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ANALYST BRIEF

Economic Implications of the Current National Program v. a Weakened National Program in 2022-2025 for Detroit Three Automakers and Tier One Suppliers

June 27, 2016 | Alan Baum & Dan Luria[1]

This Analyst Brief evaluates the economic implications of retaining or weakening the Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) emissions regulations for automakers and their suppliers under five fuel price scenarios. We conclude that the auto industry would be profitable in all five fuel price scenarios under current standards, and that weakened standards could lead to supplier business losses as well as a higher risk of market share losses for the Detroit Three in the event of a future fuel price shock.

The National Program governing GHG emissions and CAFE standards requires an increase from a *real-world* average fleet fuel economy of 25 miles per gallon (MPG) in 2015 to 37-39 MPG in 2025[2] for all new cars and light trucks sold annually in the U.S. Automakers are taking a variety of approaches to improve fuel efficiency to meet the National Program standards, with each company leveraging its strengths. At the same time, Tier One suppliers[3] are investing heavily in a wide range of fuel-saving technologies. EPA, in coordination with NHTSA and the California Air Resources Board (CARB), is currently conducting a Midterm Evaluation (MTE) of the GHG standards under the National Program, assessing whether model year 2022-25 standards should be retained, strengthened, or weakened. (In close coordination with EPA's MTE process, NHTSA is also required to promulgate new fuel economy regulations for MY2022-2025, and CARB is also reviewing its 2022-2025 standards.)[4] EPA, NHTSA and CARB are expected to issue a draft Technical Assessment Report in June or early July of this year.

This Analyst Brief is a summary for investors and policy analysts of a larger study that will be available from Ceres in August 2016. In the study, we forecast automaker pretax profits[5] under three regulatory regimes and five fuel price scenarios. The regulatory regimes considered are (1) the current 2022-2025 National Program standards, and two weakened National Program scenarios in which fuel economy requirements are frozen at 2021 levels or in which credits are added (to the same effect) (2) for trucks only and (3) for both cars and trucks. Three of our fuel price scenarios are based on the U.S. Energy Information Administration's (EIA's) April 2015

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Long-Term Forecast:[6] $2.40 per gallon (Low price), $2.95 per gallon (Mid or "reference" price), and $4.56 per gallon (High price).[7] We also evaluate a fourth *Very* Low price scenario ($1.80 per gallon), which we believe to be unlikely. In each scenario, we adjust the vehicle mix to reflect the various types of passenger cars and light-duty trucks demanded at each fuel price. We distinguish between crossover utility vehicles (CUVs) and minivans (which have both utility and passenger features and are built on car platforms) and framed trucks (pickups, sport utility vehicles (SUVs), and larger vans).

Our scenario analysis focuses on the so-called "Detroit Three" in the U.S. – GM, Ford, and the Chrysler part of Fiat Chrysler Automobiles (FCA). As Europe- and Asia-based automakers face much higher fuel prices in their home continents than automakers do in the U.S., they are better positioned to comply with the 2025 U.S. standards. As the Detroit Three have long faced much lower fuel prices due to low U.S. energy taxes, they have sometimes been less focused on fuel economy, particularly in their framed trucks. Despite that, we demonstrate -- using conservative assumptions regarding future fuel prices, consumer valuation of fuel savings, and economies of scale for suppliers – that, with the current standards left in place, the Detroit Three will be able to fully recover their compliance costs at any fuel price above $2.60/gallon. Even in the Very Low fuel price scenario of $1.80/gallon, they will still be highly profitable due to the large shift toward framed trucks that occurs when fuel is that inexpensive.

High-Level Takeaways

- The Detroit Three will be profitable under the current National Program standards in *all* fuel price scenarios in the study.

- The regulatory certainty of maintaining the current National Program standards is valuable to automakers,[8] and perhaps even more so to the Tier One suppliers that are making the majority of fuel-saving technology investments in research, development, and production capacity.

