COUNCIL on FOREIGN RELATIONS

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DISCUSSION PAPER

Automobile Fuel Economy Standards in a Lower-Oil-Price World

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November 2015

Introduction

Fuel economy standards are a central element of U.S. energy security and climate change strategy. They are the primary way that U.S. economic policy reduces the country's exposure to oil price spikes generated by conflict and instability overseas. They are also a critical element of U.S. plans to reduce carbon dioxide (CO_2) emissions in pursuit of its international climate change commitments.

The standards, which require automakers to achieve government-mandated targets for the efficiency of the vehicles they sell each year, ostensibly present a win-win-win by delivering these security and climate payoffs while saving consumers money on gasoline. Rising fuel prices over most of the last fifteen years have bolstered this logic. Congress legislated stricter standards for cars and light trucks in 2007, and President Barack Obama's administration issued escalating requirements for the Corporate Average Fuel Economy (CAFE) of vehicles sold in model years (MY) 2011–2025. The current policy aims to achieve a fleet-wide average of 48.7 miles per gallon (mpg) for new cars and light trucks sold in 2025.

In establishing targets for MY 2017–2025, the regulatory agencies responsible—the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA)—agreed to a midterm review of the requirements for MY 2022–2025. A technical evaluation, already underway, is required by November 2017 and any revisions are due by April 2018.[1]

Now global oil prices have plummeted. Lower fuel prices challenge the economic case for fuel economy standards because consumer fuel savings are smaller when fuel spending is low to begin with. Indeed, when the U.S. government released its regulatory impact analysis for the MY 2017–2025 CAFE standards in 2012, 80 percent of the economic benefits it claimed came from its forecast of consumer fuel savings under the assumption that gasoline prices would steadily increase.

Regulators' claims that the benefits of CAFE will far outweigh the costs are now more vulnerable because forecasted fuel savings are lower. Automakers are also likely to argue that the costs of upgrading vehicles will exceed regulators' predictions. This combination may raise enough doubts about the net benefits (benefits minus costs) of the standards to prompt regulators to relax them.

