The Case for Stringent Emissions and CAFE Standards for 2024-26

Executive Summary

EPA and NHTSA have proposed rules regarding GHG emissions and fuel economy (CAFE) for Model Year (MY) 2023-2026, and 2024-2026, respectively, for cars and light trucks. The proposed rules[1] compare three sets of stricter standards to those set out in the Trump administration's SAFE Part II rule, under which fuel economy only had to improve by 1.5% per year from 2019. The new draft rule from NHTSA requires annual improvements averaging 3.9%, 5.4%, or 6.5% annually for the period from 2021 through 2026, which it refers to as Alternatives 1, 2, and 3, and notes that Alternative 2 is "preferred."
The EPA rule is less stringent, so analyzing the NHTSA rule encompasses the EPA proposal. Also at issue are the design and breadth of compliance credits, which, for example, would allow automakers who rack up above-standard fuel economy performance in the early 2020s to carry forward their overage to apply in years in which they do not comply or to sell credits to other non-compliant automakers.[2]

Ceres retained the respected automotive sector analysts of Baum & Associates[3] to model the impact on automaker and supplier pretax profit for two regulatory regimes in two fuel-price environments.

Four Scenarios for Automaker and Supplier Pretax Profit in 2026

Regulatory Regime and 2021-26 Annual Improvement Required	2026 Gasoline Retail Price per Gallon (in $ of 6/30/21)	
	$2.80	$3.80
NHTSA Alternative 1: 3.9% per year	*I*	*III*
NHTSA Alternative 3: 6.5% per year	*II*	*IV*

Baum & Associates modeled the difference between how automakers might achieve Alternative 1 and Alternative 3. They determined that Alternative 3 – requiring 6.5% annual fuel economy improvement -- is entirely feasible and cost-effective even without credits, which were not included in their analysis. Automaker and lobbyist support for large and flexible credits should be resisted by rule makers. Credits

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[1] NHTSA issued the rule-making document "Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks," available at https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy. See in particular Table IV-1 on page 49745 of the September 3, 2021 Federal Register. EPA's proposed regulation is at https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-passenger-cars-and.

[2] There are also so-called off-cycle credits under consideration that are not based on powertrain improvements and, through 2025, bonus credits for battery electric vehicles.

[3] For this project, the Baum & Associates team is made up of Alan Baum and Dan Luria. Baum is the consultancy's owner and principal analyst. Prior to forming the firm in 2010, he was a senior industry 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 in this study.

should certainly not be so generous as to vitiate the air quality, fuel-saving, cost-saving, and GHG emissions-reducing advantages of the more stringent standard embodied in NHTSA Alternative 3.[4] The long-term economic and environmental benefits of a cleaner new vehicle fleet are so great that government action to stimulate the sale of low- and zero-emission vehicles[5] (ZEVs) is thoroughly justified. For this reason, a $5,000 subsidy to buyers of 2026 BEVs and $2000 for PHEVs would cover the additional costs of BEVs and PHEVs and therefore preserve profits, although higher subsidies consistent with those currently in place may be appropriate in the short term.[6]

The results of Baum & Associates' analysis for each of the four scenarios are displayed in the two following tables. To ensure that they are comparable – that they are true apples-to-apples comparisons -- in all four scenarios the trend-level size of the U.S. light vehicle market is constrained to 15.89 million units sold.[7] The first table forecasts the mix of technology packages that each automaker or automaker group would likely use to achieve compliance with Alternatives 1 and 3 in a low ($2.80 per gallon) gasoline price environment. The mix in a high ($3.80 per gallon) environment was also modeled: in it, there are more electrified vehicles sold, since their higher fuel economy is more valuable to consumers when fuel prices are high.

[4] Opponents of stricter standards argue that the standards will require a large share of battery electric vehicles (BEVs) and lead to the loss of unionized engine and transmission jobs. But we think (1) that 6.5% annual improvement can be achieved with only modest reliance on BEV sales, and (2) that the benefits of a fuller and faster transition to a more electrified new vehicle fleet could well outweigh the objections. That's because, so long as electric vehicle volumes remain modest, there is little hope of developing a meaningful U.S. EV supply chain in the short term that can achieve the economies of scale needed to compete with the Korea-Japan-China EV supply chain. Obviously, such a large-scale U.S. supply chain can be an important offset to jobs lost in the internal combustion engine (ICE) vehicle supply chain.

[5] Baum & Associates do not consider hydrogen-fueled vehicles as a viable short- or medium-term opportunity to reduce emissions. So long as natural gas remains cheap, most hydrogen fuel will be produced from it. Recent peer-reviewed research suggests that, due to the high methane emissions associated with its extraction, natural gas-based fuels are in no sense green from a climate change perspective. Producing hydrogen fuel from biomass is cleaner, but still not zero emission due to the energy required to process the raw material. Only when hydrogen is produced at scale by electrolysis from wind and solar should vehicles that run on it be treated as low emitting. High costs and a lack of infrastructure are additional concerns.

[6] Battery electric vehicles (BEVs) are a particularly important part of reducing GHG emissions and the use of fossil fuels. Because hybrids and plug-in electric vehicle (PHEVs) can operate on their ICEs when their batteries are empty, their real-world emissions and fuel economy performance – while better on average than those of ICE-only vehicles – are not sufficient to achieve the qualitative reductions in GHG emissions that are needed if the U.S. is to achieve its 2050 climate commitments.

[7] Baum & Associates has calculated the mid-2020s mid-cycle trend size of the U.S. car and light truck market as 16.5 million units sold per year. But since the proposed EPA/NHTSA rules do not include 3/4- and 1-ton pickup trucks, that reduces the total to 15.89 million. (It also sharply reduces the role of diesel powertrains as a tactic for meeting 2026 standards.)

