Light-Duty Vehicle CAFE and GHG Standards:

Key Considerations for the Mid-Term Evaluation

EXECUTIVE SUMMARY

The Mid-Term Evaluation's purpose regarding Model Year (MY) 2022-2025 fuel economy and greenhouse gas standards is to compare the government's 2011 projections with actual performance data and determine what changes may be needed to meet the targets.

While automakers have made important fuel economy gains, significant data continues to demonstrate that many factors affect the viability of such standards in the future. These factors include the relation between fuel prices and consumer demand; consumers choosing vehicles based on a wide range of needs and attributes aside from fuel efficiency; vehicle affordability; and, the real-world modeling necessary to determine future U.S. fleet fuel efficiency targets.

In many cases, 2011's rulemaking projections fell short – or overstated – what would happen in the future. Understanding the reasons behind this gap, between projections and realities, provides all stakeholders with an important opportunity to set achievable future standards while allowing policymakers to avoid basing future policy on so-called "over projections."

This document provides recommendations and related considerations that the Alliance and its members believe the Environmental Protection Agency (EPA), the National Highway Traffic Safety Administration (NHTSA), and the California Air Resources Board (CARB) must address during the Mid-Term Evaluation.

Key findings in this document include:

- Automakers are producing and offering for sale more fuel-efficient vehicles than ever before. While this has boosted the U.S fleet's overall fuel economy, it is critical to remember that the government's efficiency targets may soon outpace these fuel economy increases.

- Meeting future targets will require all vehicle segments to continue improving. Some segments must improve more than others over the MY 2014 baseline.

- Meeting MY 2025 targets will require the average vehicle in 2025 to be more efficient than some modern hybrids. Real world, holistic, modeling predicts up to 47 percent of the U.S. car fleet will need to be as efficient as modern hybrids.

- The EIA reports that gasoline prices are near historic averages when adjusted for inflation.

- Fuel prices directly affect sales of alternative powertrains and also impact the car/truck fleet mix.

- Even when using agency-assumed costs, the payback period for alternative technologies extends beyond the timeframe most consumers consider; it is likely to remain that way.

- While fuel economy is important, new car buyers report it is not their top factor in making a purchase.

- The attribute car-truck based targets do not fully account for consumer choice; consumers still choose how much they are willing to spend on features other than fuel efficiency improvements within the same vehicle platform (even within the same footprint and class).

- Unfortunately, the One National Program (ONP) is not a reality. An optimized fleet cannot meet all Federal and state requirements. To be truly a single program, the ZEV mandate and related cost/benefit analyses must be incorporated into the ONP discussion.

Recommendations and related considerations include:

1. A strong economic analysis is critical in determining vehicle affordability and the impact that vehicle affordability may have on U.S. manufacturing, sales and support jobs.

2. The Mid-Term Evaluation must consider how lower fuel prices impact consumer buying decisions and the standards' achievability. This review should compare past predictions for technology development and technology uptake against the agencies' most recent predictions in this area.

3. The Mid-Term Evaluation should account for the higher level of electrified vehicle sales needed to meet future standards.

4. It is critical that the ZEV mandate be an integral part of any ONP cost and resource analysis.

5. The Mid-Term Evaluation should assess the degree to which off-cycle improvements – which are an integral part of ONP – are needed for future compliance.

6. The Mid-Term Evaluation should use the most up-to-date information available.

7. The Mid-Term Evaluation should account for competing regulatory demands.

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INTRODUCTION

Four years ago, the National Highway Traffic Safety Administration (NHTSA) and U.S. Environmental Protection Agency (EPA), in collaboration with the California Air Resources Board (CARB), set forth Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) standards for model years (MYs) 2017-2025 light-duty vehicles. These regulations call for the agencies to perform a "Mid-Term Evaluation" to re-evaluate all relevant factors considered in the original rulemaking and decide whether adjustments are needed for MYs 2022-2025.[1] Today, the agencies, the Administration, CARB and others are preparing for this Mid-Term Evaluation.

The purpose of this report is to help inform the Mid-Term Evaluation process with an overview of recent changes in vehicle technologies, consumer acceptance, the economy, and the market for alternative fuel vehicles.

BACKGROUND

In 2011, many, but not all, automobile manufacturers signed letters agreeing to the basic terms of a CAFE and GHG program covering MYs 2017-2025.[2] These terms were subsequently implemented in 2012 through a joint EPA/NHTSA rulemaking.[3] Two critical factors made the 2011 agreement with manufacturers possible. The first was the commitment to conduct a rigorous, fact-based Mid-Term Evaluation to ascertain the evolution and cost of technologies necessary for meeting the standards in addition to other relevant factors such as consumer acceptance, particularly in the latter years. The second was the idea that ONP, originally agreed to in 2009, would continue – ensuring that California and states (that follow California's lead) would harmonize their rules with those promulgated at the federal level by EPA and NHTSA.

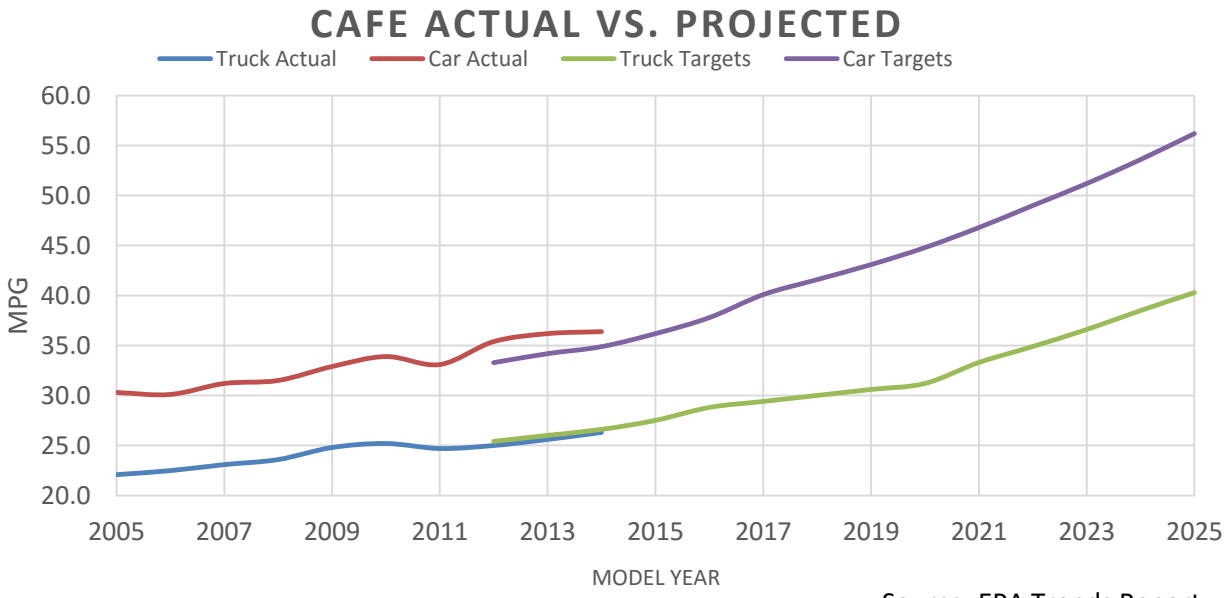
The Mid-Term Evaluation is well underway. In 2015, a National Academy of Sciences (NAS) panel on light-duty fuel economy released a report on the feasibility, costs and market barriers to fuel-saving technologies (2015 NAS Report). The EPA and NHTSA already have submitted a draft Technical Assessment Report (TAR) to the White House Office of Management and Budget that was formally received on June 14, 2016. This draft TAR is intended to review the implementation of fuel-saving technologies and the outlook for continued progress through 2025. This TAR is expected to be released in late June or early July 2016. At some point after the close of the TAR comment period, EPA is expected to release a proposed determination on the appropriateness of the regulations for MYs 2022-2025 in 2017 and then a final determination by a mid-April 2018 deadline.

[1] 77 Fed. Reg. 62624 (Oct. 15, 2012).
[2] https://www3.epa.gov/otaq/climate/letters.htm
[3] Id.

AUTOMAKERS ARE MOVING QUICKLY TO INTRODUCE FUEL-EFFICIENT TECHNOLOGIES

To date, some automakers have been quite successful in meeting the current GHG and CAFE targets by rapidly deploying a variety of cost-effective technologies. This is undeniably good news and is the result of a concerted effort on the part of automakers to improve the fuel efficiency of all their vehicles. In fact, automotive engineers began laying the technological groundwork more than a decade ago for the highly fuel-efficient vehicles in dealer showrooms today...These improvements were spurred on by the Energy Independence and Security Act of 2007 which increased and reformed the CAFE Standard and then were incorporated into the ONP agreement in 2009 which covered light duty cars and trucks sold in MY 2012-2016.