- By requiring automakers to field a slightly more fuel-efficient 2022-25 fleet than they otherwise might with low fuel prices, the current National Program provides a form of insurance for automakers and their suppliers against future market share loss in the event of a return to high fuel prices. The current standards also keep the Detroit Three focused on the car/CUV platforms that are key to their global success. In 1985, more than two-thirds of Detroit Three unit sales were in North America; by 2025, we project that only one-third will be.

Detailed Results and Discussion

Impact of Standards on the Detroit Three Automakers

As outlined above, we constructed a number of scenarios to examine how the stringency of the National Program and fuel prices in 2025 affect vehicle sales mix, the automaker-borne share of compliance cost (i.e., total compliance cost minus what can be passed on to customers), and Detroit Three pretax profits. In addition, we examined how each scenario affects the level of orders to automobile suppliers. Results for the Detroit Three are described here and summarized in Table 1.

1. Under the current 2025 standards, in a trend-sized U.S. market of 16 million units,[9] the Detroit Three together have annual sales of 6.8 million units and are profitable in all five fuel-price scenarios.[10]

2. At any gasoline price above $2.60 per gallon, the Detroit Three automakers are able to pass on their full $1,353 per vehicle average cost of compliance (see Appendix A for how that figure is calculated).[11,12]

3. With gasoline at either EIA's Midrange or "reference" forecast price ($2.95 per gallon)—and certainly at anywhere near EIA's 2025 High forecast price ($4.56)—automakers are able to pass through the full $1,353 -per vehicle cost of compliance, so the standards do not have a material impact on their pretax earnings. At fuel prices above about $3 a gallon, automakers can often *increase* profits by charging a premium over cost on fuel-saving technologies. For example, Ford has been able to charge more than its cost of compliance for its F-150 EcoBoost variants.

4. With gasoline at the EIA's "Low" forecast level for 2025 ($2.40), automakers can pass on $1,148 of their $1,353 average compliance cost. The Detroit Three have to absorb the other $205 per vehicle, costing them $1.4 billion. That reduces their pre-tax profit from selling vehicles in the U.S. from $15.6 billion to a still-healthy $14.2 billion.

5. Even though automakers can pass on only $736 of the $1,353 per-vehicle compliance cost (relative to 2014) under a highly unlikely Very Low 2025 fuel price scenario ($1.80 per gallon), the Detroit Three would still earn $1.2 billion more than they would at $2.40 gasoline due to the additional shift toward framed trucks that would occur at $1.80 per gallon fuel.[13]

Table 1: Impact of National Program Regime and Fuel Price on the Detroit Three in 2025

2025 FUEL PRICE	TRUCK % OF US SALES	COMPLIANCE COST PER VEHICLE *Passed Through by Automakers*	COMPLIANCE COST PER VEHICLE *Borne by Automakers*	DETROIT 3 PRETAX PROFIT WITH CURRENT 2025 STANDARDS	
				TOTAL	PER VEHICLE
$1.80 *VERY LOW*	63.5%	$736	$617	**$15.4** *BILLION*	$2,265
$2.40 *LOW*	59.5%	$1,148	$205	**$14.2** *BILLION*	$2,088
$2.95 *MID*	54.5%	$1,353	$0	**$12.8** *BILLION*	$1,883
$4.56 *HIGH*	50.5%	$1,353	$0	**$6.3** *BILLION*	$926

Fuel price, cost, and profit values are in 2013 dollars.

Standards as a Hedge Against Future Fuel Price Increases

Some automakers argue that the current National Program standards impose an economic burden because automakers cannot pass on all of their compliance costs under low fuel prices. However, that burden may be partially, fully, or even more than fully offset if retaining the standards provides automakers with an effective "insurance policy" against higher fuel prices in the future. This is because the standards provide an incentive for the Detroit Three to field a fleet of vehicles throughout the 2020s that can reduce their risk of lost market share and profits in the event that fuel prices rise sharply between now and 2025.