2026 Mix of Technology Packages (% of Total) to Achieve EPA/NHTSA Alternatives 1 and 3 in a $2.80 Gasoline Price and Higher Battery Cost Environment

Technology Package:	Improved ICEs		Hybrids		Plug-In Hybrid EVs (PHEVs)		Battery EVs (BEVs)		Diesels	
CAFE Rule:	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3
GM	89.2%	84.7%	-	-	-	-	7.4%	12.4%	3.5%	2.9%
Ford	78.3%	72.4%	7.2%	9.9%	1.1%	1.7%	11.4%	14.9%	2.1%	1.1%
Stellantis	89.6%	83.7%	-	-	4.3%	7.3%	2.5%	6.4%	3.6%	2.6%
Detroit Three	85.8%	80.5%	2.3%	3.2%	1.5%	2.6%	7.3%	11.5%	3.0%	2.2%
EV Specialists	-	-	-	-	-	-	100.0%	100.0%	-	-
European	84.0%	78.4%	-	-	3.0%	5.3%	12.5%	16.3%	0.6%	-
Asian	85.7%	70.5%	9.9%	20.8%	1.3%	2.7%	3.1%	6.0%	-	-
All Groups	*83.2%*	*73.4%*	*5.4%*	*10.8%*	*1.6%*	*2.9%*	*8.5%*	*12.0%*	*1.3%*	*0.9%*

2026 Mix of Technology Packages (% of Total) to Achieve EPA/NHTSA Alternatives 1 and 3 in a $3.80 Gasoline and Lower Battery Price Environment

Technology Package:	Improved ICEs		Hybrids		Plug-In Hybrid EVs (PHEVs)		Battery EVs (BEVs)		Diesels	
CAFE Rule:	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3
GM	88.7%	84.0%	-	-	-	-	7.7%	13.0%	3.6%	3.0%
Ford	76.6%	70.3%	7.7%	10.7%	1.2%	1.8%	12.3%	16.0%	2.2%	1.2%
Stellantis	88.9%	82.6%	-	-	4.6%	7.8%	2.7%	6.8%	3.8%	2.8%
Detroit Three	84.9%	79.3%	2.4%	3.4%	1.6%	2.7%	7.7%	12.2%	3.2%	2.4%
EV Specialists							100.0%	100.0%		
European	82.7%	77.4%	-	-	3.2%	5.5%	13.4%	17.1%	0.6%	0.0%
Asian	84.6%	69.8%	10.7%	21.3%	1.4%	2.8%	3.3%	6.1%	0.1%	0.0%
All Groups	*81.9%*	*72.1%*	*6.0%*	*11.3%*	*1.7%*	*3.0%*	*9.2%*	*12.6%*	*1.3%*	*0.9%*

Note that even under Alternative 3, ICE-only vehicles still comprise 73.4% of the 2026 new light vehicle fleet and BEVs a modest 12.0% when gasoline is cheap. Even in the event that gasoline costs $3.80 rather than $2.80 per gallon in 2026, the BEV share still only rises to 12.6% of the new light vehicle fleet. With the strong expectation that future 2030 rulemaking will require more BEVs to meet even the targets that automakers have set for themselves, Alternative 3 is essential to getting the automakers and their suppliers on the "glide path" to compliance with the likely 2030 requirements, even if the 2026 requirements require less electrification.

European automakers are ahead of their counterparts in both PHEVs and BEVs, while Asian automakers are the leaders in hybrid technology. GM has eschewed hybrids and plug-ins, while Ford and Stellantis include them in their mix of electrified vehicles.

Having forecasted each automaker and automaker group's 2026 mix of propulsion types, we modeled our best estimates of their costs and of consumers' valuation of the fuel saving each type delivers vis-à-vis ICE-only vehicles. The difference between the two represents the profit that automakers must forego to sell non-ICE-only models in both a $2.80 (Scenarios I and II) and a $3.80 (Scenarios III and IV) fuel price environment. A $5,000 BEV and $2,000 PHEV subsidy is built into the results; the rationale for these subsidies is covered in our full paper.

Our analyses of both automaker and supplier profit find them to be well-nigh insensitive to whether the 2026 CAFE requirements are those of Alternative 1 or Alternative 3, which illustrates that Alternative 3 is very feasible. The big shifts in profitability for automakers occur when comparing fuel price environments, not regulatory regimes. For example, when gasoline costs $2.80 a gallon, the Detroit 3 make $13.35 billion in regulatory Alternative 1 and $13.12 billion in Alternative 3, a trivial difference of just $23 million or 1.7% of total pretax profits. But at $3.80 gasoline, their pretax profit is $4.07 billion in Alternative 1, vs. $4.59 billion in Alternative 3, which is an increase of 12.8% in pretax profit. Thus ***Alternative 3 actually acts as a hedge, or an insurance policy, against the possibility that fuel prices will be much higher in 2026 than they are today, as well as putting both automakers and suppliers on a realistic glide path toward achieving the improvements likely to be required in 2030 and beyond***. By driving the Detroit Three to offer more nontraditional propulsion type vehicles, Alternative 3 in effect cushions the drop in profit associated with higher gas prices.

For suppliers, Alternative 3 is better for profits than Alternative 1 in either a $2.80 or a $3.80 gas price environment. That's because suppliers' content, and their share of profits, is higher in nontraditional than in traditional ICE-only vehicles.

The table below, which assumes $2.80 gasoline, summarizes our profit results for automakers/automaker groups and their suppliers.

Automaker and Supplier 2026 Pretax Profit by Regulatory Scenario at $2.80 Gasoline, in Billions of 2021 Dollars

	Alternative 1			Alternative 3		
Automaker or Group	Automaker or Group	Its Suppliers	Both	Automaker or Group	Its Suppliers	Both
GM	$5.10	$3.59	$8.69	$5.00	$3.62	$8.63
Ford	$4.48	$3.28	$7.77	$4.41	$3.32	$7.73
Stellantis	$3.76	$2.61	$6.37	$3.70	$2.66	$6.36
Detroit 3	***$13.35***	***$9.48***	***$22.83***	***$13.12***	***$9.61***	***22.72***
Electric Specialists	-$0.53	-$0.22	-$0.75	-$0.53	-$0.19	-$0.72
Europe Group	$5.85	$4.27	$10.13	$5.97	$4.50	$10.47
Asia Group	$7.05	$4.91	$11.96	$6.84	$4.99	$11.83
All	***$25.72***	***$18.45***	***$44.17***	***$25.39***	***$18.90***	***$44.30***

Even with the $5,000 subsidy for buyers of 2026 BEVs and the $2,000 subsidy for buyers of PHEVs, automakers earn just $325 million less pretax profit in Alternative 3 than in Alternative 1 when gasoline costs $2.80 a gallon. But if 2026 gasoline instead costs $3.80 a gallon, Alternative 3 is actually $1.387 billion *more* profitable for automakers than Alternative 1. That's mainly because *at higher fuel prices, hybrids, PHEVs, and BEVs produce large consumer fuel savings, making consumers willing to pay more for new vehicles*, and because battery costs will be lower when more electrified vehicles are built and sold.

