The total private disposable income associated with U.S. BOF light truck and related engine and transmission employment is estimated at $71.9 billion in 2015, and the net gain to the government treasury is estimated at $26.56 billion. U.S. BOF truck and related employment represents 0.82 percent of total U.S. private sector employment, but 1.06 percent of total U.S. private sector compensation, which demonstrates that jobs related to the manufacture of BOF light trucks are on average better compensated than the remaining private sector jobs.

Table 2: Economic Contribution of U.S. Body-on-Frame Truck Manufacturing, 2015

Economic Impact	U.S. Body-on-Frame Truck Manufacturing
EMPLOYMENT	
Direct	84,200
Intermediate	437,300
Subtotal (Direct + Intermediate)	521,500
Spin-Off	821,400
Total (Direct + Intermediate + Spin-off)	**1,342,900**
MULTIPLIER	
(Direct+Intermediate+Spin-off)/Direct	**15.9**
TOTAL EARNINGS BY PLACE OF WORK, PRIVATE NON FARM ($ BILLIONS NOMINAL)	$98.46
Less: Contributions for Government Social Insurance	$10.51
Less: Personal Current Transfer Receipts	$3.69
Less: Personal Income Taxes	$12.36
Equals Private Disposable Personal Income ($ Billions Nominal)	**$71.90**
CONTRIBUTION AS % OF TOTAL PRIVATE ECONOMY	
Employment	0.82%
Compensation	1.06%

Source: Center for Automotive Research analysis

These economic contributions are conservative estimates, as they are calculated only on BOF truck and associated engine and transmission employment; including all light trucks would yield higher employment, personal income, personal income and social insurance taxes paid, and government transfer payment impacts.

Observations and Conclusions

Light trucks represent an important segment, and are a vital economic contributor to the U.S. Economy. Light trucks represent a majority of light vehicles sold and manufactured by all automakers in the United States. In 2015, over 155,000 workers were employed by 11 U.S. vehicle manufacturers in the production of light trucks, and engines and transmissions for light trucks. Light truck sales and production are essential to U.S. automotive assembly and parts supplier employment, the economies of the 13 states and numerous communities that host truck assembly and supplier plants, and the financial health of the automakers.

Light trucks, and specifically pickup trucks, represent an important source of profits for several vehicle manufacturers. On a per vehicle level, every incremental unit of light truck sales brings in an average, across the entire light truck segment, of $6,000 in profits at Ford and GM. This per vehicle estimate includes large SUVs and pickup trucks that are among the most profitable vehicles sold in the United States; profits on pickup trucks can be as high as $13,000. Clearly, light trucks drive profits for many companies. The importance of these profits from such a concentrated portion of the vehicle manufacturers' product portfolio cannot be underestimated. Profits from light truck sales provide significant financial underwriting for everything from research and development of future powertrains, to product renewal across all vehicle segments. Profits also support assembly plant job security, cash flow to lower the companies’ perceived risk and interest rates for corporate borrowing, and add to the balance sheet reserves vehicle manufacturers need to cushion inevitable sales downturns.

Manufacturers are adopting fuel economy technologies at unprecedented rates, but the added costs of these technologies, and uncertain consumer acceptance may make meeting regulatory standards difficult. Consumers value light trucks for their versatility, interior space, and performance compared to cars as well as a perceived safety advantage. Many of these attributes may be difficult to continue to be delivered given pending GHG and fuel economy regulations, which in turn may affect consumer demand. This could greatly decrease profitability, employment, and the economic contributions of the industry to the U.S. economy

Accounting for some CUVs as passenger cars instead of light trucks negatively impacts both passenger car and light duty truck fuel economy standards and puts further pressure on each company’s portfolio of products. The bifurcation of how CUV models are categorized as both passenger cars and light trucks has created a challenge for meeting both fleet standards. Shifting higher fuel economy models from the light truck to passenger car classification will lessen the ability of manufacturers to meet light-duty truck standards, thus putting greater pressure on vehicle manufacturers to increase fuel economy for BOF trucks. Concomitantly, switching CUVs into the passenger car fleet will negatively impact automakers’ ability to meet the car standards.

Credits and technology incentives may not provide sufficient push to meet standards. Due to very low current market acceptance, incentives for using advanced "game-changing" technologies—specifically for HEV pickups—may not help with meeting the CAFE and GHG standards. Consumer acceptance of HEV BOF trucks is extremely low—comprising just 0.01 percent of the total market in 2015. Due to the market penetration rates required to garner incentives, pickup truck HEV credits may not be useful in meeting the federal standards. Also, the model year 2016 change in accounting for flex fuel credits will negatively impact credit balances, which will put added pressure on many automakers' truck profits.

Technology costs to meet BOF duty cycle requirements may be excessive. Meeting future fuel efficiency standards for all vehicle segments will require costly technologies. However, due to the required duty cycles of BOF vehicles, the added costs may be even more severe—or possibly require levels of performance degradation that consumers find unacceptable.

Mid-sized pickup trucks may be especially challenged to meet standards throughout the regulatory time frame. Unlike many full-size pickup trucks, mid-sized pickups are not on the flat part of the footprint curve, and thus are more challenged to meet the standards. Thus, the structure of the standards may negatively impact this growing segment—a segment that provides opportunity to shift some buyers toward more fuel efficient vehicles. Further, the midsize pickup segment may be more price sensitive than the full size pickup segment, making it more challenging to add costly powertrain technologies or lightweight materials to midsize pickups.

Stranded capital is a concern for all, but may be more severe for BOF pickup trucks. Since pickup trucks have historically had long product life cycles, redesigns often require manufacturers to make large technology steps to be compliant with future regulations in the later years of the product. Rapidly increasing standards may lead to even greater cycle-to-cycle leaps, which increases both risk and product development and engineering costs. Alternatively, companies may choose to shorten BOF product life-cycles, which also increases development and engineering costs, but limits the production volume over which these costs can be amortized. Either strategy decreases the likelihood of achieving the required internal rate of return for BOF pickup trucks.

Unintended outcomes from regulatory standards may lead to economic disruption for companies and communities. While there are regulatory provisions that offer some compliance flexibility through credits, credit banking and trading, and technology incentives, it is not at all certain that vehicle manufacturers will meet the regulatory targets for light trucks. With real fuel prices nearing historic lows—and projected by the U.S. Energy Information Administration to stay low through 2035—U.S. regulators must take care during the ongoing MTE to set realistic and achievable standards for light trucks. Anything that could dampen the market for light trucks consumers want to buy would result in large economic and financial impacts in the United States. These impacts would be especially large at FCA, Ford, and GM—companies with a current sales mix that is 72 percent light trucks, and a manufacturing mix that is 76 percent light trucks. Lower truck sales would not only impact these three automakers, but also BMW, Daimler, Honda, Hyundai-Kia, Renault/Nissan, Subaru, and Toyota and the large, long, and heavily U.S.-based supply chain that is completely interdependent in its support of all light truck manufacturing in the United States.

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