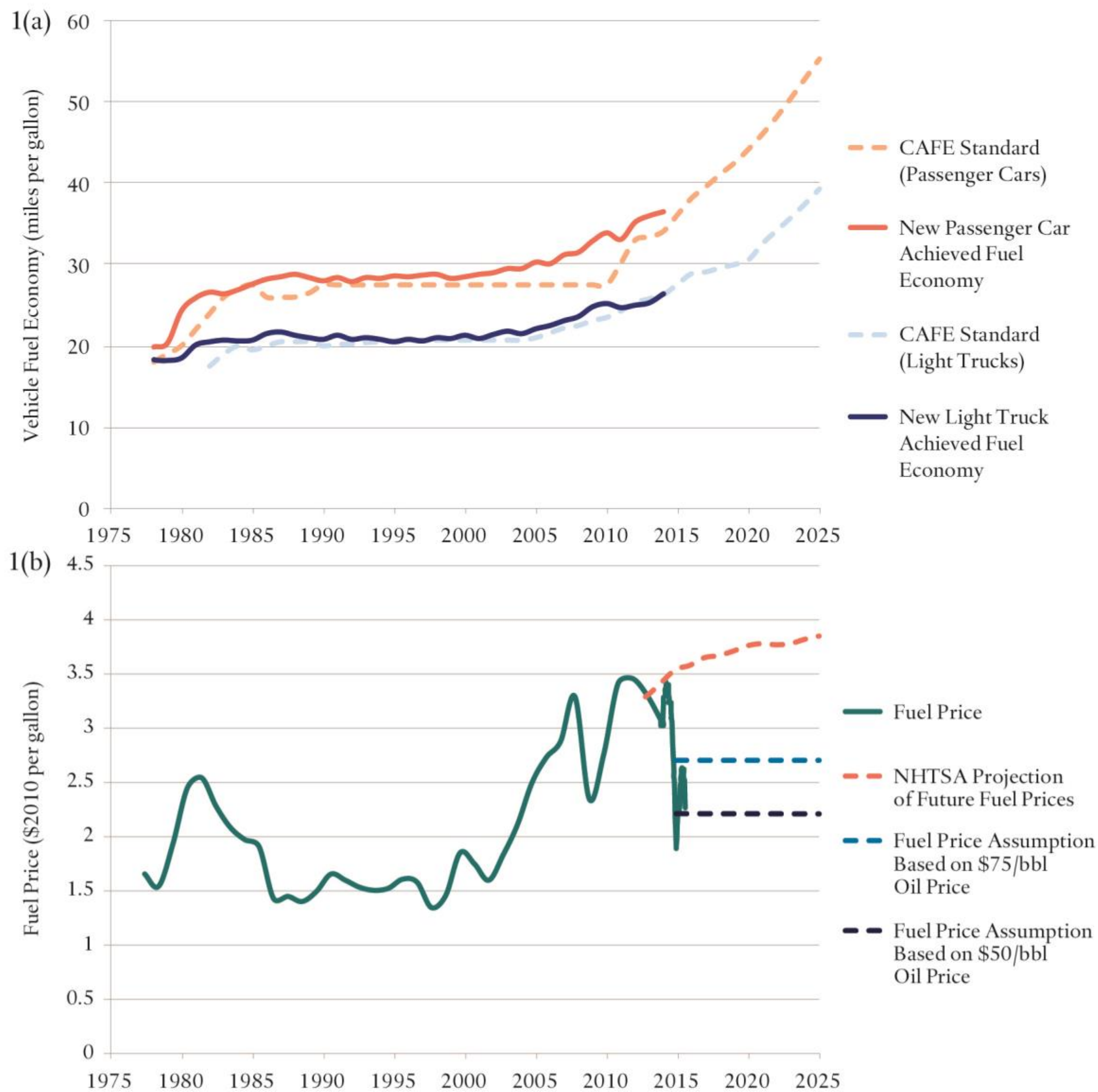
Yet, given current EPA and NHTSA assumptions about vehicle technology costs, maintaining planned CAFE standards for MY 2022–2025, rather than relaxing them, would likely be better for the United States despite the fall in oil prices. This paper shows that adjusting regulators' previous estimates of fuel savings to reflect a lower oil price still yields an estimate of CAFE benefits well in excess of costs. Indeed, under the regulators' framework for calculating costs and benefits, the current fuel economy targets should still deliver greater net benefits than any less stringent target would, though this conclusion is sensitive to future assumptions about technology costs.

These conclusions are partly due to recent U.S. government guidance that increased the projected damage due to greenhouse gas emissions. Because CAFE standards reduce such emissions even more in a low-oil-price environment, the environmental benefits of the standards are projected to be more significant. In addition, this paper shows that analyzing a wider range of oil-market- and national-security-related benefits provided by stricter fuel economy rules than regulators have included previously—specifically protection against oil price volatility, option value of higher standards in case prices rise again, and lower world oil prices resulting from reduced U.S. oil use—would strengthen the case for maintaining stringent CAFE standards.

A Tight Link Between CAFE Standards and Fuel Prices

Since the inception of CAFE standards, global oil market developments and the resulting changes in gasoline prices have influenced policymaker appetite for tighter standards. Congress enacted the first CAFE standards in 1975 in response to the 1973 oil crisis exacerbated by the Arab oil embargo. These laid out a schedule of efficiency requirements—a set of annual targets for the average vehicle sold, measured in miles per gallon—for automakers in upcoming years (figure 1). Throughout the 1970s and early 1980s, NHTSA continued raising the standards, as oil markets experienced a second supply shock from the 1979 Iranian Revolution and fuel prices surged.

Figure 1. (a) CAFE Standards and Actual Fleet Fuel Economy
(b) Historical Fuel Prices and Alternative Future Projections



Source: NHTSA, Energy Information Administration.