Thanks to higher supplier content in non-ICE-only vehicles (as compared to ICE-only vehicles), suppliers' aggregate pretax profits in Alternative 3 increase by $450 million when fuel costs $2.80 a gallon and by $1.61 billion when it costs $3.80. For the industry as a whole, i.e., comprising both automakers and their suppliers, Alternative 3 results in $3 billion more pretax profit than Alternative 1 in the high fuel price environment, despite the fact that the PHEV and BEV subsidies are almost identical in the two Alternatives. If and as fuel prices rise to the $3.80 mentioned above and battery costs decline, automaker profitability can be expected eventually to recover to – or even grow beyond – levels that would exist with an all-ICE-only fleet.

While the Detroit Three's profitability declines modestly in Alternative 3 relative to Alternative 1, that decline is only 1.7% of the more permissive alternative. While this short-term impact is modest, the quicker adoption of new technologies required by the stricter policy will pay dividends for the Detroit Three and other automakers going forward by increasing volumes of these products. Overall automaker profit declines by only 1.3%, while total industry profit increases since supplier profit increases by 2.4% as they claim additional content and profits of the vehicles encouraged by the stricter regulatory policy.

Moreover, these pretax profit calculations may well understate both automakers' and suppliers' likely 2026 earnings. Broader electrification of cars and trucks enables and is nearly always associated with a sizable increase in *computing power* in the vehicle. While necessary for the propulsion of the nontraditional vehicle, that power is also available for other vehicle functions, including navigation, online services, and semi-autonomous (perhaps eventually driverless) functionality. That enables automakers to charge drivers for those features on an ongoing basis, providing them with an additional stream of revenue and profit.

High fuel prices negatively impact the earnings of GM, Ford, and Stellantis. That's because high-priced fuel will reduce demand and erode pricing for their hyper-profitable framed pickups and SUVs. But these automakers' dominance in those truck segments will remain a continuing source of profitability. In addition, their strength in these segments is encouraging them to focus their electrification efforts on framed trucks and, by doing so, solidify their hold on these profitable vehicles as the industry transitions to electrified vehicles. That means that, even in the Alternative 3 regulatory regime, every automaker remains solidly profitable, while suppliers see greater profits, and the public and the planet reap the large benefits to air quality and reduced GHG emissions that Alternative 3 produces relative to Alternative 1.

Detailed Analysis

CAFE Alternatives Modeled

On August 5, 2021, NHTSA issued its proposed standards, "Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks which was published in the Federal Register on September 3, 2021." Table IV-1 on page 49745 contrasts the SAFE Part II requirements (termed Alternative Zero) to three updated 2026 standards. Alternative (or "Alt") 0 would result in 2026 CAFE just 7.7% higher than 2021's, while Alt 3 would require CAFE to rise by 37.1% over the same five-year period. In light of the fact that Alt 0 is utterly out-of-step with long-term GHG emissions reduction goals, we did not analyze its impacts. Thus, the CAFE debate will really be between Alt 1 and Alt 3, with Alt 2 as NHTSA's suggested compromise. By comparing Alt 1 and Alt 3, this paper clarifies what the technology (and therefore cost and profit) implications are of the more (Alt 3) and less (Alt 1) stringent versions of the current CAFE rulemaking.

RULE	SAFE Rule	Alt 1	Alt 2	Alt 3	SAFE Rule	Alt 1	Alt 2	Alt 3
Year	Index Numbers (2019 = 100)							
2019	100.00	100.00	100.00	100.00	Annual Percent Change			
2020	101.50	101.50	101.50	101.50	1.5%	1.5%	1.5%	1.5%
2021	103.02	103.02	103.02	103.02	1.5%	1.5%	1.5%	1.5%
2022	*104.57*	*104.57*	*104.57*	*104.57*	1.5%	*1.5%*	*1.5%*	*1.5%*
2023	106.14	106.14	106.14	106.14	1.5%	1.5%	1.5%	1.5%
2024	107.73	117.03	114.63	116.75	1.5%	10.3%	8.0%	10.0%
2025	109.35	120.85	123.80	128.42	1.5%	3.26%	8.0%	10.0%
2026	***110.99***	***124.79***	***133.70***	***141.27***	1.5%	3.26%	8.0%	10.0%
					Avg Increase per year. 2021-26			
					1.5%	***3.9%***	***5.4%***	***6.5%***

EPA/NHTSA versus Industry Definitions

Readers should understand that EPA and NHTSA do not always use categories and definitions that accord with the way the auto industry presents the data. In particular:

- EPA and NHTSA treat front wheel drive small crossover utility vehicles ("FWD Small CUVs") as cars. The industry groups all CUVs – regardless of whether they are front wheel drive (FWD) or all wheel drive (AWD) -- as trucks. We use the segment CUVSML to cover both FWD and AWD variants.
- EPA and NHTSA are promulgating car and light truck CAFE standards that exclude class 2B pickup trucks – those weighing 8,501-10,000 pounds -- even though the industry includes them in its definition of light-duty vehicles. We have excluded class 2B (also known as 250- and 350-series, or ¾- and 1-ton) pickups from our analysis to conform to EPA/NHTSA definitions.

Our modeling ignores all business cycle effects. We assume a mid-cycle trend market size of 16.5 million, reduced to 15.89 million by the exclusion of the larger pickup trucks. As we will show, because of their much larger market share in pickups and the SUVs built on pickup platforms, the Detroit Three lose unit sales when fuel prices are high, while other automakers gain share. With gasoline at $2.80 a gallon, the Detroit Three sell 6.25 million units in the U.S. in 2026, while they sell 5.90 million (or 350,000 fewer) if gasoline costs $3.80 per gallon. (See below for the source of the $2.80 and $3.80 gasoline price predictions.)

The "Automaker Groups"

That difference of 350,000 Detroit Three units goes non-linearly from the truck-specializing Detroit Three to the car- and CUV-specializing automakers of the Europe, Asia, and Electric Specialist groups, with the largest volume gainers being automakers with the best fuel economy performance. The groups are:

- Detroit Three Group: GM, Ford, and Stellantis (formerly FCA, and before that Chrysler)
- Europe Group: BMW, Mercedes, Volvo, VW (including Porsche and Audi), and Jaguar-Land Rover[8]
- Asia Group: Toyota, Nissan, Honda, Subaru, Mazda, Mitsubishi, Subaru, and Hyundai-Kia
- Electric Specialist Group: Tesla, Fisker, Rivian, and ELMS.[9]

Our Light-Duty Market Segments

While these automakers and automaker groups make a huge variety of models, we sort them into just seven categories. Names in parentheses tie to abbreviations used in tables below.