FIGURE I - FUEL ECONOMY SINCE 2005 CAFE ACTUAL VS. PROJECTED TARGET



Source: EPA Trends Report

EPA reports:

Two engine technologies first introduced over 20 years ago—variable valve timing (VVT) and multi-valve engines—are both projected to be used on nearly all MY 2015 vehicles. Gasoline Direct Injection (GDI) engines have increased market share by more than a factor of 5 from 8% in MY 2010 to 46% in MY 2015. Turbochargers, which often are used in conjunction with GDI, have also increased market share by more than a factor of five since MY 2010.[4]

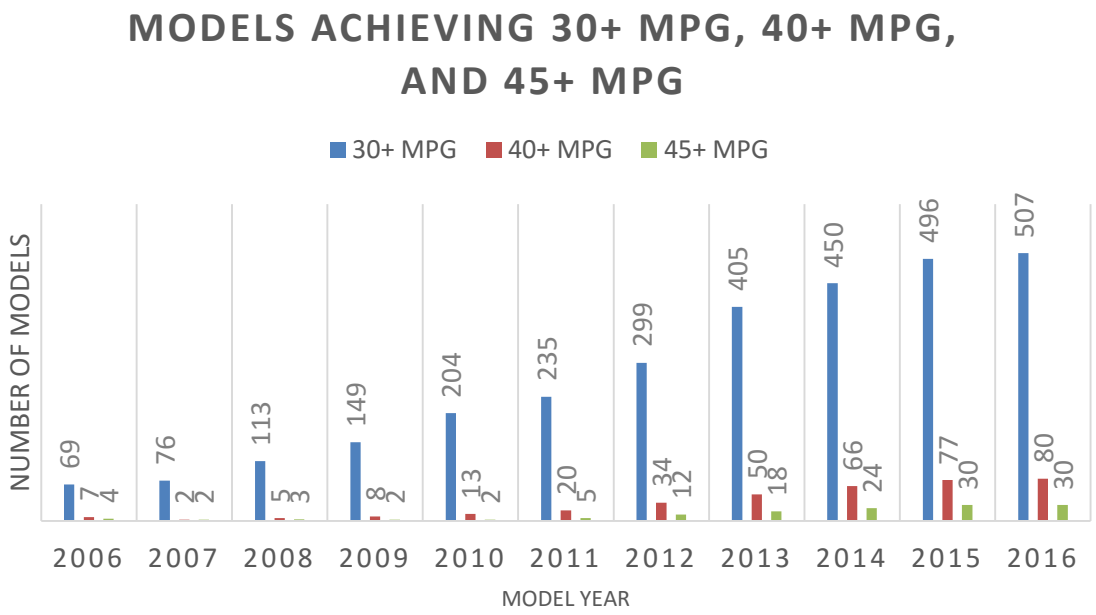
Manufacturers also are reducing vehicle loads by reducing mass, improving aerodynamics and adopting low rolling resistance tires, as well as including features such as stop-start. It is important to recognize

[4] https://www3.epa.gov/otaq/fetrends.htm

that while the standards increase in stringency each year, automakers do not release new refreshed models each year; therefore, yearly compliance of the entire fleet will vary.

The industry's innovations have resulted in a fast-growing selection of fuel-efficient models in both conventional and alternative powertrains. According to www.fueleconomy.gov, the government's official source for fuel economy information, the number of models achieving EPA label ratings of 30 MPG or higher highway fuel economy has grown by over 700 percent since 2006, while the number of models achieving 40 MPG or more has increased tenfold over the same period. In 2013, light duty vehicles of 30 MPG or higher highway fuel economy comprised 43 percent of vehicle sales – well over double the 17 percent share just five years before. By MY 2015, light duty vehicles included 46 models of hybrids, 18 battery electric models, and 12 plug-in hybrids, plus hundreds of new high MPG gas and diesel offerings.[5] As the chart below shows, manufacturers have accelerated the development of new technology and continue to offer ever more fuel-efficient models in an effort to meet future targets and consumer demand. However, exhausting technological avenues and competing regulations (such as new safety requirements and Tier 3 emissions standards) will likely temper future gains.

FIGURE II- MODELS ACHIEVING HIGHER FUEL ECONOMY*



Source: fueleconomy.gov | * Highway Rating

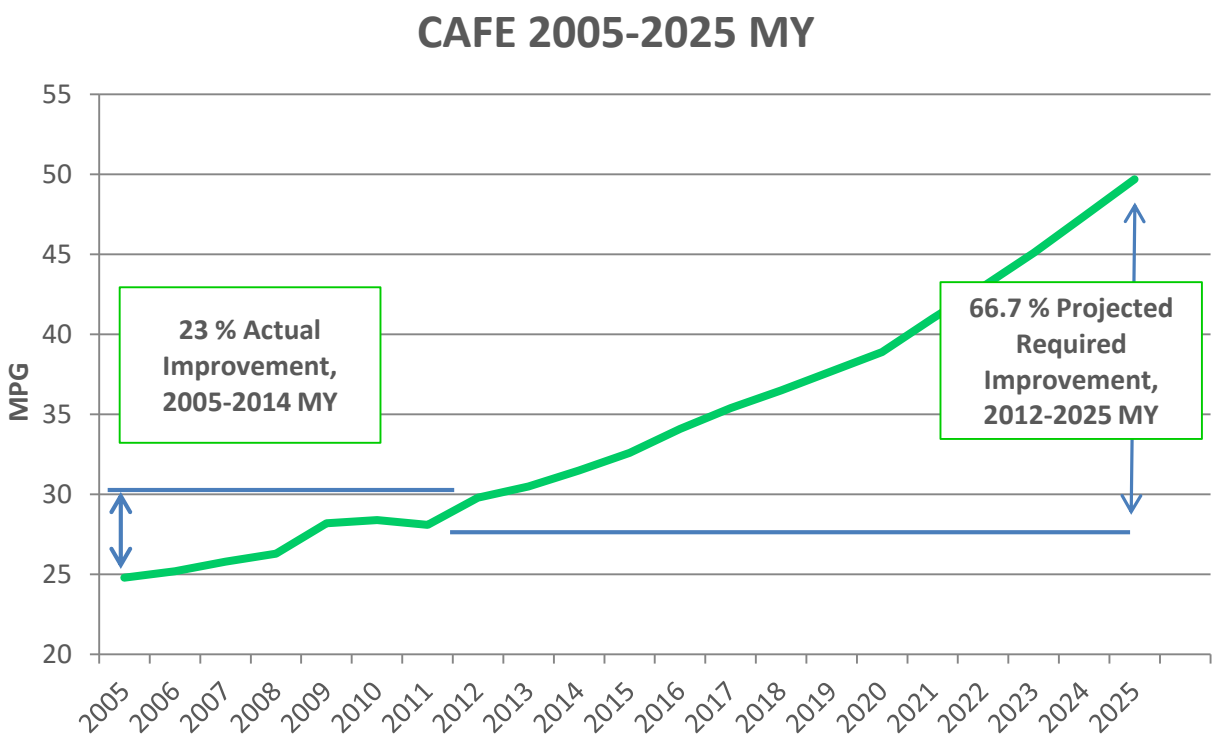
Key Finding: Manufacturers are producing and offering for sale more fuel-efficient vehicles than ever, resulting in increasing U.S. fleet fuel economy. This increase in fleet fuel economy, however, may soon be outpaced by government efficiency requirements.

[5] www.FuelEconomy.gov

CAFE PAST AND PROJECTED

Looking closely at the CAFE target pattern over a 20-year window from 2005 to 2025, the compliance curve grows progressively steeper.[6] In order to meet the fuel economy projections of 2025, the rate of innovation and technology deployment must accelerate faster than it has since 2005. Even though fuel economy will continue to improve with sustained effort, it is unclear if it is realistic to expect further fuel efficiency gains necessary to satisfy the agencies' initial assumptions in the 2012 rule.

FIGURE III – CAFE, PAST AND PROJECTED



Source: EPA Trends Report

The 2012 target schedule assumes fuel economy gains of about 5 percent per year for cars and about 3.5 percent per year for trucks during the 2012-2021 portion of the program. The final three years impose an expectation of fuel economy gains of about 5 percent each for both cars and trucks.

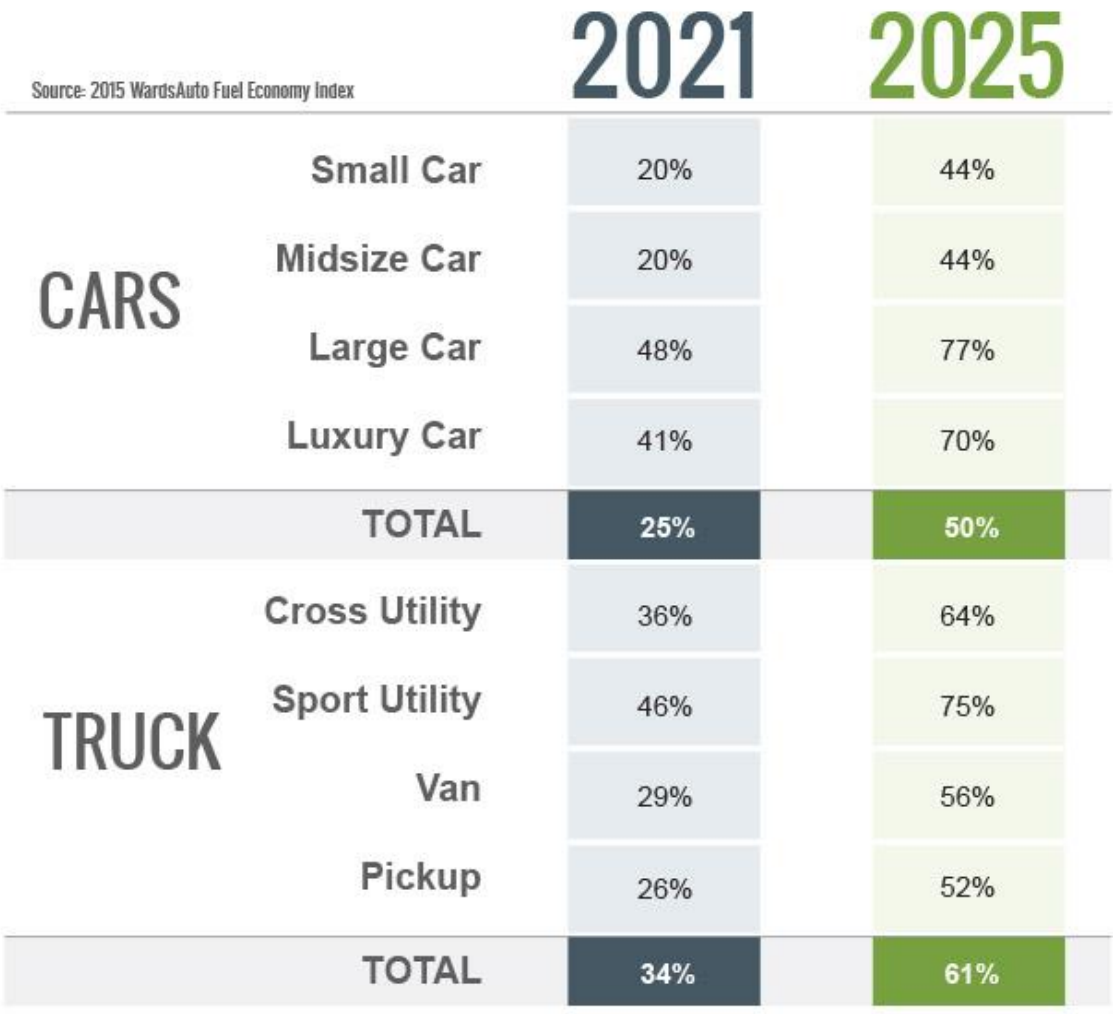
Key Finding: Future CAFE requirements may be overly optimistic based on historical data.