To evaluate whether the current National Program standards are a cost effective hedge (i.e. a correctly priced insurance policy) against future fuel price spikes, we compared the net savings of weakened standards at Very Low fuel prices to the net losses of weakened standards in the event of a price spike. To quantify the latter point, we modeled a fifth fuel price scenario that we call "Snapback." In it, the standards are weakened and fuel prices stay Very Low through 2020 but then climb toward the EIA High forecast level ($4.15 per gallon in 2020, rising to $4.56 per gallon in 2025). This scenario is closely reminiscent of fuel price trends in 1978-81 and again in 2004-11. With the 2025 standard left in place, the Detroit Three earn $6.3 billion with High fuel

prices in an average-volume year, as shown in the table above. Our analysis shows that if the standards were weakened following the Midterm Evaluation and if fuel prices were to jump back into the $4/gallon range, then the Detroit Three would lose market share in cars and small CUVs to their Europe- and Asia-based competitors.[14] Based on an analysis of historical Detroit Three share loss between 1995 and 2015, our modeling predicts that the Detroit Three would lose 301,000 car and small CUV sales to other automakers in this fuel-price Snapback scenario. That loss in sales would reduce Detroit Three unit sales in 2025 from 6.8 million to just under 6.5 million, a loss of 1.9 points of U.S. market share. We estimate that this share loss would reduce the Detroit Three's annual pretax profit by $1.08 billion.[15]

Impact on Suppliers

Suppliers too stand to gain or lose from retaining or weakening the 2022-2025 National Program. Suppliers make up a significantly larger portion of the U.S. economy and of U.S. employment than do the automakers. In April 2016, automakers (NAICS code 3361) employed 214,700 people in the U.S., while makers of auto parts (suppliers in NAICS code 3363[16]) employed 564,100, or 2.6 times as many.[17] Stronger standards lead to increased supplier revenue because as much as 80% of the $1,353 per vehicle in additional Detroit Three compliance costs from 2014 to 2025 represents increased purchases from suppliers. Our analysis predicts that over the 12-year period 2014-25 with the 2025 National Program standards left in place, automakers (not just the Detroit Three) will spend an estimated $111 billion on fuel-saving technology, about $89 billion of which will be paid to suppliers.[18]

OEM and Supplier Impacts at Very Low Fuel Prices

Returning to whether the standards are a cost-effective insurance policy for automakers, we quantify the net savings of weakened standards by weighing Detroit Three savings against supplier order losses under Very Low fuel prices and weakened standards. This is, of course, an extreme scenario. While the U.S. briefly experienced $1.80 per gallon fuel prices in late 2015, that price is still 60 cents per gallon, or 25%, below the EIA's *Low* scenario for 2025.

We quantify the automaker savings component of net savings first. Because new trucks or both cars and trucks will get fewer miles per gallon under a weakened regulatory regime -- real-world mpg would be 3-5 mpg lower -- consumers' valuation of three-year fuel savings will fall. As a result, the Detroit Three automakers, as a group, appear to save either $383 per vehicle (weakened truck standards only) or $537 per vehicle (weakened standards for both cars and trucks). However, the automakers' projected savings are reduced to $235-261 per vehicle because consumers will be willing to pay less for the poorer fuel economy permitted by weakening the standards.[19] Across the 6.8 million new vehicles sold, not having to spend $235-261 per vehicle saves the Detroit Three $1.60-$1.78 billion.

Next, we quantify the suppliers' loss component of net savings. About eighty percent of automaker compliance costs are paid to suppliers of fuel-saving technologies, so those savings to automakers also represent a $1.28-$1.42 billion loss in orders for suppliers. Thus, when one considers both automakers and suppliers, *the net effect of weakened regulations to the industry would be no more than $360 million* because the Detroit Three's $1.78-billion maximum savings are offset by a $1.42 billion in suppliers' order losses. It is worth noting that the $360 million in maximum net savings is contingent on anomalously low gas prices lasting deep into the 2020s. The actual savings are likely to be much lower. If, for example, 2025 fuel prices are instead at the EIA's Low level of $2.40 a gallon, the $360-million savings is reduced to just $120 million.