1. Small Non-Luxury Cars (SMALL)
2. Midsize and Large Non-Luxury Cars (MID)
3. Luxury Cars (LUX)
4. Small Crossover Utility Vehicles or CUVs (CUVSML)
5. Mid-sized Crossover Utility Vehicles or CUVs (CUVMID)
6. Pickups (PICKUP)
7. Sport Utility Vehicles (SUV)

All but the last two of these segments are built on unibody car platforms, while pickups and SUVs are built on truck frames.

Motor Fuels Price Derivation and Impact on Segmentation and Profit

No one knows exactly how much gasoline, diesel, and other motor fuels will cost next *week*, let alone in 2026. Average monthly U.S. retail prices for unleaded 87-octane gasoline ranged from $1.82 to $4.05 over the past ten years.[10] For this paper, we consulted the U.S. Department of Energy's Energy Information Agency (EIA) near- and long -term forecasts of crude oil prices and made robust assumptions about refining and distribution costs, wholesale and retail markups, and federal and state motor fuel taxes. That led us to consider two fuel price cases for 2026 (expressed in dollars of mid-2021):

- Low: $2.80 per gallon -- $65 per barrel oil / 42 gallons per barrel = $1.55 + $1.25 in distribution, wholesale and retail markup, and federal and state fuel taxes
- High: $3.80 per gallon -- $97 per barrel oil / 42 gallons per barrel = $2.30 + $1.50 in distribution, wholesale and retail markup, and federal and state fuel taxes.

[8] We are aware that Volvo is owned by China-based Geely and that Jaguar and Land Rover are brands of India-based Tata Motors. However, because of their heritages, respectively, as Swedish and British brands and in light of the geography of the companies against which they mainly compete as well as their product lineup, we have placed them in the Europe Group.

[9] By 2026, there may be a few additional Electric Specialists, but if so, their collective sales volume will be very modest.

[10] Based on EIA data on price per liter, compiled by Trading Economics at https://tradingeconomics.com/united-states/gasoline-prices.

Thanks to the broad range of fuel prices over the 1979 - 2021 period, we have been able to develop detailed algorithms to describe how sales in each segment move in response to sustained changes in fuel prices. For example, when we compare periods with cheaper motor fuels to periods when those fuels cost significantly more, we observe predictable shifts away from pickups and SUVs into CUVs and from larger to smaller cars.

Moreover, fuel prices affect automakers' pricing and therefore their profitability. Thus, for example, in the 2004 – 2018 period, not only were roughly 20% fewer pickups sold when gas was expensive than when it was cheap, but each contributed about $2,500 less to their makers' pretax profit thanks to dealer incentives that automakers had to offer to sell them.

Going forward, we can infer that these fuel price-driven segmentation shifts will continue but be more muted. That's mainly because there will be more fuel-efficient vehicles in every segment. Not only, for example, will most automakers offer hybrid, PHEV, and/or BEV versions and, in fewer cases, diesel versions of many of their models, but even ICE-only vehicles will average 10% greater fuel efficiency in 2026 than they do in 2021 in either regulatory Alternative 1 or 3. Thus, for the Detroit Three, for example, our model predicts that $3.80 versus $2.80 gasoline will result in 5% more CUVs and 11% fewer framed trucks being sold in 2026. Car and CUV pricing will remain about the same regardless of which fuel price environment occurs, but each framed truck sold will contribute about $1,800 less to profit at $3.80 fuel than at $2.80 fuel as retail incentives will be needed to induce consumers to purchase or lease these vehicles at higher fuel prices.

Technology "Packages" and Their Fuel Economy Contributions

Over the next five years, literally thousands of technological changes – from tiny software tweaks to air-fuel mixtures to utterly new ways to build and pack battery cells – will occur in vehicles produced for sale in the U.S. and abroad. Some automakers will focus on getting incremental performance gains from legacy powertrains, while others will focus on various forms of electrification. Some will achieve, and others fail to comply with, regulatory requirements, the latter buying credits from the former to avoid civil penalties. To make sensible analysis possible, we have grouped the coming changes in "packages" and assigned costs to each relative to ICE-only 2021 vehicles. Because cars and CUVs are typically lighter and less often used for towing than framed trucks, we have adjusted costs for alternative powertrains to reflect differences in weight and required capability for the various vehicle classes.

Based on EPA-reported MPG and MPGe[11] information, we built a matrix of fuel economies for every automaker in every segment and then rolled those up into representative MPG figures across all automakers selling cars and light trucks in the U.S. Several adjustments had to be undertaken to make the matrix fit the vehicle mix forecasted for 2026. For example, we had to make some assumptions for vehicles not yet in production but that will be available by 2026. After making these, and other smaller, adjustments, we arrived at the following "stylized facts" for each technology package's MPG in each of our seven market segments.

[11] MPGe is a concept that EPA uses to make it possible to compare vehicles of different propulsion types even though some of those types don't actually use "gallons" of an energy source. The idea is to compare vehicles with dissimilar powertrains on a common measure of "gallon-equivalents", thus the term MPGe. We use the Combined Unadjusted Fuel Economy measure provided by the Environmental Protection Agency for all vehicles in order to have a consistent metric applicable to all propulsion types. The EPA provides this information in a downloadable file on a continuous basis at www.fueleconomy.gov. It is consistent with the fuel economy requirements of the NHTSA and EPA rules that provide the basis for this report.