[6] This is more linear due to the metrics used (miles per gallon vs. grams per mile).

FUTURE REQUIREMENTS BY CLASS

To understand the magnitude of this challenge, *WardsAuto* looked at the improvements needed in each vehicle category. Accordingly, government CAFE targets for all passenger vehicles must increase by 30 percent between Model Year 2014 and 2021 and 57 percent between 2014 and 2025. This steep increase especially affects light trucks (vans, SUVs, pickups), which must improve mileage by 34 percent between 2014-2021 and 61 percent between 2014-2025-- essentially doubling the extraordinary improvements required by 2021 in four short years.

FIGURE IV– CAFE IMPROVEMENTS REQUIRED BY CLASS



Key Finding: All vehicle segments must improve to meet future targets. Some segments must improve more, over the 2014 MY baseline, than others.

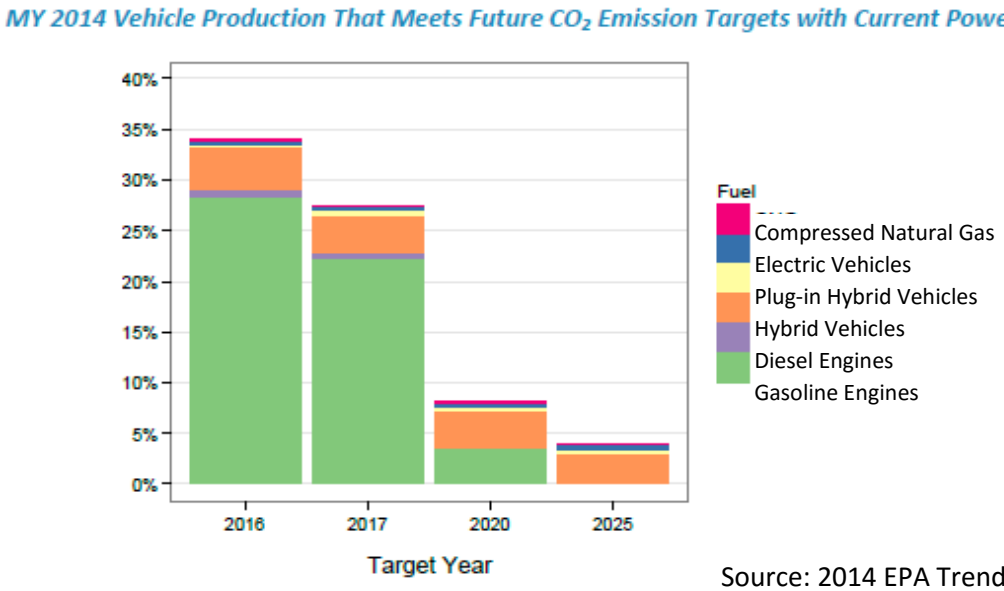
FUTURE REQUIREMENTS FOR THE FLEET

Automakers have significantly accelerated their efforts to introduce fuel-efficient vehicles. Some are ahead in meeting government standards now. However, substantially greater consumer purchases of the highly fuel-efficient vehicles, particularly alternative energy vehicles, are required to meet the future standards.

EPA and NHTSA anticipated in their 2012 analysis that new technologies will surface and the costs of existing and new technologies will decline over time, making these targets feasible in a market that relies primarily on the internal combustion gasoline engine. As a result, the agencies may continue to suggest -- even if the market relies primarily on the internal combustion gasoline engine -- that current projections are feasible through 2025. The current facts, including consumer preferences, contradict such a conclusion.

One way to assess feasibility of existing targets (adopted in 2012) is to examine what percentage of MY 2014 vehicles meet future CO^2 emission requirements. The results are intriguing. Almost 30 percent of MY 2014 vehicles operating with diesel or gasoline (non-hybrid) meet the 2016 target, but ***no*** diesel or gasoline (non-hybrid) vehicles meet the 2025 target. In fact, all current hybrids do not meet the 2025 targets. **EPA projected in 2012 that 2025 compliance would not require significant hybridization or electrification of the fleet.** However, that projection seems to reflect a leap of faith, in further Internal Combustion Engine (ICE) improvements, that goes beyond current technological realities. Even if gasoline or diesel engines significantly improve between now and 2025, those powertrains must become as fuel efficient or more efficient than current hybrid electric vehicles in one to two design cycles (i.e., 5-10 years). Such a conclusion is not realistic.

FIGURE V – 2014 SALES MEETING PROJECTED FUTURE TARGETS



Source: 2014 EPA Trends Report

Key Finding: To meet MY 2025 targets, today's average vehicle must be more efficient than some modern hybrids.

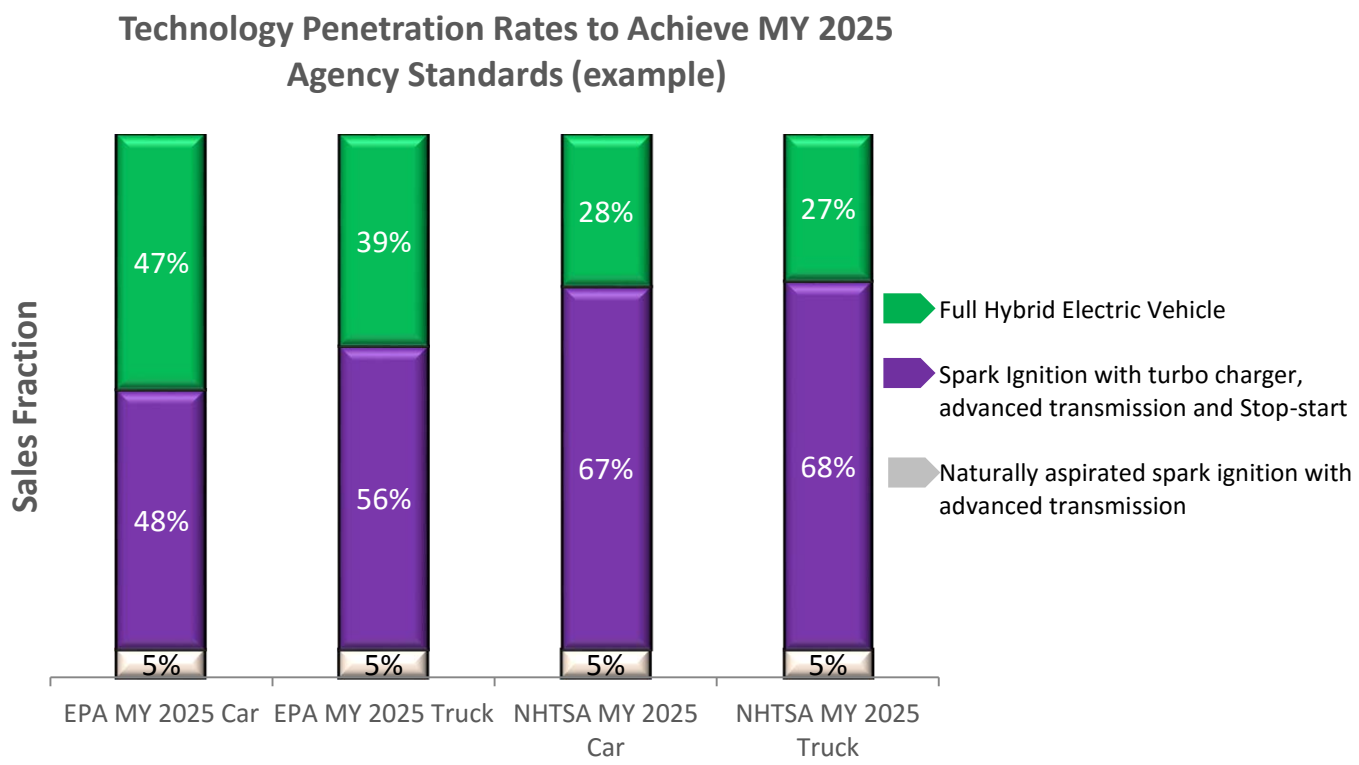
HOLISTIC, REAL WORLD MODELING

In the 2012 rulemaking, EPA's modeling predicted that to meet the 2025 standards, the U.S. fleet would need to include 5 percent Hybrid Electric Vehicles (HEV) whereas today, sales of hybrid and battery electric vehicles combined make up less than 3 percent of total sales. A recent modeling analysis by Novation Analytics (Novation), prepared on behalf of the Alliance and Global Automakers contradicts EPA's projection. Novation found that manufacturers must develop/add considerably more technologies than the agencies initially predicted in order to meet projected targets and that post-2021 standards cannot be achieved without significantly higher sales of advanced technology vehicles, including HEVs, Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs). One scenario Novation modeled shows that up to 47 percent of all cars must be HEVs to meet the existing 2025 targets (see Figure VI below). The actual cost of the program depends on this projected technology mix.

The fuel-savings potential of each technology is dependent on the market segment they are applied to (i.e. compact car, large car, mid-size truck, full-size truck, etc.). With respect to modeling approaches, at the vehicle level, both Novation and the agencies apply technologies (i.e., improvements) and take into account technology interactions and the existing level of technology on a "baseline" vehicle. The difference between modeling approaches is that the agencies use this process to model possible improvements to a limited set of vehicles and then apply that possible reduction to all vehicles in the fleet in a "one size fits all" approach. Novation applied technologies across the fleet by modeling each vehicle type individually. In addition, the analysis approach, used by Novation, takes into account real-world constraints such as requirements for criteria emissions, durability, reliability and drivability. However, the approach used by the agencies overlooks these constraints and therefore, provides an overly optimistic assessment of fuel-savings potential.