This inescapable conflict of interest between the automakers seeking to meet the 2022-25 targets and the suppliers whose technology can help them do so poses a critical question: is the maximum $360 million potential savings, which will only be realized under Very Low ($1.80 per gallon) fuel prices, enough to justify weakening the 2025 standards? To answer this question, we compare the net savings from weakened standards at Very Low fuel prices to the results of the Snapback scenario in which fuel remains cheap until around 2020 but then jumps back to the EIA High scenario level. We found that if that snapback occurs, Detroit Three pretax profit from U.S. new vehicle sales would fall by $1.08 billion per year. The math is therefore straightforward: since $360 million is exactly one-third of $1.08 billion, the standards are a cost-effective insurance policy if one puts the probability of a fuel price spike between now and 2025 at more than about one in three.

Regulatory Certainty

Finally, regulatory certainty is invaluable to automakers, suppliers, and their investors. The world's automakers are daily making decisions on which their futures – and therefore the future earnings of their stockholders, bondholders, employees, and communities – depend. Several dozen global Tier One suppliers[20] are reacting to automakers' decisions to increase fuel economy by pouring resources into R&D, adding production capacity, and issuing purchase orders to hundreds of *their* suppliers. Several hundred thousand workers and dozens of communities depend on automakers and their suppliers making prudent decisions. In considering whether or not to weaken the standards, regulators should not ignore the cost of stranding supplier assets and the range of products they develop at least partly in response to those standards.

Appendix A: Modeling the Cost of Compliance

In our modeling, we assume the lowest cost option of six common fuel saving "technology packages"[21] is added to every model car forecasted to be sold by each automaker in 2020 and 2025. We employ this technology package approach in recognition of the fact that many technologies target the same inefficiencies, so their combined application results in a lesser efficiency improvement than would be expected were their individual impacts assumed to be independent. Unit cost and the amount of fuel saved for each package are calculated based on a number of sources. These sources include the work of Meszler Engineering Services;[22] data from the National Program;[23] and results from a recent committee of academic, industry, and trade organizations knowledgeable on fuel economy convened by the National Research Council.[24] Finally, our modeling incorporates estimates of profit contribution by automaker and vehicle segment based on an average of estimates from financial firms that study the industry. The technology packages are shown below in Table A-1. The content of each package is fully explained in the longer study.

Table A-1: Price per Fuel-Saving Technology Package

Technology Package	Unit Price
ICE Low	$515
ICE High	$1,423
Hybrid	$3,101
Plug-in	$9,801
BEV	$10,501
Diesel	$2,338

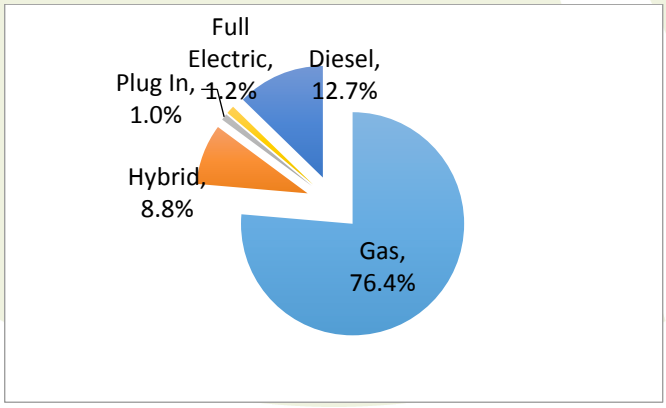
We applied packages to each model on the assumption that automakers seek to comply at the lowest cost, and that their recipe for doing so is influenced by their historical strengths. For example, FCA, BMW, Mercedes, and VW have used more diesels; Ford has focused on a variety of technologies reflected in its EcoBoost engines; Toyota, Subaru, and Hyundai/Kia have relied more on hybrids; and, of course, Tesla has relied entirely on battery electric vehicles (BEVs). The segment share for each automaker is shown in Table A-2 below.