2026 Sales-Weighted Average EPA-Unadjusted Fuel Economy by Propulsion Type and Market Segment

	Improved ICE	Hybrid	PHEV	BEV	Diesel
SMALL	49.8	76.3	90.0	165.0	60.0
MID	42.7	63.2	80.0	160.0	
LUX	39.2	60.0	75.0	155.0	
CUVSML	41.3	55.5	75.0	160.0	
CUVMID	33.9	47.4	70.0	150.0	40.0
PICKUP	27.2	34.4	55.0	140.0	33.3
SUV	29.3	35.6	55.0	140.0	30.4

In calculating fuel use, GHG emissions, and consumers' decisions about whether or not to buy ICE-only vehicles versus more fuel-saving technology packages, we convert these unadjusted EPA fuel economy figures to what consumers might expect to achieve in actual driving by multiplying those figures by 74%, which makes them closely correspond to the fuel economy sticker affixed to each new car and truck. We also round the results to the nearest tenth of an MPG. Thus:

2026 *Real World* Fuel Economy by Propulsion Type and Market Segment

	Improved ICE	Hybrid	PHEV	BEV	Diesel
SMALL	36.9	56.5	66.6	122.1	44.4
MID	31.6	46.8	59.2	118.4	
LUX	29.0	44.4	55.5	114.7	
CUVSML	30.6	41.1	55.5	118.4	
CUVMID	25.1	35.1	51.8	111.0	29.6
PICKUP	20.1	25.5	40.7	103.6	24.6
SUV	21.7	26.3	40.7	103.6	22.5

The Cost of Technology Packages

The battery sizes and costs shown below draw from a multitude of sources, including seminal work of Dan Meszler.[12] Battery sizes are representative of those used, recently announced, or forthcoming in new products by global automakers. Because higher fuel prices will mean more PHEVs and BEVs sold, resulting in economies of scale, we model battery pack prices based on per-kWh costs of $115 when fuel is expensive and $130 when it is cheaper. These figures emerge from a comparison of several forecasts, including but not limited to those published by BNEF, ICCT, and the Boston Consulting Group.[13] Note that PHEVs and BEVs (not to mention some hybrids) require a number of other features that ICEs don't need

[12] Meszler Engineering Services (MES) is an engineering consultancy specializing in air quality and energy-related research and analysis. MES's founder, Dan Meszler, brings more than 35 years of experience along with a background in civil and environmental engineering.

[13] See, among others:

- BNEF, "Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh" (12/16/2020) at https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/
- ICCT, "Update on electric vehicle costs in the United States through 2030" (4/1/2019) at https://theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf
- Boston Consulting Group, "The Future of Battery Production for Electric Vehicles" (9/11/2018) at https://www.bcg.com/publications/2018/future-battery-production-electric-vehicles

(e.g., power-splitting, regenerative braking, inverters, heat dissipation, and sophisticated electronic controls), and these are not free. However, BEVs also don't need some components that ICEs, hybrids, and PHEVs require, among them an engine, a multi-speed transmission or transaxle, and exhaust and emissions hardware and software. The "adds" and "backouts" in the next table are based on Baum & Associates analysis done for Ceres in previous studies of light-, medium-, and heavy-duty vehicles.

Throughout this paper, all dollar figures are expressed in real terms at the US dollar's value as of mid-2021.

Additional Cost Relative to 2021 Light Vehicles for 2026 Light Vehicles, by Propulsion Type

	2026 Cars & CUVs			2026 Pickups & SUVs		
	Battery Size	Low Fuel Cost Low Fuel	High Fuel Cost	Battery Size	Low Fuel Cost	High Fuel Cost
Improved ICE		**$ 1,000**	**$ 1,000**		**$ 1,000**	**$ 1,000**
Full hybrid		**$ 2,500**	**$ 2,500**		**$ 2,750**	**$ 2,750**
PHEV adds	*15 kWh*	*$ 3,950*	*$ 3,725*	*20 kWh*	*$ 4,600*	*$ 4,300*
PHEV backouts		*$ (500)*	*$ (500)*		*$ (750)*	*$ (750)*
PHEV Net		**$ 3,450**	**$ 3,225**		**$ 3,850**	**$ 3,550**
BEV adds	*75 kWh*	*$ 12,750*	*$ 11,625*	*125 kWh*	*$ 19,250*	*$ 17,375*
BEV backouts		*$ (6,000)*	*$ (6,000)*		*$ (7,500)*	*$ (7,500)*
BEV Net		**$ 6,750**	**$ 5,625**		**$ 11,750**	**$ 9,875**
Diesel		**$ 2,500**	**$ 2,500**		**$ 3,250**	**$ 3,250**

Modeling the Cost of Four 2026 New Light Vehicle Fleets

Our methodology begins with an estimate of each automaker's sales in each segment, which is primarily a function of its historical share in the segment, its product plans, and, as noted, the impact on its share (if any) of high and low fuel prices. That is to say, we start from the current powertrain distribution by automaker by segment. We then estimate, based on what is required to meet the 2026 CAFE standard (whether it is Alt 1 or Alt 3), i.e., how many improved ICEs, hybrids, PHEVs, BEVs, and/or diesels will need to be sold to hit the required fuel economy. The mix of hybrids, PHEVs, etc. is heavily dependent on how fuel-efficient each automaker already is and in which technologies they specialize. Thus, for example, Toyota is likely to increase fleet CAFE primarily by making and selling more hybrids, while Volvo and Tesla will improve their fleet fuel economy almost entirely (Volvo) or exclusively (Tesla) by selling more BEVs. Finally, in the next section, we take account of the cost of each automaker group's "recipe" – how many ICE-only, hybrid, PHEV, BEV, and diesel vehicles it sells.

Because our model is a classic nonlinear programming approach with more variables than equations, the precise mix of technology packages that we predict will be produced and sold based on the 2026 CAFE requirements relies heavily on the authors' informed judgments, since a multiplicity of propulsion mixes could meet the requirements. Our judgment is based on our knowledge of each automaker's capabilities (including their relative costs) in the various powertrain options, the "return" in fuel economy they will obtain given their segmentation mix, and the consistency of these approaches with their manufacturing and marketing strategies both in and beyond the US.

How Automaker Groups Will Comply with 2026 CAFE Requirements

The tables that follow show each automaker group's mix of technology packages for each of the four scenarios (i.e., two alternative 2026 CAFE requirements in two fuel price environments). We do not take account of the credits that are included in the several versions of the EPA/NHTSA rulemaking documents. As noted, we oppose credits that make it qualitatively easier for automakers to avoid achieving the intent of more stringent CAFE regulation.