Another difference in modeling approaches is determining what reasonable level of improvement is possible with a given technology. The agencies' approach is to use theoretical values or to apply increases to even "laboratory" maximums in order to estimate potential improvements within a given technology. The agencies' approach often results in optimistic results. Instead, the Novation analysis assumes a fuel-savings benefit for each technology based on the performance demonstrated by the best applications of each technology currently demonstrated in the market (top 10 percent). Novation's approach means that the best-in-class technology today would be the average performance of that same technology in 2025. Although optimistic, it is one method of estimating the increases in technology performance from 2015 to 2025 within a given technology set commonly referred to as learning. Using the top 25 percent of applications of each technology, currently demonstrated in the market, should be used to model realistic future improvements; this approach would actually result in even higher levels of electrification technologies required by 2025 than depicted in figure VI.

FIGURE VI – SCENARIO OF PROJECTED TECHNOLOGIES



Source: Novation Analytics, LLC

Key Finding: Real world, holistic modeling, predicts up to 47 percent of the U.S. car fleet must be as efficient as modern hybrids by 2025.

Novation's analysis finds that by 2021, two things must occur to achieve the targets in the current regulations:

(1) the fuel economy performance of the *entire fleet* must be equal to today's most efficient gasoline vehicles; and,
(2) in addition to adding technologies, vehicle loads must be reduced 1 percent annually (by reducing mass, improving aerodynamics and adopting low rolling resistance tires).

By 2025, the *entire fleet* must achieve the 10 percent load reduction *and* exceed the fuel efficiency of today's most efficient gasoline powertrains. Moving the entire industry to the current best spark-ignition powertrains would provide compliance only to MY 2020. Advanced gasoline technologies, either currently unknown, undeveloped and/or unproven in production, and/or high rates of electrification will be required by MY 2025.[7] Essentially, using the agencies' vehicle modeling assumptions and combining them with more realistic modeling methodology, Novation's analysis indicates that significant

[7]Novation Analytics, LLC, Trade Association Studies Powertrain Technology Effectiveness, Phase II, Technical Briefing Prepared for the California Air Resources Board, May 17, 2016.

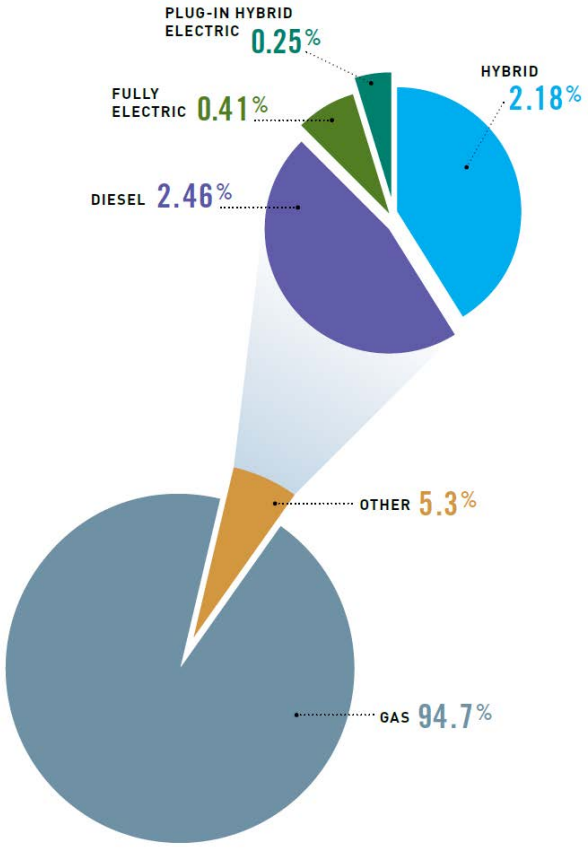
electrification or some other, yet-to-be defined, technology must see very broad market penetration rates for the fleet to meet future targets that are the subject of the Mid-Term Evaluation.

Key Finding: Using modern- top 10 percent best-in-class vehicles- even with agency assumed mass, aero and tire improvements, the fleet must be more efficient than the most efficient gasoline vehicles currently on the market by MY 2021.

HOW ARE CONSUMERS RESPONDING TO THE INCREASING AVAILABILITY OF ALTERNATIVE POWERTRAINS?

A key component of the Mid-Term Evaluation should be an assessment of consumers' behavior in the marketplace. A key uncertainty, critical to the success of the CAFE and GHG program, is the adoption rate of technologies that can perform at a level equal to or better than today's alternative powertrains (such as diesel, gasoline hybrids, and other forms of electrification) and are necessary to comply with the MY 2022-2025 targets. The challenge is that, in 2015, consumers overwhelmingly choose gasoline-powered engines (95 percent) over alternative powertrains (<3 percent). One reason is customers are familiar with gasoline-powered engines and another is the cost of alternative powertrains. As conventional gasoline engines have become significantly more fuel-efficient, the economic benefit of greater efficiency from alternative powertrains diminishes, even with higher gasoline prices. Just as the efficiency of advanced gasoline engines moves closer to modern alternative powertrains, the cost, complexity and consumer acceptance challenges also rise.

FIGURE VII – 2015 MARKET SHARE BY POWERTRAIN TYPE



Source: WardsAuto

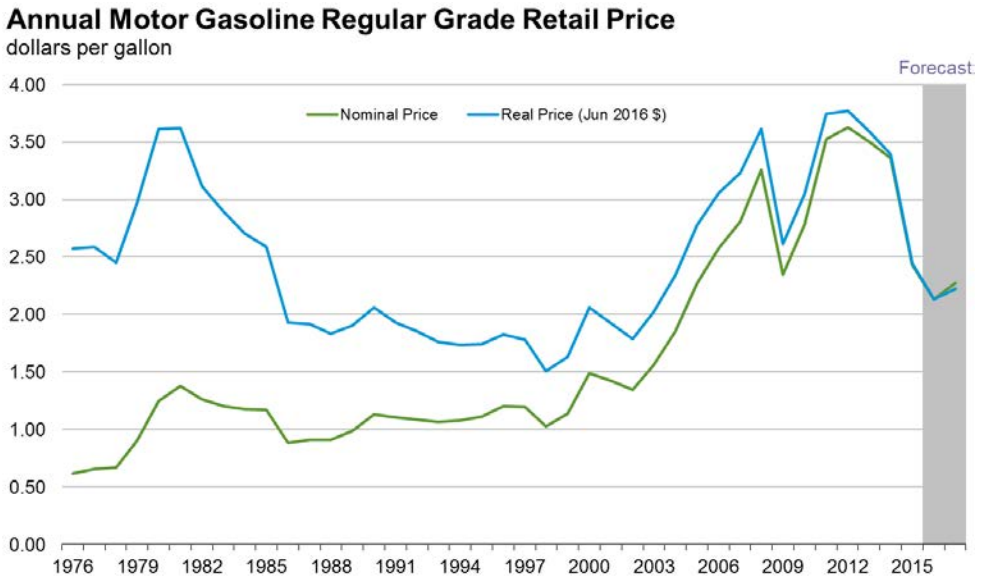
Were the CAFE and GHG program based solely on ensuring that highly efficient vehicle choices are offered to customers, the industry would be well-situated to meet future targets. But consumers are in the driver's seat when it comes to raising the fuel economy of the fleet, especially since compliance is determined by customer decisions when purchasing vehicles. Developing new technologies and building safe, reliable, efficient vehicles is not the end of the challenge.

Among the vehicles on sale during 2015, there were 76 models that achieved 40 MPG or more, as stated on new vehicle fuel economy labels… However, vehicles getting more than 40 MPG accounted for only about 1 percent of total new vehicle sales. Likewise, there are more than 75 models of hybrid-electric vehicles, plug-in electric vehicles and full battery electric vehicles in dealer showrooms. The combined sales of these vehicles in 2015 (497,683) was less than the sales of the single best selling pickup truck alone (780,354).

Key Finding: Even with a wide array of fuel efficient choices, consumers overwhelmingly choose gasoline (non-hybrid) powered vehicles.

HOW DO GAS PRICES INFLUENCE VEHICLE CHOICE?

The assumptions about gasoline prices that the agencies relied upon in 2012 in adopting the CAFE and GHG target schedules deserve examination. The agencies projected that gas prices would be difficult to predict, over the longer-term. In the agencies' original analysis of the 2017-2025 standard, they predicted gas prices would be $3.87 in 2010 dollars by 2025, or about $5 a gallon. Figure VIII reveals these assumptions were made when fuel prices were at their highest level in the past 40 years, exceeding even those of the late 1970's and early 1980's. Recent fuel prices (2015-2016) are more consistent with long-term averages, representing neither peak nor valley fuel prices.



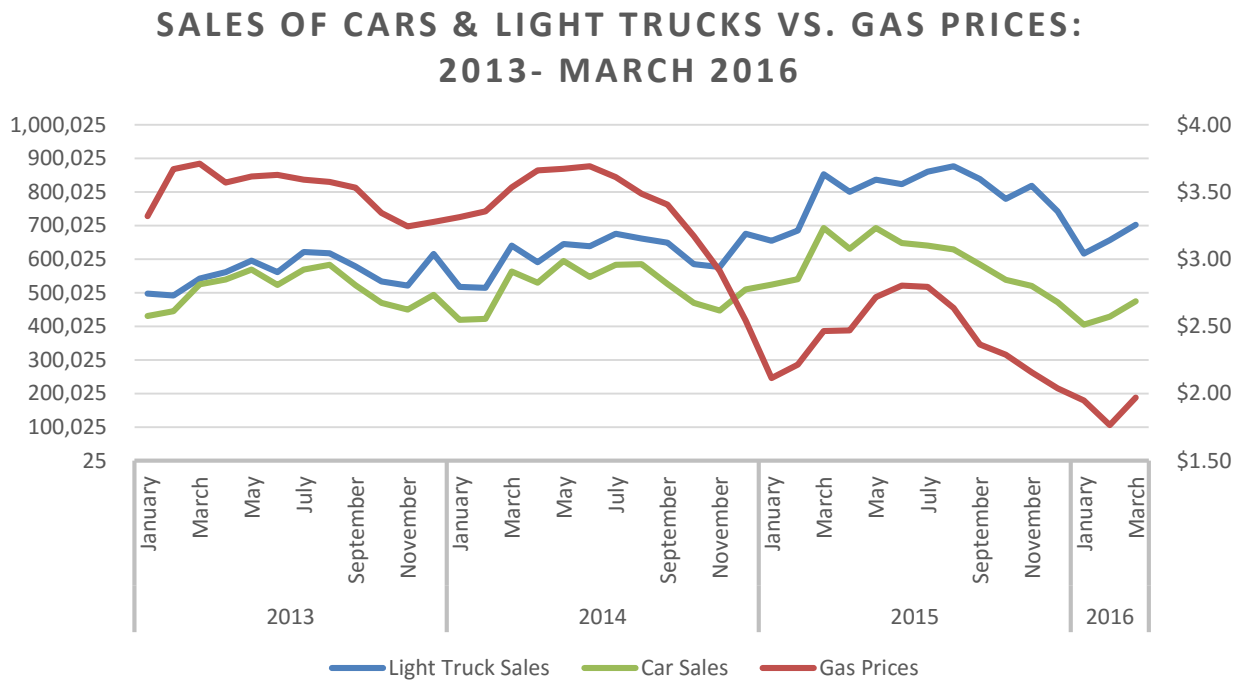
Key Finding: According to the EIA, gasoline prices are near historic averages when adjusted for inflation.