However, upon the oil price crash in the second half of the 1980s, the U.S. government not only halted the planned escalation but also mildly relaxed the standards. From 1987 to 2010, the required passenger car mileage under CAFE remained fixed at 27.5 mpg. Legislation in 2007 and a U.S. government directive in 2009 resulted in the first CAFE standards hike in two decades. Subsequent rulemakings resulted in a CAFE schedule culminating in a forecasted 49 mpg fleet-wide average fuel economy for MY 2025 vehicles.[2]

AGENCY ASSESSMENT OF BENEFITS FOCUSES ON FUEL SAVINGS

Regulators were able to conclude that CAFE benefits overwhelmingly outweigh costs by pointing to large future savings on fuel bills that consumers would enjoy. Although each agency issued its own MY 2017–2025 fuel economy provisions—the NHTSA regulates fuel economy (mpg), whereas the EPA regulates emissions intensity (grams of emitted carbon dioxide per mile)—the two agencies harmonized their regulations so that compliance with one agency's set of metrics will, in theory, entail compliance with the other's. This study focuses on the NHTSA analysis because fuel savings, rather than reduced CO_2 emissions, are the main benefit underpinning the standards. However, any change to NHTSA's cost-benefit analysis could apply differently to EPA's cost-benefit analysis because of its distinct statutory guidance under the Clean Air Act to regulate vehicle emissions.

All federal agencies are required to conduct cost-benefit analyses before promulgating regulations with economic impacts over $1 billion. These analyses have two basic objectives: they establish that the regulation provides positive net benefits compared with a baseline projection without the regulation, and they determine the level of stringency that maximizes those net benefits. The Office of Management and Budget (OMB) sets out guidelines requiring agencies to consider thirty years of benefits and costs, and to formally present a sensitivity analysis that explores how their results vary with changes to the input assumptions.[3,4]

In NHTSA's analysis of the MY 2017–2025 standards, the agency considered the costs and benefits of requiring vehicles sold to meet the proposed standards in each model year from 2017 to 2025 over the lifetimes of those vehicles, and compared those with a reference case in which future standards are held frozen at the MY 2016 level. This lifetime societal value comprises a wide range of costs and benefits and, according to the agency, reflects the "maximum feasible" schedule of fuel economy standard escalation as required by statute.[5] The largest of those costs and benefits are as follows:

Costs

- More efficient vehicles cost more. This cost is borne by manufacturers and consumers.
- More efficient vehicles are driven more. This causes congestion, accidents, and noise.

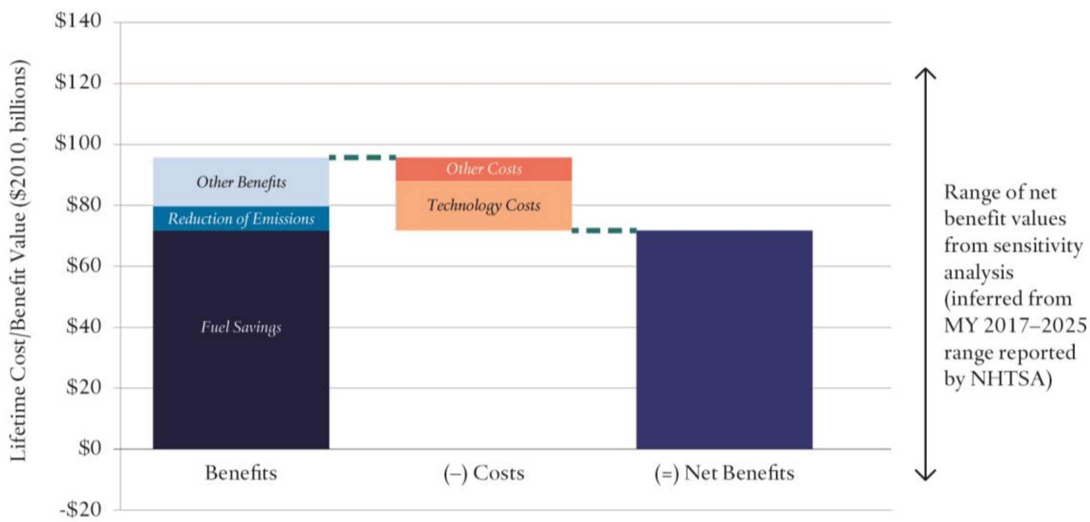
Benefits

- Consumers save money on fuel by driving more efficient vehicles.
- More efficient vehicles emit less pollution (particularly CO_2) by burning less fuel.
- Lower total fuel consumption reduces U.S. economic exposure to oil supply shocks.