Table A-2: Segment Shares by Automaker

2025	Hybrid Share	Plug In Share	BEV Share	Diesel Share	ICE High	Total Volume
BMW	12.8%	4.8%	2.0%	34.1%	46.4%	477,000
FCA	0.0%	0.0%	0.0%	21.5%	78.4%	1,902,500
Ford	7.1%	0.7%	0.0%	15.5%	76.6%	2,319,000
Fuji	18.8%	0.0%	0.0%	13.3%	67.9%	597,300
GM	1.5%	1.7%	1.1%	15.9%	79.7%	2,607,200
Honda	7.9%	0.2%	0.0%	6.3%	85.6%	1,481,300
Hyundai	13.3%	0.2%	0.1%	3.6%	82.8%	1,287,600
Mazda	0.0%	0.0%	0.0%	16.7%	83.3%	289,600
Mercedes	5.0%	0.4%	1.4%	25.9%	67.3%	390,500
Mitsubishi	0.0%	6.5%	0.0%	0.0%	93.5%	43,900
Nissan	3.6%	0.0%	2.7%	4.6%	89.1%	1,405,200
Tata	0.0%	0.0%	0.0%	16.6%	83.4%	67,900
Tesla	0.0%	0.0%	100.0%	0.0%	0.0%	121,900
Toyota	23.6%	0.7%	0.0%	4.5%	71.3%	2,350,500
Volvo	11.4%	1.4%	0.0%	15.0%	72.2%	56,800
VW	18.8%	4.9%	0.3%	21.1%	54.9%	601,800
Total	8.8%	1.0%	1.2%	12.7%	76.4%	16,000,000

Note that for all automakers except Tesla, alternative powertrains are not the predominant way that compliance is achieved. According to EPA and NHTSA estimates, compliance with the 2025 standards is possible with fleet wide sales of 0-2% electric vehicles. Furthermore, plug-in and battery electric vehicles are a very modest share of each company's fleet (again, with the obvious exception of Tesla).

Figure 1: Overall market segmentation



As a result of there being multiple recipes for achieving compliance and automakers having different starting points for average fuel economy in 2014, compliance costs vary considerably across automakers. The compliance costs range from just $695 for Hyundai/Kia to more than

$1,500 for GM and Mitsubishi. GM and Mitsubishi, along with FCA, spent relatively little prior to 2014. For all automakers selling in the U.S. market, the average 2014-25 compliance cost increase is $1,155; the sales-weighted average compliance cost for the Detroit Three is $1,353.[25] The costs shown in Table A-3 below also include the compliance costs by company that are not specific to any of the six technology packages (which are generally focused on the powertrain), most notably mass reduction.

Table A-3: Compliance Cost per Vehicle

Automaker	Cost per Vehicle Sold in 2014	Cost per Vehicle Sold in 2025	Additional Cost per Vehicle Sold, 2014-2025
BMW	$ 1,453	$ 2,534	$ 1,081
FCA	$ 379	$ 1,779	$ 1,399
Ford	$ 989	$ 2,060	$ 1,071
Fuji	$ 801	$ 1,860	$ 1,059
GM	$ 470	$ 2,047	$ 1,577
Honda	$ 410	$ 1,629	$ 1,219
Hyundai	$ 1,014	$ 1,709	$ 695
Mazda	$ 690	$ 1,576	$ 886
Mercedes	$ 995	$ 1,899	$ 905
Mitsubishi	$ 317	$ 1,964	$ 1,647
Nissan	$ 662	$ 1,773	$ 1,111
Tata	$ 814	$ 1,575	$ 761
Tesla	$ 10,501	$ 10,501	$ -
Toyota	$ 966	$ 1,916	$ 951
Volvo	$ 727	$ 1,871	$ 1,144
VW	$ 1,469	$ 2,366	$ 897
Total	**$ 762**	**$ 1,917**	**$ 1,155**

Appendix B: Tier One Fuel-Saving Technology Suppliers with U.S. Technical and/or Manufacturing Operations

The following charts list the major Tier Ones that provide many of the fuel economy enhancing technologies. All of them have a substantial U.S. footprint for their R&D, technical sales, and/or manufacturing activities.