Source: U.S. Energy Information Administration Short-Term Energy Outlook Real Prices Viewer (http://www.eia.gov/forecasts/steo/realprices/)

Even without the recent fall in gasoline prices, consumers show signs that their interest in buying the "super" fuel efficiency gains has diminished either because fuel economy is a secondary consideration or they are very pleased with the existing fuel economy gains. It is not clear if consumer decisions are due more to economic or environmental concerns –. In effect, some consumers seem to be saying "enough is enough – let's bank these savings" – and allocate what they might have spent on larger fuel-savings alternatively on other safety, style and performance attributes – or other household priorities such as retirement savings or college tuition.

Figure IX tracks the relationship between the average nationwide price of regular gasoline and the purchase pattern of cars and light trucks/SUVs. While the break in favor of trucks/SUVs pre-dates the decline in fuel costs, the appetite for trucks/SUVs spikes even further as the cost at the pump falls.

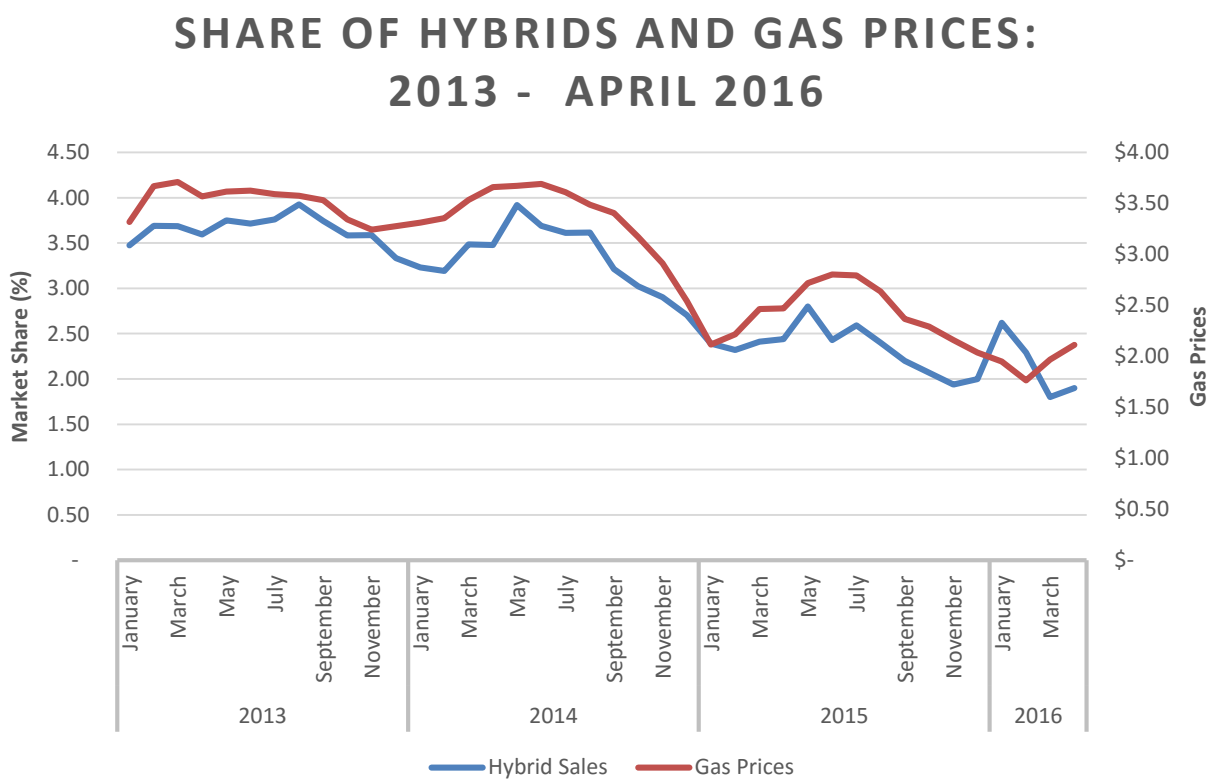
FIGURE IX – RETAIL SALES OF CARS AND TRUCKS COMPARED TO GAS PRICES



Sources: EIA and R.L. Polk

Likewise, Figure X highlights that sales of fuel-efficient hybrid-electric vehicles decline as gasoline prices drop. Hybrids can be viewed as a surrogate for consumer willingness to pay for the most fuel-efficient technologies. Even accounting for other attributes, working off of this rather straightforward assumption, one can clearly see the effect of fuel prices on the willingness of consumers to make fuel efficiency a priority.

FIGURE X – RETAIL SALES OF CARS AND TRUCKS COMPARED TO GAS PRICES

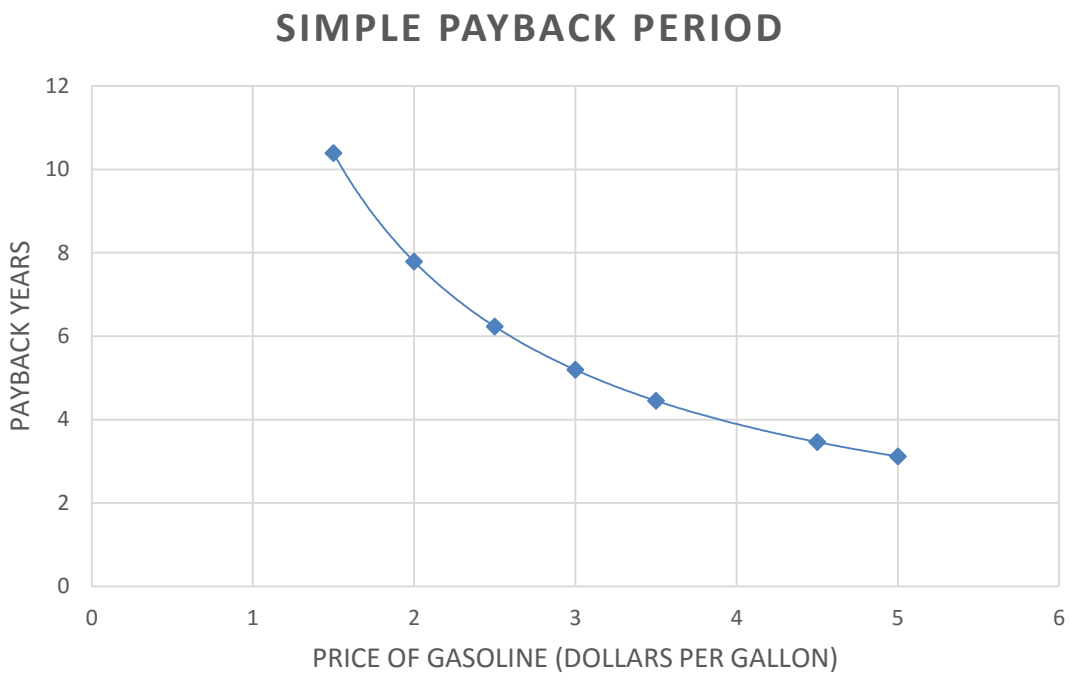


Sources: EIA and R.L. Polk

Key Finding: Fuel prices affect sales of hybrids (fuel efficiency priority vehicles) and the car/ truck fleet mix.

Another reason consumers may be choosing to purchase less expensive fuel-saving technologies (via an Internal Combustion Engine) could include the increased payback period with lower gas prices. Using the targeted fleet requirements of 35.5 mpg in 2016 MY and 54.5 mpg in 2025, along with the agencies' projected cost of approximately $1,800 in added technology needed, it is easy to calculate a simple payback period analysis at varying fuel prices. The figure below assumes all prices are in 2010 MY dollars and that consumers do not discount their projected stream of fuel-savings. Even with these optimistic assumptions, the payback period is quite sensitive to gasoline prices. At two dollars per gallon (in 2010 dollars), the payback period is about eight years; well beyond what most consumers consider worthwhile when buying a new vehicle. In addition, more consumers are opting to lease a new vehicle, which now accounts for roughly one-third of all new vehicle purchases. The combined impact of consumer spending decisions based on the payback period of such fuel-saving technologies and the increase in lease transactions (with terms of less than five years) highlights how the projected $1,800 cost of such technologies warrants a reevaluation based on consumer practices.