2026 Mix of Technology Packages (% of Total) to Achieve EPA/NHTSA Alternatives 1 and 3 in a $2.80 Gasoline Price and Higher Battery Cost Environment

Technology Package:	Improved ICEs		Hybrids		Plug-In Hybrid EVs (PHEVs)		Battery EVs (BEVs)		Diesels	
CAFE Rule:	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3
GM	89.2%	84.7%	-	-	-	-	7.4%	12.4%	3.5%	2.9%
Ford	78.3%	72.4%	7.2%	9.9%	1.1%	1.7%	11.4%	14.9%	2.1%	1.1%
Stellantis	89.6%	83.7%	-	-	4.3%	7.3%	2.5%	6.4%	3.6%	2.6%
Detroit Three	85.8%	80.5%	2.3%	3.2%	1.5%	2.6%	7.3%	11.5%	3.0%	2.2%
EV Specialists	-	-	-	-	-	-	100.0%	100.0%	-	-
European	84.0%	78.4%	-	-	3.0%	5.3%	12.5%	16.3%	0.6%	-
Asian	85.7%	70.5%	9.9%	20.8%	1.3%	2.7%	3.1%	6.0%	-	-
All Groups	*83.2%*	*73.4%*	*5.4%*	*10.8%*	*1.6%*	*2.9%*	*8.5%*	*12.0%*	*1.3%*	*0.9%*

2026 Mix of Technology Packages (% of Total) to Achieve EPA/NHTSA Alternatives 1 and 3 in a $3.80 Gasoline and Lower Battery Price Environment

Technology Package:	Improved ICEs		Hybrids		Plug-In Hybrid EVs (PHEVs)		Battery EVs (BEVs)		Diesels	
CAFE Rule:	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3	Alt 1	Alt 3
GM	88.7%	84.0%	-	-	-	-	7.7%	13.0%	3.6%	3.0%
Ford	76.6%	70.3%	7.7%	10.7%	1.2%	1.8%	12.3%	16.0%	2.2%	1.2%
Stellantis	88.9%	82.6%	-	-	4.6%	7.8%	2,7%	6.8%	3.8%	2.8%
Detroit Three	84.9%	79.3%	2.4%	3.4%	1.6%	2.7%	7.7%	12.2%	3.2%	2.4%
EV Specialists							100.0%	100.0%		
European	82.7%	77.4%	-	-	3.2%	5.5%	13.4%	17.1%	0.6%	0.0%
Asian	84.6%	69.8%	10.7%	21.3%	1.4%	2.8%	3.3%	6.1%	0.1%	0.0%
All Groups	*81.9%*	*72.1%*	*6.0%*	*11.3%*	*1.7%*	*3.0%*	*9.2%*	*12.6%*	*1.3%*	*0.9%*

Note particularly the difference between ICE-only and BEV shares in the four scenarios. Alternative 3 is more stringent and thus requires higher levels of non-ICE powertrains. Different companies react to this requirement in different ways, based on their capabilities and product range. Higher fuel prices and lower battery costs draw more consumers to non-ICE technologies as fuel savings grow and the price penalty of electrification declines.

Automaker Strategies

Automakers will achieve the higher fuel economy required in Alternative 3 according to their particular strategies and capabilities. GM will accelerate its battery electrification efforts, including in its SUV and pickup products. Ford will increase electrification across hybrids, plug-ins, and BEVs, including in its F-150 Lightning and hybrid Escapes and F-150s. While Stellantis is currently behind the curve, a more rigorous regulatory regime would force it to more quickly increase the share of plug-ins and BEVs, the former in their Jeep lineup and the latter moving beyond the niche products they have recently announced, including potentially in a battery-powered Ram pickup.

European automakers are relatively well positioned in plug-in products and already have a number of BEVs planned for the near-term. Volumes would increase particularly in Alternative 3, with increased electrified models offered and sold across both technologies and market segments. More stringent regulatory requirements would encourage them to direct more product to North America, thereby revising their current plans, which favor China and Europe, where stronger requirements are already in place.

Asian automakers are industry leaders in hybrid propulsion, and will continue to use that strategy, with Toyota, Honda, and Hyundai/Kia all active in hybrids in many market segments. More stringent fuel economy requirements would significantly increase hybrid penetration, as Toyota in particular enjoys both a marketing and a cost advantage relative to its competitors. Hyundai/Kia has a line of upcoming BEVs; stronger regulatory requirements would increase their volume and hasten their launch. Honda and Toyota are both moving relatively slowly in BEVs, though Honda has indicated more interest of late. Stronger regulatory requirements would push both companies to higher BEV volumes.

Costs of Compliance

It would be nice if we could simply add up the extra cost of non-ICE technology packages, deduct it from predicted automaker pretax profit, and declare victory. Alas, reality is more complex than that. A 160-mpg-equivalent 2026 BEV small CUV, when fuel is cheap, costs its automaker $6,750 more than a 2026 ICE-only small CUV. But that's only the beginning, not the final result:

1. How much more does the automaker charge customers for the BEV than for the ICE-powered vehicle?
2. How much more are customers willing to pay for the BEV version?

Our modeling answers these questions as follows, starting with the second one:

- The consumer is only willing to pay an additional amount up to his or her anticipated fuel cost saving, which depends on whether gasoline is cheap or expensive.
- The automaker wants to recoup all of the extra $6,750 that the BEV version costs it to produce, but can only raise prices by an amount justified by the consumer's perception of fuel saving.

We recognize that this is an oversimplification. Some customers will value fuel saving more than others; some will be willing to pay more for the more exhilarating torque of a BEV; and some will be resistant to having to recharge for an hour on a consistent basis in normal use and for a longer period every 300-400 miles or if they take many long trips. But our method is, if inexact, both robust and conservative.

Ceres

How Consumers Value Fuel Economy Improvement

It would also be nice if we could simply calculate fuel saving based on the number of miles that cars and light trucks are typically driven before they are scrapped. But something like one in three vehicles is leased rather than bought. And for the 2026 new vehicle fleet, we can only model the purchase decisions of the first buyer, who is unlikely to take into consideration the hard-to-quantify possibility that his or her hybrid, PHEV, BEV, or diesel model will probably have a higher trade-in value than its ICE-only counterpart.

In the numerous studies we have performed, we have consistently relied on two sources for consumer valuation of the fuel saving resulting from technology packages[14]:

- Following Alcott and Wozny (2014), we assume that consumers value fuel saving for the first three years of ownership or lease term. Further, we believe that they undervalue those savings by 24%, i.e., they implicitly multiply anticipated three-year reductions in gasoline purchases by 0.76.
- Following Oak Ridge National Laboratory's (ORNL) analysis for the Federal Highway Administration (2011), we assume that during vehicles' first three years of ownership or lease term, they are driven 41,931 miles (or just shy of 14,000 miles per year); as vehicles age, they are driven less and less each year.