Table B-1: Engine-Enhancing Technologies

Product Line	Tier Ones
Direct injection	Bosch, Continental, Delphi, Siemens
Electric power steering	Denso, JTEKT, Mando, Nexteer, NSK, NTN, ZF TRW
Exhaust gas recirculation components	BorgWarner, Metaldyne, Senior Flexonics
Low rolling resistance tires	Bridgestone, Continental, Goodyear, Michelin, Yokohama
Turbochargers	ABB, BorgWarner, Bosch, Continental, Eaton (superchargers), Honeywell
Variable valve lift and timing	Aisin, BorgWarner, Delphi, Eaton

Table B-2: Transmission-Enhancing Technologies:

Product Line	Tier Ones
Automated manual transmissions	Aisin, BorgWarner
Automatic—high speed (6 or more)	Aisin, ZF TRW
Continuously variable transmissions	Aisin, JATCO
Dual clutch transmissions	Aisin, BorgWarner, Magna (Getrag), ZF TRW

Table B-3: Hybrid and Electric Vehicle Technologies:

Product Line	Tier Ones
Batteries	A123 Systems, ABB, BorgWarner, Bosch, BYD, Compact Power (LG Chem), Continental, GS Yuasa, Hitachi, Honeywell, Johnson Controls, NEC, Panasonic, Samsung SDI, Sanyo, Tesla Motors, Toshiba
Battery cooling systems	Behr, Halla Climate Control
Battery materials	3M, Applied Materials, BASF, Celgard (Polypore), Chemetall Foote, Dow, DuPont, Hollingsworth and Vose, Honeywell, Mitsubishi, Novolyte Technologies, Superior Graphite, Toda
Electric motors	BorgWarner (Remy), Brose, Continental, Hitachi
Electronic content including controllers and electronic control modules	Bosch, Continental, Danaher, Delphi, Denso, Intersil, Magna, Maxim, NEC, Rohm, Sanyo, Texas Instruments, ZF TRW
Infrastructure such as charging stations	Aerovironment, ChargePoint, Eaton, General Electric, GridPoint, Lear, Leviton
Inverters	Denso
Power splitters	Delphi Electronics
Start/stop systems	Bosch, Continental, Denso, Valeo
Wiring including harnesses and advanced controls	Inteva Products, Lear, Leoni, Sumitomo Electric, Yazaki

Table B-4: Lightweight Materials

Product Line	Tier Ones
Aluminum	Alcoa, Aleris, Kobe Steel, Novelis, Shiloh Industries, Wise Metals Group
Carbon fiber & other composites	BASF, Plasan Carbon Composites, SGL Group, Toray, Owens Corning
High-strength steel	AK Steel, ArcelorMittal, ARJ Manufacturing, Nano Steel, Pro-Tec Coating, RG Steel, U.S. Steel
Magnesium	Gibbs Die Casting, Meridian Magnesium Products, Shiloh Industries, Spartan Light Metal Products, TRU Group, Wanfeng

Notes

[1] Baum is Principal of Baum & Associates, an automotive forecasting and research consultancy. Prior to its launch, he was an analyst and forecaster with the State of Michigan, IRN, and The Planning Edge. Luria is an independent industry analyst whose career included eight years in the UAW Research Department and 28 as VP and Research Director at the Michigan Manufacturing Technology Center. Since 1990, Baum & Luria have collaborated on a respected quarterly forecast of North American vehicle, engine, and transmission sales and production. The forecast has been used in numerous studies for OEMs, suppliers, unions, financial institutions, and non-governmental organizations, including this study.