FIGURE XI – PAYBACK PERIOD



A team of researchers from the Indiana University School of Public and Environmental Affairs recently published a report on Phase 1 of an ongoing peer-reviewed study designed to offer technical suggestions and policy options for consideration during the Mid-Term Evaluation. The Phase 1 report explains the importance of this issue:

> ***There has been a significant decrease in fuel prices since the federal and [Zero-Emission Vehicle] rules were developed from 2009 to 2012. Official government projections of fuel prices have been revised downward and remain relatively low through 2030. Regulations should be reevaluated during mid-term reviews with these lower fuel price projections, emphasizing revised consumer payback periods and impacts on new vehicle sales***[8]

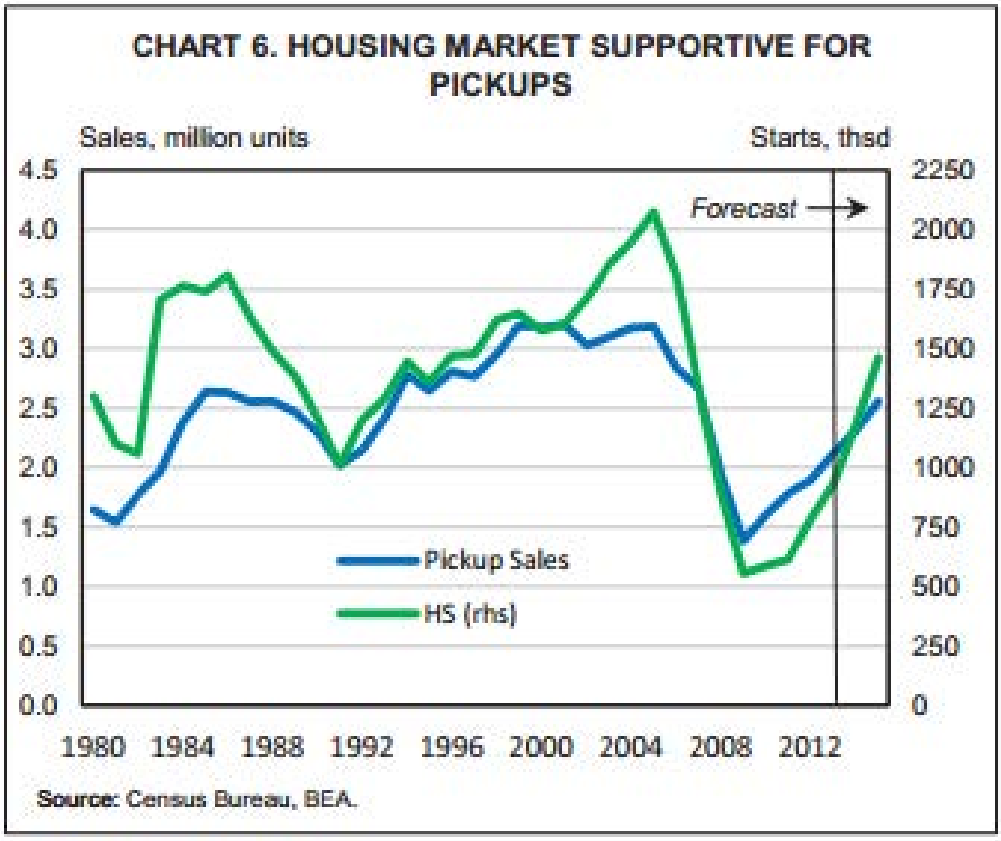
Key Finding: Payback period, even using agency assumed costs, extends beyond the timeframe most consumers consider and it is likely to remain that way.

When gasoline prices fall, especially in the context of improving mileage across segments of the market, the desire to walk out of the showroom with a hybrid (or other alternative powertrain) diminishes. A strengthening economy compounds this dynamic, driving up demand for trucks and vans to meet new business needs. The *Washington Post* recently reported, "[t]here is a strong correlation between the real

[8] Carly *et al., Rethinking Auto Fuel Economy Policy: Technical and Policy Suggestions for the 2016-17 Mid-term Reviews,* Feb. 2016, p. 6, https://spea.indiana.edu/doc/research/working-groups/fuel-economy-policy-022016.pdf (hereafter, "Phase 1 IU Report")

estate market and auto sales – particularly when it comes to the most iconic American vehicle of all, the pickup truck." The *Washington Post* article included the chart below:[9]

FIGURE XII – RETAIL SALES OF PICKUP TRUCKS AS COMPARED TO HOUSING STARTS



Key Finding: A growing economy generally leads to increased truck sales.

IS FUEL EFFICIENCY A CONSUMER PRIORITY?

The nature of polling is that it isn't too tough to discover apparently contradictory opinions. Accordingly, it's vital to peel the onion a bit – and look critically at multiple ways of asking the question - in order to derive a full understanding of what really is going on.

In 2015, EPA leaders cited the National Automotive Dealers Association (NADA) Used Car Buying Guide to assert that fuel efficiency was the number one priority of consumers. Similarly, the *Consumer Federation of America* reported that 86 percent of the public said gas mileage would be "important" when purchasing their next car, with 57 percent responding that MPG would be a "very important" factor. Yet other

[9] https://www.washingtonpost.com/news/wonk/wp/2014/03/05/why-a-boost-in-pickup-truck-sales-means-the-housing-market-is-in-for-good-news/

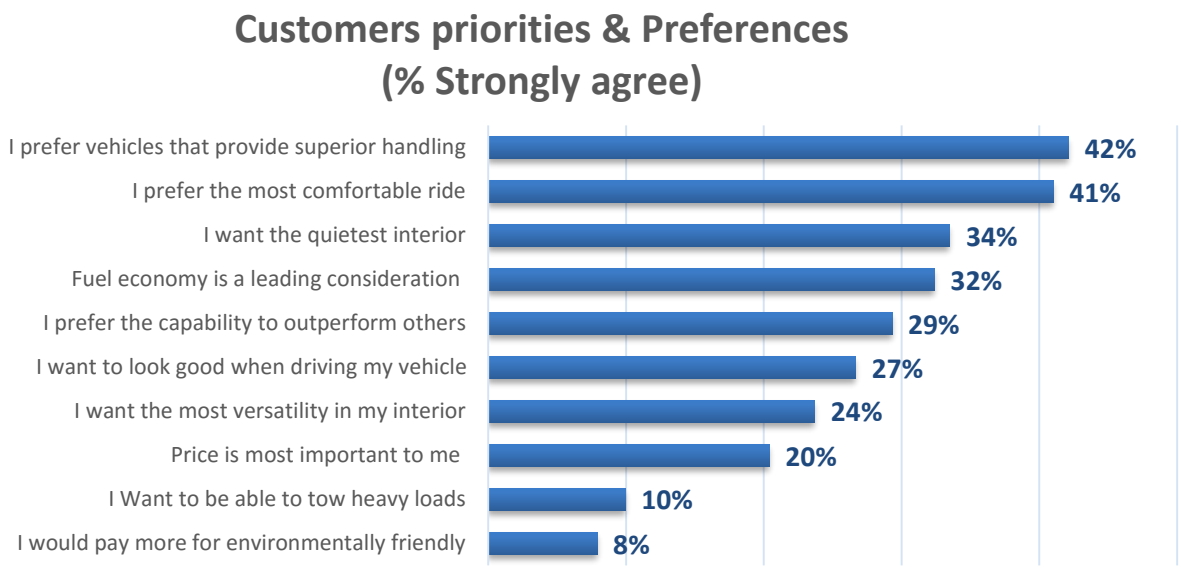
analyses, using actual purchaser behavior, suggest a more complex picture; purchasers are assigning less importance to fuel economy during their purchases.

The Strategic Vision Data

Strategic Vision conducted a comprehensive post-purchase survey of over 300,000 new car buyers each year, investigating the motivations driving consumer choices. The 2015 NAS Report acknowledges that Strategic Vision provides "the most reliable information about consumer preferences."[10]

Taking information gathered by Strategic Vision, the next two charts show that interest in fuel efficiency must be considered contextually. Figure XIII reveals that 32 percent of buyers assert "fuel economy is a leading consideration," behind superior handling, ride comfort and a quiet interior.

FIGURE XIII – CONSUMER PRIORITIES AND PREFERENCES



Source: Strategic Vision - 2014 New Vehicle Experience Study (NVES)

Although fuel economy matters to consumers, buyers have multiple priorities to balance when making a vehicle purchase. Strategic Vision's polling showed that the decision on what vehicle and what options to buy is informed by many other factors, as well. Figure XIV indicates that fuel economy/mileage ranks 15th as a purchase rationale.

[10] 2015 NAS Report, p. 325.

FIGURE XIV – VEHICLE BUYER PURCHASE REASONS

Rank	Purchase Reasons	*Percent*
1	Overall Safety of the Vehicle	63%
2	Overall Driving Performance	59%
3	Overall Value for the Money	58%
4	Overall Impression of Durability/Reliability	58%
5	Price/Deal Offered	56%
6	Safety Features	56%
7	Riding Comfort	54%
8	Handling	53%
9	Braking	52%
10	Comfort of Front Seat	52%
11	Affordable to Buy	50%
12	Road Holding Ability	50%
13	Front Visibility	50%
14	Engine Performance	50%
15	Warranty Coverage	50%
16	Overall Seat Comfort	48%
17	Overall Exterior Workmanship	47%
18	Maneuverability	47%
19	Fun to Drive	46%
20	Fuel Economy/Mileage	46%

Source: NVES 2015 Survey

In 2015, after reviewing the Strategic Vision survey results, the NAS panel concluded that, "…while consumers value fuel economy, they do so in the context of other attributes they also value… they look for the most fuel-efficient version of a vehicle they already want to purchase… Consumers are buying fuel efficient versions of vehicles that suit their wants and needs."[11]

Key Finding: Fuel economy, although important, is not a top purchase reason for new car buyers.