We surveyed the more recent literature on both consumer fuel-saving valuation and vehicle miles traveled, and determined that the Alcott & Wozny and ORNL figures remain valid.

Combining the Cost of Fuel-Saving Packages with Consumers' Valuation

Baum & Associates calculated the fuel saving of every automaker's vehicles in each of the seven segments, comparing each propulsion package to an ICE-only vehicle, bearing in mind that those ICE-only vehicles will also incur an average of $1,000 in cost to improve *their* fuel economy. Rather than present huge tables showing four automaker groups x two regulatory regimes x two fuel price environments x seven market segments, it makes more sense simply to provide an example.

Consider a consumer who is shopping for a mid-sized CUV ("CUVMID") such as the Chevrolet Traverse or the Toyota Highlander. The ICE-only version of a CUVMID gets 33.9 mpg, while the PHEV version gets 70 MPGe.

- We first convert these laboratory figures to real-world fuel economy by multiplying them by 74%: thus 25.1 for the ICE-only and 51.8 for the PHEV version.
- We then take 41,931 miles, the number of miles a new vehicle is typically driven in its first three years of ownership or lease, and divide it by the appropriate miles per gallon-equivalent to arrive at the number of gallons of fuel (including the imputed "fuel" for the PHEV's battery pack) required to drive that distance.
- The fuel saving of the PHEV relative to the ICE-only vehicle is calculated, then multiplied by the price of fuel in 2026.

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[14] Our calculations of consumers' valuation of fuel savings are based on very conservative assumptions. First, we assume that consumers only consider fuel savings realized during the first three years of ownership, during which time new cars and light trucks are driven an average of 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.

- Finally, the result is deflated by 24% because of consumers' systematic discounting of future fuel saving.

Calculating the Pretax Profit Contribution Penalty of a Mid-sized CUV

Item	Metric	Formula	ICE-Only CUVMID		PHEV CUVMID	
1	Miles Driven in First 3 Years		41,931			
2	MPG		25.1		51.8	
3	Gallons of Fuel Required	1 / 2	1,671		809	
4	Fuel Price per Gallon-Equivalent		$2.80	$3.80	$2.80	$3.80
5	Cost of Fuel Required	3 x 4	$4,679	$6,350	$2,265	$3,074
6	Value of PHEV Fuel Saving	ICE less PHEV			$2,414	$3,276
7	Discounted Fuel Saving	X 0.76			$1,835	$2,490
8	Additional Technology Cost		$1,000	$1,000	$3,450	$3,225
9	Reduction in Automaker Profit	7 - 8	-$1,000	-$1,000	-$1,615	-$ 735
10	PHEV Profit Penalty (-) vs ICE-Only				-$ 615	+$ 265

Smart, Efficient Subsidies

Note that, while our illustrative customer thinking about buying or leasing a PHEV considers only the 862 gallons saved over three years, and discounts even that by 24% to just 655 gallons, the United States and the planet get much greater air quality and GHG reduction benefits – almost 2,600 gallons' worth (i.e., 862 gallons x 3, where the 3 comes from the vehicle being driven not just 41,931 miles but more like its lifetime total of about 125,000).

If saving those 2,600 gallons' worth of pollution and GHG emissions is sufficiently valuable to society, regulators logically should encourage automakers to sell more PHEVs and fewer ICE-only models. Based on the math in the table above and in the hundreds of other such comparison tables we generated, a subsidy or incentive of approximately $2,000 should be considered for PHEVs.

When we repeat the same analysis comparing a *BEV* pickup truck with an ICE-only one, line 10 shows a much larger consumer fuel saving, but it's also associated with greater foregone automaker profit. That suggests that a larger subsidy or incentive is justified for BEVs – on the order of $5,000.
And these subsidies can and should be reduced, and eventually eliminated, as battery costs decline and a more fulsome charging infrastructure is in place.[15]

[15] Thus Baum & Associates favors a system of providing a subsidy to BEV buyers (and a lesser amount to buyers of plug-ins) that does not unduly favor, but also that does not exclude, high-income consumers. Such a system would enable dealers to provide the BEV buyer with a government check for $5,000 but that amount would be treated as income for tax purposes. The cost of the BEV would be reduced by $5,000 for all buyers, but when federal taxes come due, a BEV buyer in the 10% marginal tax bracket would owe the government $500, while a BEV buyer in the 40% bracket would have to repay $2,000. Receiving the subsidy at the time of purchase would also reduce the current bias in favor of higher-income buyers who can afford to wait 4-18 months for their credit after they file their taxes in April of the year following purchase. PHEVs deserve a smaller subsidy than BEVs because they have ICEs as well as batteries, and so during many of the miles they are driven they are ICE- rather than battery-powered. (Regional differences are important, of course: while in dense coastal cities, hybrids and PHEVs may be low-emission commuting vehicles, in much of the rest of the nation they are simply gasoline-powered vehicles after the first few dozen miles.)

Revenue and Pretax Profit for the Automaker Groups & Their Suppliers

Baum & Associates calculated the table above for every pairwise comparison between a non-traditional propulsion type vehicle and an ICE-only vehicle, and calculated the foregone profit associated with selling fewer ICE-only models in 2026. Except obviously for the Electric Specialist group, in 2026 every full-line automaker group makes less profit when fewer ICE-only vehicles are sold. If that were not the case, there would be little need for CAFE requirements or subsidies.

But that is not the whole story. Suppliers, as a group, have considerably more content in hybrids, PHEVs, BEVs, and diesels than in ICE-only vehicles (although some automakers hope to capture some of that content in the time period beyond 2026, often through joint ventures with major battery and electronic parts suppliers). As a result, any "recipe" with fewer ICE-only cars and trucks is *better* on average for suppliers' revenue and pretax profit. To parse the division of revenue and profit as between automakers and suppliers, consider the relative size, revenue, and profitability of the two.