[2] The popular press reports the National Program 2025 standard as 54.5 mpg, but the use of specific credits reduces that to 46.2 mpg. The credits are fully detailed in the rule, with respect to the amount of fuel economy increment that is available for each vehicle that has the technology as well as the limits on the use of credits that can be applied industry wide. The reduction in fuel economy that is required after the credits is based on the expected use of credits under these conditions.) Under the regulations, automakers earn credits for using particular technologies (e.g. plug-ins, BEVs, and fuel cells) to meet the target, as well as for using greener air-conditioning refrigerants, engine idle stop/start systems, electric heater circulation pumps, active engine and/or transmission warm-up, high-efficiency exterior lighting, waste heat recovery, active aerodynamics, solar panels and other specific technologies. Moreover, the mpg listed on a vehicle's window sticker, which reflects *real-world* fuel economy, is roughly 20% lower, so that 46.2 is really about 38.8 mpg. In addition, note that the standard is footprint-based. That is to say, standards are lower for bigger vehicles. As a result, the relative car/truck sales mix does not affect an automaker's ability to meet the standards. Fuel at $1.80 per gallon (rather than the midrange $2.95 per gallon) raises the framed truck share of sales from 54.5% to 63.5%, and that reduces the 38.8 real-world average to 37.4 mpg.

[3] Suppliers are often classified by "tiers" that reflect the commercial relationship between the supplier and the manufacturer of the final product. Tier One suppliers provide products directly to automakers. Tier Two suppliers provide products to Tier One suppliers.

[4] In August 2012, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) announced a joint rule (National Program) establishing Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) standards for model years 2017-2025. The rule requires automakers to increase their new vehicle fuel economy by an average of about 50% from 2012 to 2025. The agreement brought a significant measure of certainty to the industry, both by providing a target for fuel economy and by eliminating the need to meet most state-specific requirements, notably California's. The National Program provides that EPA and NHTSA, in close collaboration with California Air Resources Board, must conduct a Midterm Evaluation of the standards for model years 2022-2025. NHTSA must then promulgate final 2022-25 standards by April 1, 2018. Both NHTSA's and EPA's decisions will be informed by the TAR, which will be issued in mid-2016.

[5] We forecast each of the Detroit Three's pretax profit from sales of new vehicles in the U.S. as follows. First, we model the size of each segment based on fuel price scenario, e.g., automakers sell fewer small cars when fuel is cheap. Second, we assign a per-vehicle profit contribution to each segment for each automaker, averaging several proprietary series from major financial institutions. Third, we vary segment pricing to take account of changes in incentives at each fuel price scenario, e.g., with expensive fuel, pickup truck transactions prices fall sharply. Fourth, having built up a total contribution for each of the Detroit Three, we subtract fixed costs.

[6] U.S. Energy Information Administration (EIA), Annual Energy Outlook, April 14, 2015, at http://www.eia.gov/forecasts/aeo/. At this time, that is the most recent forecast available.

[7] All fuel prices and profit figures are in 2013 dollars.

[8] Indeed, auto industry trade associations have advocated for regulatory certainty in the past. On page 19 of the Brief of the Association of Global Automakers and the Alliance of Automobile Manufacturers in the 2012 case *Coalition for Responsible Regulation v. EPA*, the association argued that, "The potential invalidation of the Tailpipe Rule would create substantial uncertainty for the automobile industry concerning the types of vehicles it must plan to produce ... [T]he automobile industry typically redesigns its models every five years, and requires regulatory stability in order to justify the significant upfront investment that comes with major vehicle redesign."

[9] In the longer study of which this Brief is a summary, we explain in detail why we treat 16 million as the trend level of sales (e.g. expected sales in an average economic year). Basically, the dollar value of the units sold has been setting records since early 2015, but growth in units is constrained by income distribution, improvements in quality (leading to longer vehicle life), urbanization, and in the future by growing trends such as car sharing. Comparing 1978 and 2015, the driving-age U.S. population grew by 53%, but new vehicle unit sales by only 11%.