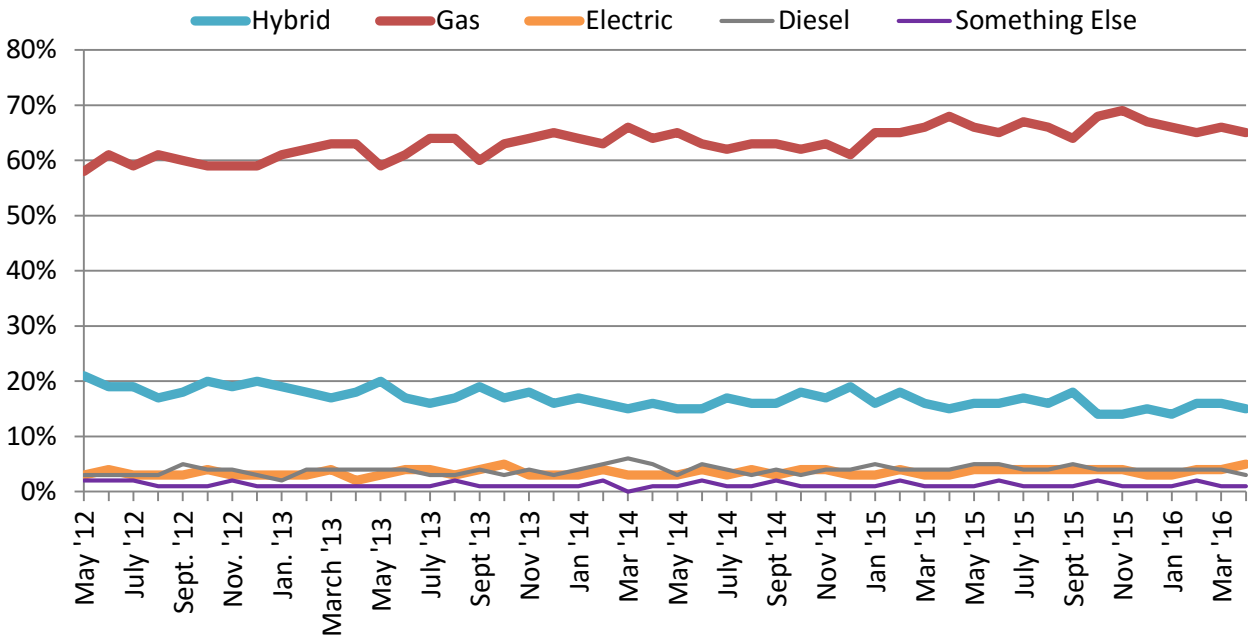
[11] 2015 NAS Report, p. 327.

RESULTS FROM THE AUTO INDEX

The Alliance conducts monthly opinion polling of consumers, registering 60,000 opinions each year. While many consumers consider alternative powertrains when car-shopping, most project that their next vehicle will be the same as their current automobile.

FIGURE XV – CONSUMER EXPECTED NEXT POWERTRAIN

What Type of Engine Will Your Next Vehicle Most Likely Be Powered By?



Source: Auto Index 2012-2016

Over the past four years, consumers overall have drifted away from buying an alternative-powertrain vehicle. Most consumers expect to buy a traditional gasoline engine. This trend predates the recent return of gas prices to historic norms.

One reason may be that, as the 2015 NAS Report suggests, fuel efficiency is a secondary attribute to decide between similar vehicles, not a primary attribute driving the initial purchase decision. Vehicle size, overall value, utility, and performance are more likely to be deciding factors (*e.g.,* a person with a seven-person family can care about fuel economy, but they will preferentially gravitate to larger vehicles before higher fuel economy vehicles because, regardless of fuel economy ratings, other requirements must be met first). Another reason may be that when consumers go into the showroom looking for fuel efficiency and are open to the idea of new powertrains, they see the MPG of the conventional offerings and decide they are satisfied with that level of fuel economy and then seek out other vehicle attributes (size, utility, safety and performance).

ACCOUNTING FOR CONSUMERS

Some would point to the attribute-based targets and separate requirements for car and truck classes as a complete solution to shifts in consumer choice due to lower gas prices. Although attribute-based standards help ensure the entire fleet improves regardless of large shifts in demand, consumers still choose how much they are willing to spend on features other than fuel efficiency improvements within the same vehicle platform (even within the same footprint and class). Often within a model, consumers demand options for different levels of performance and features that affect fuel economy and CO^2 emissions. As a result, achieving fuel economy targets even within a particular vehicle footprint/platform depends on consumers' willingness to pay for the greater fuel economy options within that platform. Relying completely on the attribute-based targets and fleet split as a way to address fuel prices ignores the reality of consumer choice. For this reason, it is important that analyses of consumer choice not end at attribute-based targets and fleet mix, or even the payback period, but also address the role of other attributes (such as those revealed in Finding 9.6 of the 2015 NAS Report) and economic considerations that introduce heterogeneity into vehicle purchase decisions.

The 2015 NAS Report recommended that the agencies conduct more research on consumer purchasing behaviors, urging that this be a key component of any regulatory impact analysis:

> ***Finding 9.6** The value of fuel economy is related to the value of other vehicle attributes to consumers. Therefore, understanding the value to consumers of vehicle attributes other than fuel economy is important for the assessment and implementation of the fuel economy rules. If consumers value other attributes, and such attributes are forgone to obtain fuel economy in order to meet the regulations, the benefits and costs of these attributes will need to be accounted for in an assessment of the rule. These attributes could include any technological progress to vehicles that could be made in lieu of fuel economy, including horsepower, acceleration, or accessories that add weight, for example. The few existing studies have found a wide range of values for different vehicle attributes, including for fuel economy, but new survey and statistical approaches may offer promise for improving estimation of the value of these different attributes*[12]

Key Finding: The attribute car-truck based targets do not fully account for consumer choice.

IS THERE MORE TO CONSUMER ACCEPTANCE THAN FUEL PRICES?

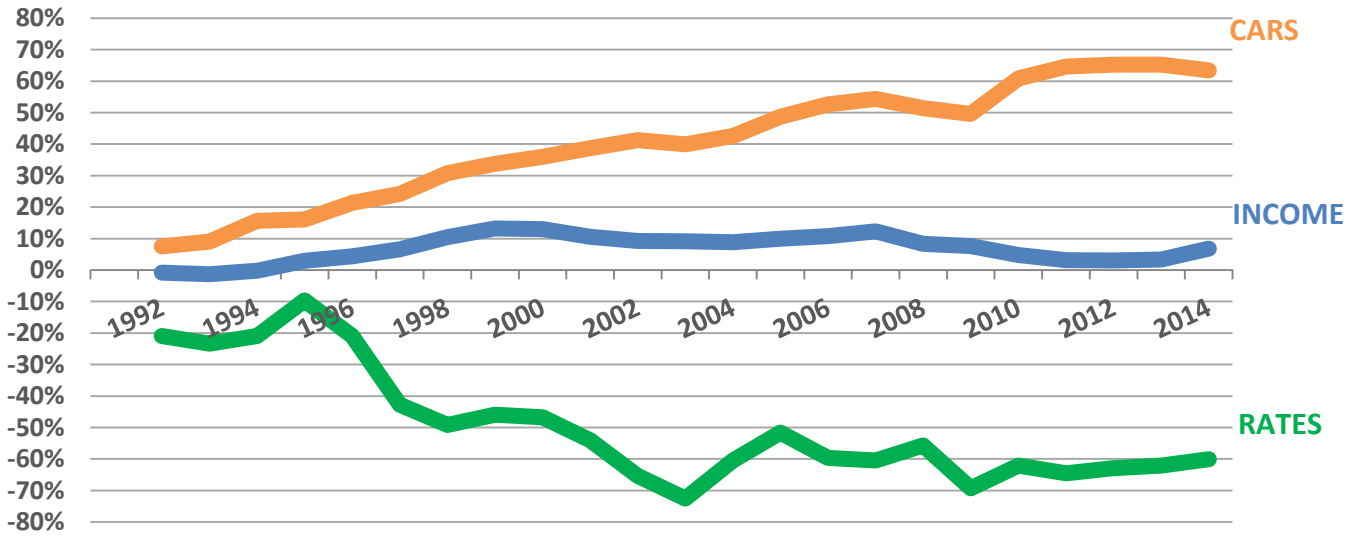
During the initial years of the ONP, automakers have generally been able to meet fuel economy targets by introducing available, affordable fuel-saving technologies to consumers. As the Novation analysis depicted in Figure VI on page 10 of this report shows, future targets will require newer and costlier technologies. Consumer acceptance entails more than preferences or willingness to pay for efficiency – factors often influenced by fuel prices as previously discussed. It also entails their ability to pay for the increased costs associated with highly efficient technologies that are necessary to comply with future

[12] 2015 NAS Report, p. 333.

targets. This is a complex affordability issue requiring analysis of new vehicle costs, household disposable income and the cost of capital.

Over the past 23 years, automakers have added new emission control and fuel-efficient technologies, safety features (electronic stability control, backup cameras, tire pressure monitors, automatic braking systems, etc.), connectivity and infotainment technologies and other features drivers increasingly demand. These new features, combined with the growing demand for SUVs and light trucks, caused average new car prices to increase by more than 60 percent since the early 90's. In December 2015, the *Kelly Blue Book* reported the estimated average transaction price for light vehicles in the United States had reached an all-time high of $34,428.[13]

FIGURE XVI – NEW CAR PRICES COMPARED TO MEDIAN HOUSEHOLD INCOME AND INTEREST RATE



As noted in the figure above, as new car prices increased, interest rates dropped dramatically and remained low, making it possible for consumers to continue buying new light-duty vehicles. As a result, the increased vehicle cost was offset by the low cost of capital. In addition, average loan terms have lengthened significantly, approaching seven year terms. While this trend allows consumers to keep their monthly payments affordable, the risk is that the vehicle could depreciate below the remaining loan amount before it is paid off, leaving the consumer "under water." For the Mid-Term Evaluation, the agencies (as well as Congress, state officials, and the general public) must evaluate how the slowdown in growth of disposable personal income,[14] combined with the Federal Reserve's recent decision to begin increasing interest rates (thereby increasing the cost of capital), will impact consumers' ability to afford the increasingly expensive technologies necessary to meet the future CAFE and GHG standards. All this while keeping in mind that other regulations, improving tailpipe emissions and safety, will simultaneously have an impact on vehicle production costs and achievable fuel economy. Note, the EPA is not statutorily

[13] http://mediaroom.kbb.com/record-new-car-transaction-prices-reported-december-2015
[14] http://www.tradingeconomics.com/united-states/disposable-personal-income

bound to consider the impact greenhouse gas regulations have on overall vehicle costs – particularly when it comes to safety advancements and other technologies that are, or could be, added to new vehicles to mitigate or prevent accidents from happening on U.S. roadways. If consumers have difficulty affording the cost of new technologies required for compliance, they may decide to hold onto their current vehicles longer or purchase from the used vehicle market. In either case, the virtuous cycle of fleet turnover with ever more fuel-efficient vehicles is stalled and the standards do not achieve their anticipated benefits.

Key Finding: Vehicle prices are increasing despite flat median household incomes. Reversal in interest rates, combined with regulatory costs, will adversely affect sales.