The Automaker - Supplier Split: Jobs

As a group, automotive suppliers – companies that provide parts, components, and services to automakers – represent a far larger part of the U.S. economy than do the automakers themselves. In 1978, the automakers employed 694,000 hourly and 119,000 salaried workers in the US. In 2020, they provided jobs to only 155,000 hourly and 47,000 salaried employees, a decline of 74%. But the overall sector – encompassing both automakers and suppliers – changed much more modestly in size, dropping from 1.4 million to 1.27 million, based on Bureau of Labor Statistics figures. The figures below have been adjusted to exclude production for the aftermarket, which is assumed to account for one-third of suppliers' production and employment. (Numbers, but not the automaker-supplier splits, may modestly overstate sector employment due to the inclusion of jobs associated with production of 3/4- and one-ton pickup trucks, which account for 5-6% of industry output and employment.)

U.S. Automaker and Supplier Employment

	1978		2020	
	Number	% of Total	Number	% of Total
Automaker Jobs	813,000	67.5%	202,000[16]	22.2%
Supplier Jobs x 2/3	392,000	32.5%	709,000	77.8%
Total Auto Sector Jobs	1,205,000		911,000[17]	

In a word, suppliers are a much larger share of the automotive sector today (and will be in 2026) than they were four decades ago when the first CAFE rules were promulgated.

The Automaker - Supplier Split: Revenue and Pretax Profit

Because auto suppliers have, on average, somewhat lower levels of capital per worker and, therefore, lower labor productivity, the division of *value* (i.e., of cost plus profit) is somewhat less skewed than the

[16] See Annual Reports and 10-Ks of GM, Ford, and Stellantis for 2020. For 1978 data, we used proprietary data provided to each automaker by the United Auto Workers in 1981.

[17] See Bureau of Labor Statistics' Current Population Survey, for 2020, at https://www.bls.gov/cps/cpsaat18.htm. 1978 data from BLS (total) and the UAW Research Department (Detroit Three automakers).

split of labor time. The value split also reflects the so-called *oligopsonistic* character of the industry, where a small number of buyers (automakers) have enormous market power vis-à-vis the huge stable of suppliers, though that is less the case the more it would cost automakers to insource what they now buy outside from suppliers with meaningful technical strengths. The table below shows, for traditional ICE-only vehicles, hybrids, PHEVs, BEVs, and diesel-powered cars and trucks Baum & Associates' estimate of the 2026 automaker-supplier split of vehicle value, with value broken out into *cost* and *pretax profit*. Note that automakers are quite concerned that – particularly in BEVs – some of their suppliers have enough market power to claim a higher share of total profit per unit; hence their attempts to recapture this market power via joint ventures with key suppliers.

	ICE-Only	Hybrid	PHEV	BEV	Diesel
Automakers					
% of Cost	*35%*	*30%*	*30%*	*25%*	*30%*
% of Profit	*60%*	*55%*	*50%*	*45%*	*55%*
Suppliers					
% of Cost	*65%*	*70%*	*70%*	*75%*	*70%*
% of Profit	*40%*	*45%*	*50%*	*55%*	*45%*

We now have all of the pieces needed to calculate automakers' and suppliers' profit in regulatory Alternatives 1 and 3 in the two fuel price environments.

Automakers, Suppliers, and Society

The table below presents automaker and supplier profits, consumer fuel-saving, and taxpayers' cost for the PHEV and BEV subsidies.

	In millions of US dollars of 2021				In millions	In cents
Difference, Alt 3 vs Alt 1	Automakers, from Consumers	Suppliers, from Automakers	Consumers, from Taxpayers	Net Cost to Society	Gallon-Eqvts of Fuel Saved	Cost per Gallon-Eqvt Saved
$2.80 Fuel	$ (324.9)	$ 455.4	$ (3,153.8)	$(3,023.2)	3,730.6	81.0
$3.80 Fuel	$1,387.0	$1,610.2	$ (3,154.8)	$ (157.7)	3,731.8	4.2

Among advanced economies, the U.S. is anomalous in taxing motor fuels only lightly at both the federal and state levels. When fuel is cheap, CAFE requirements send automakers, suppliers, and consumers a mixed message by directing the production of more non-traditional fuel-saving vehicles. At a higher fuel price, however, regulatory requirements work *with* the market. As a result, the PHEV and BEV subsidies advocated in this paper cost just pennies per gallon of fuel (and its attendant emissions when burned) when gasoline is more expensive.

Obviously, the lower the proportion of ICE-only cars and light trucks sold in 2026, the lower *most* automakers, and the higher supplier group's, revenues and profit, though due to automakers' greater market power they will continue to claim an outsized share of earnings. That will be somewhat less true for more expensive technology packages such as PHEVs and BEVs, however, as – especially if fuel prices are low – it will be automakers rather than suppliers who will need to absorb the difference between what those technologies cost and how much consumer valuations of fuel saving allow them to charge. It will be interesting to see whether the shift in revenue and profit share associated with electric vehicles induces at least some automakers to bring battery cells as well as packs in-house (even beyond the strategy of joint ventures), and whether power electronics and electric drive motors migrate toward the automakers as well.

Conclusions from the Analysis

NHTSA Alternative 3, under which light vehicle fuel economy must rise 6.5% per year, is achievable and markedly better for air quality and climate change avoidance than Alternative 1, and will not be qualitatively harder to achieve. It will require somewhat more hybrids, PHEVs, and BEVs, but in 2026 – even if gasoline is expensive – such propulsion type vehicles will still account for a modest 27.9% of all light vehicles sold in the US and 12.6% will be BEVs. In comparison, 8.9% of all light vehicles expected to be sold in 2021 are hybrids, PHEVs and BEVs, and 2.6% will be BEVs.

Alternative 3 obviously will lead automakers to sell more of the highest-MPG vehicles – BEVs -- but, as noted, this is a good thing if there is to be any real opportunity to onshore the EV supply chain at economic volumes. Further, this strategy will enhance the cost competitiveness of automakers and suppliers operating in North America, as it will be more consistent with the stricter standards in and planned for other regions of the world. The more the U.S. standards and those in the rest of the world align, the lower automakers' and suppliers' development and production costs will be and their earnings will be correspondingly less reduced.

The Detroit Three will, in the 2026 timeframe and probably into the 2030s, take a larger hit to pretax profit than their competitor groups. That's arguably proper, since they've made a lot more money than their competitors in the past decade as the sales mix has shifted toward the high-emitting framed trucks in which they specialize. As battery costs fall, especially if fuel prices rise and stay high (and by doing so, increase consumers' valuation of fuel saving), any Detroit Three profit reduction eventually will be reversed.