[11] Our calculations of consumers' valuation of fuel savings are based on very conservative assumptions. First, we assume that consumers only consider fuel savings during the first three years of ownership, during which time new cars and light trucks are driven 41,931 miles ("Developing a Best Estimate of Average Vehicle Mileage," June 2011 at http://nhts.ornl.gov/2009/pub/BESTMILE.pdf). Second, following the seminal meta-analysis of Alcott and Wozny, we assume that consumers only value fuel savings at 76% of the actual amount that is saved. (See Alcott and Wozny (2014) at http://www.mitpressjournals.org/doi/pdf/10.1162/REST_a_00419).

[12] Much of the longer paper of which this Brief is a summary is a detailed analysis of how each automaker will meet the 2025 standard. See the Cost of Compliance (Appendix A).

[13] The Detroit Three earned pretax profits from U.S. new vehicle sales of approximately $22 billion in 2015 due to strong sales of framed trucks -- pickups, SUVs, and full-sized vans – aided by Low gasoline and diesel fuel prices.

Framed Trucks' Percent of Detroit Three Units Sold and of Variable Profit Earned, 2020 and 2025

	Fuel Price Scenario							
	Very Low		Low		Mid		High	
Automaker	% Of Units	% of Var Profit	% of Units	% of Var Profit	% of Units	% of Var Profit	% of Units	% of Var Profit
GM	45.0%	60.5%	37.5%	57.8%	34.7%	50.5%	32.6%	45.0%
Ford	48.3%	66.9%	39.9%	60.1%	37.3%	53.5%	40.0%	56.1%
FCA	51.2%	69.7%	42.0%	62.0%	40.0%	56.1%	37.7%	50.0%

Our 2025 pretax profit forecasts should not be compared to that $22 billion figure: in 2015, the Detroit Three sold 7.86 million cars and trucks -- a 45.2% share of a 17.4-million-unit U.S. market; in 2025, we

forecast that they will have a 42.5% share of a trend-sized 16-million-unit U.S. market, selling 6.8 million cars and light trucks.

[14] This loss of market share to the European and Asian automakers would result from the fact that the European and Asian automakers' vehicle fleets will be compatible with *global* consumer demand for fuel-efficient vehicles. Meanwhile weakened standards could lead the Detroit Three to be caught without enough highly fuel-efficient cars and small CUVs to meet the U.S. consumer demand associated with $4-plus fuel.

[15] The standards deserve some credit for helping keep this number smaller than it would otherwise be. Without the standards in place for 2017-2025, the 2014-15 plunge in fuel prices might well have induced one or more of the Detroit Three to tilt their U.S. product plans even further away from cars and small CUVs.

[16] In fact, NAICS code 3363 is not a full accounting of auto suppliers, since it only counts companies whose primary classification is auto parts. Many companies that make tooling, machinery, and plastic parts for the auto industry are classified in other NAICS codes.

[17] Bureau of Labor Statistics, at http://www.bls.gov/iag/tgs/iagauto.htm

[18] In this product area, automakers are particularly dependent on the talents of key suppliers that have focused their research and development efforts on fuel-saving technologies.

[19] The relatively small ($26 per vehicle) difference between automaker pretax profit from loosening only the truck standard versus both the car and truck standards suggests that the latter would have a very small impact compared to reducing only the truck standard.

[20] Please see "Tier One Fuel-Saving Technology Suppliers with U.S. Technical and/or Manufacturing Operations" (Appendix B).

[21] The content of the technology packages is fully explained in the full-length study.

[22] Meszler Engineering Services (MES) is an engineering consultancy specializing in air quality and energy-related research and analysis. MES founder, Dan Meszler, brings over 30 years of experience along with a background in civil and environmental engineering.

[23] See http://www.nhtsa.gov/fuel-economy Filename: 2017-25_CAFE_Final_Rule.pdf.

[24] See http://www.nap.edu/catalog/21744/cost-effectiveness-and-deployment-of-fuel-economy-technologies-for-light-duty-vehicles

[25] To be conservative, we assume no reduction in the cost of fuel-saving technologies as a result of rising volumes, i.e., no economies of scale. By 2025, per-vehicle compliance costs may well be lower than the figures we are using.