IS ONE NATIONAL PROGRAM A REALITY?

What is called the "One National Program" (ONP) was launched by the EPA and NHTSA in 2009 to avoid piecemeal, fragmented automotive policy that was inefficient and raised costs to consumers. ONP acknowledges the necessity of a single regulatory voice to avoid conflicting or counter-productive regulations from multiple sources, both within the Federal government and among the states.

ONP was designed to consider broad national policies. For instance, state programs do not consider effects on auto jobs in the Midwest and South or how requiring lighter vehicles could affect overall passenger safety. By contrast, NHTSA is statutorily mandated to consider potential effects of fuel economy regulations on affordability, jobs, safety, fuels availability, energy infrastructure and more.

In at least two respects, however, the idea of ONP is compromised in practice and effect. The first is that California already is moving forward with a different schedule on the Mid-Term Evaluation. By the end of 2016 -- a full 16 months before the Federal government might issue a final decision on its Mid-Term Evaluation and possibly more than three years before NHTSA is required to promulgated a CAFE rulemaking – California's Air Resources Board (CARB) is expected to determine the Mid-Term Evaluation results [15] This early determination could threaten the ONP, unless the Federal agencies later reach the same conclusion as CARB. To date, CARB has not provided any rationale for reaching conclusions earlier than the Federal agencies.

The second way ONP is compromised is the Zero Emissions Vehicle (ZEV) mandate, a program established by California and adopted by nine other states around the country that, collectively, represent 30 percent of new vehicle sales.[16] The states require manufacturers to sell (as opposed to requiring consumers to buy) an increasing percentage of ZEVs such as fully electric vehicles, plug-in electric vehicles or hydrogen fuel-cell vehicles. By 2025, manufacturers will be compelled to sell enough ZEVs to reach at least 15.4 percent of total new vehicles sales in each ZEV state. Despite various state sales incentives, there are concerns that the future ZEV sales requirements cannot be met in the time required, particularly in the cooler, less-populous Northeast states that have adopted the ZEV requirement.

[15] Mobile Source Strategy, California Air Resources Board, http://www.arb.ca.gov/planning/sip/sip.htm

[16] Section 177 of the Clean Air Act allows states to either follow the federal requirements or adopt California's vehicle emission regulations. Nine other states adopted the California ZEV regulation: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont.

COSTS TO CONSUMERS AND THE ECONOMY:

The Federal government estimates the total cost of the current ONP to be about ***$200 billion*** from 2012-2025.[17] According to CARB, the ZEV program is expected to cost ***an additional $20-$40 billion*** from 2018-2025. To date, the economic impact analyses performed by NHTSA and EPA have never taken the ZEV mandate into account.[18]

EPA maintains that the ZEV mandate is unrelated to ONP and that while electrification is not necessary to reach the 2025 target, if it is reached, that helps manufacturers to comply with the CAFE schedule. This conclusion ignores the realities of the market. The sale of electric cars still requires significant automaker subsidies (in addition to government incentives), which raises the cost of all new vehicles for consumers regardless of whether they are purchasing a vehicle in one of the ten ZEV states. Automakers may well also have to subsidize additional other high-MPG offerings to comply with CAFE. As with any business or industry, money is limited and there is only so much subsidization that can occur without compromising the underlying economics of designing, manufacturing and selling automobiles that are safer and more fuel efficient than the average age (11+ years) of vehicles on the road today. Moreover, compliance with both of these mandates requires different investment strategies in R&D. In short, the ZEV and CAFE and GHG regulatory obligations cannot be isolated from one another. Both require compliance; they are not necessarily complementary and industry has a limited capacity to nudge buyers to purchase vehicles they either don't want or are not willing to pay the actual cost for.

In 2015, Resources for the Future (RFF), an independent, nonpartisan organization that conducts economic research and analysis, issued a report that examined the relationship between the CAFE credit system and the California ZEV mandate. RFF affirmed the interrelated dynamic between these programs:

> ***The effect [of ZEV] is to increase the price of credits and to shrink both the EPA and NHTSA credit markets. There is no change in the emissions of the national fleet, however, since [manufacturers] are still complying with the same standards, just achieving those standards in a different way and at higher cost. Emissions in California will be lower, but higher in non-participating states around the country[19]***

More recently, researchers at Indiana University concluded:

> ***The ZEV regulation was not incorporated into the 2012 uniform national program designed by the Obama administration. CARB's 2011 RIA was undertaken as if the federal programs did not exist. In addition, the 2012 EPA and NHTSA [Regulatory Impact Analyses] were conducted as if the ZEV program did not exist… Further, the potential interactions between the federal and ZEV programs need to be analyzed because the presence of the ZEV program can have***

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[17] See http://www.epa.gov/otaq/climate/regulations/420r10009.pdf (EPA RIA for 2012-16 rule) and http://www.epa.gov/otaq/climate/documents/420r12016.pdf (EPA RIA for 2017-25 rule).

[18] Phase 1 IU Report, p. 44.

[19] Benjamin Leard and Virginia McConnell, *New Markets for Pollution and Energy Efficiency: Credit Trading under Automobile Greenhouse Gas and Fuel Economy Standards,* May 2016, p. 22. http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-15-16.pdf

major implications for manufacturer compliance strategies, federal credit-trading markets, and attainment of environmental benefits[20]

Key Finding: The One National Program is not a reality in that an optimized fleet cannot meet all Federal and state requirements. The ZEV mandate and related cost/ benefit analysis must be part of the One National Program discussion.

RECOMMENDATIONS AND RELATED CONSIDERATIONS

There are many factors that affect the U.S. fleet average fuel economy, and many factors that are unpredictable and outside of the control of automobile manufacturers. Consumer preferences, global events, the fate of the economy, gas prices and a series of other governmental policies around the country (e.g., incentives) will combine to determine whether the future CAFE and GHG targets are viable. For the Mid-Term Evaluation, the agencies should examine the interrelated factors that have been presented in this document.

1. **Strong economic analysis is critical in determining vehicle affordability and the impact affordability may have on U.S. jobs in manufacturing, sales, and support.** The Mid-Term Evaluation must evaluate how the slowdown in growth of disposable personal income, combined with the Federal Reserve's recent decision to begin increasing interest rates (thereby increasing the cost of capital), will impact consumers' ability to afford the increasingly expensive technologies necessary to meet the future CAFE and GHG standards and other technologies required by regulation. This analysis also is critical since certain fuel economy and emissions standards also could impact the affordability of new vehicles that are or could be equipped with safety technologies that can mitigate or prevent crashes from happening. In the end, affordability directly impacts vehicle sales volume, the resulting economic activity including manufacturing, and the sustainability of the light duty industry.

2. **The Mid-Term Evaluation must consider how consumer buying decisions and the achievability of the standards have been impacted by low fuel prices and should compare past predictions for technology development and uptake against the agencies' most recent predictions**. Automakers support a strong fuel economy program where government targets align with affordable technology and market realities. For now, some automakers are ahead in meeting fuel economy targets because of the focus on bringing the affordable fuel-saving technologies to market over the last decade – not to mention the fact that auto manufacturers utilized credits that were previously earned for over compliance in the past. Still, there are concerns about one fact: sales of the most fuel-efficient powertrains remain low. To meet government emissions and fuel economy targets, automakers are evaluated on what consumers *choose to buy*. Low consumer interest in high-mileage options presents a serious challenge to the government's ambitious CAFE and GHG targets that were envisioned in 2012 – a challenge that must be addressed by government agencies and officials to reflect current economic and consumer realities.

3. **The ZEV mandate should be an integral part of any analysis of the cost and resource implications of ONP.** Federal regulators have never taken into account the ZEV standards in California and nine other

[20] IU Phase 1 Report, p. 44.

states that, collectively, represent 30 percent of new vehicle sales. Clearly, the Federal and state programs are related and interactions between the two programs need to be analyzed, especially considering the ZEV program will cost consumers up to $40 billion during 2017-2025 – regardless of whether they live in a ZEV state or buy a new vehicle in a ZEV state.

4. **The Mid-Term Evaluation should use the most up-to-date information available.** Currently, the agencies plan to issue a draft TAR in late June or early July 2016, relying primarily on three years of data (MYs 2012-2014) to predict future technology effectiveness, costs, deployment rates and other key variables. When this rule was announced in 2011, regulators recognized the difficulty of predicting so many factors 14 years into the future. For example, in 2011, the government expected gas to cost roughly twice what consumers are paying at the pump today. After issuing a draft TAR, the government should incorporate the full 2015 sales data and use as much 2016-2017 MY technology effectiveness data as possible in any Notice of Proposed Rulemaking or Draft Determination. If not, a rule or determination could be published using dated material when much more recent data is available that could paint a very different picture than MY 2014.

5. **The Mid-Term Evaluation should account for the higher level of electrified vehicle sales necessary to meet future standards.** Despite dramatic improvements in the fuel economy of cars and light duty trucks, the future targets are so high that only about 4 percent of current models meet 2022 targets and the sales of these most energy-efficient vehicles remain low (less than 3 percent of 2015 new vehicle sales). In fact, not all hybrids on sale today meet the MY 2025 targets. With steeper government targets projected, substantially greater consumer purchases of the highly energy-efficient vehicles on sale today will be necessary to meet the future standards. However, despite a variety of federal and state incentives, consumer acceptance of electrified powertrains is relatively low and various barriers exist for vehicle charging infrastructure, vehicle range, convenience and the overall ownership cost.

6. **The Mid-Term Evaluation should evaluate the degree to which off-cycle improvements, an integral part of ONP, are necessary for future compliance.** Certain off-cycle benefits, measureable in the "real world" require a lengthy multi-year approval process and must clear agency hurdles that are largely reliant on regulatory interpretation. The Mid-Term Evaluation should consider the industry's future ability to utilize these off-cycle improvements and should evaluate mechanisms for streamlining their utilization.

7. **The Mid-Term Evaluation should account for competing regulatory demands.** The Mid-Term Evaluation should identify regulatory actions, taken after the original 2017-2025 rulemaking, that have increased the challenge to meet the CAFE requirements. These include the Tier 3 standards for criteria pollutant emissions, any new emissions test procedure, and the impact of new vehicle safety standards.