Even though NHTSA considered costs and benefits for the entire MY 2017–2025 period, the mid-term review will only consider the MY 2022–2025 standards, which are the focus of this paper. Maintaining the assumptions used by NHTSA in its original analysis, a comparison of the estimated impact from the MY 2022–2025 standards to a baseline scenario in which MY 2021 standards are maintained through MY 2025 reveals total costs of $22 billion, total benefits of $96 billion, and thus net benefits of $74 billion (all dollar figures in this paper are in 2010 dollars). (Details for this and other calculations in this paper are in the appendix.) Costs are primarily driven by the fact that CAFE compliance makes vehicles more expensive. Benefits are dominated by consumer fuel expenditure savings (76 percent), with CO_2 reductions (9 percent) second.

Central to NHTSA's estimate of the benefit from fuel savings was its projection of steadily rising oil prices. Its oil price assumptions were based on the reference case in the Energy Information Administration's (EIA) 2012 *Annual Energy Outlook* (AEO). This case assumed that the price of a gallon of gasoline would increase slightly faster than inflation through 2061 from a base price of $3.31 in 2012 (see figure 1). NHTSA also included a sensitivity analysis to pressure-test its results. In the analysis, the agency varied many of the parameters that influence simulation results to compute the possible range of net benefits. In particular, it tested alternative fuel price trajectories—for example, it varied the fuel price from $2.47 to $4.79 per gallon in 2017. The resulting spectrum of net benefit estimates was almost exclusively positive, enabling NHTSA to conclude that the probability of benefits exceeding costs would be higher than 99 percent.

Figure 2. Breakdown of Costs and Benefits in the NHTSA Regulatory Impact Analysis of the MY 2022–2025 CAFE Standards



Source: NHTSA.

LOW FUEL PRICES REDUCE BENEFITS, BUT BENEFITS STILL EXCEED ESTIMATED COSTS

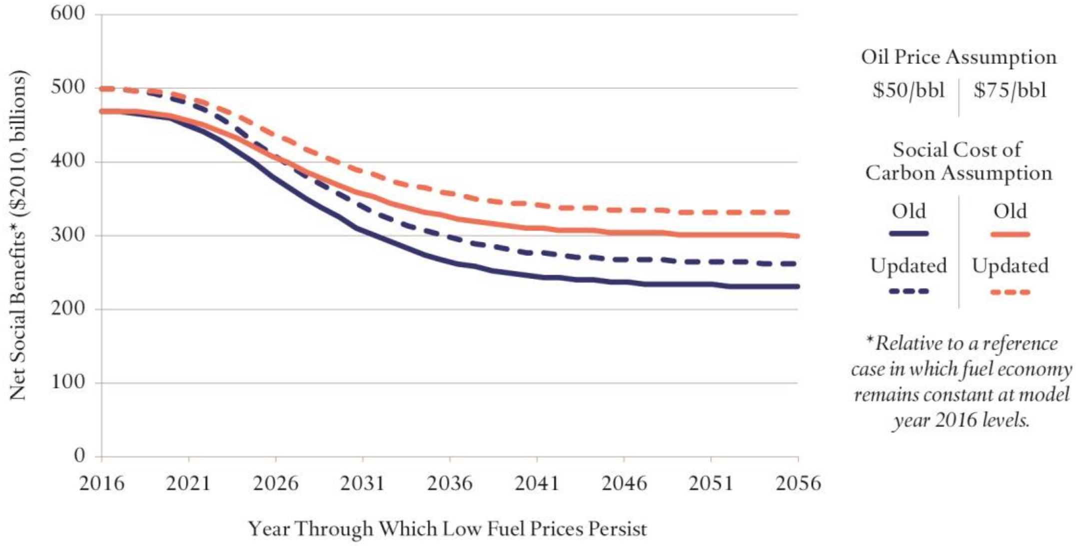
The sharp decline in oil prices since mid-2014 suggests that the range of fuel prices NHTSA considered may not have been adequate to accurately forecast likely policy costs and benefits. In both the headline result and the accompanying sensitivity analysis, the lowest fuel price considered was $2.47 per gallon (gal) in 2017, based on an underlying oil price of $65 per barrel (bbl). This is higher than the average fuel price in September 2015, which in 2010 dollars was $2.24/gal. More importantly, since the original NHTSA analysis was conducted, many analysts have come to believe that considerably lower oil prices may be a strong possibility, instead of an unlikely scenario, appropriate for relegation to a sensitivity test. Analysts continue to debate where prices will ultimately settle, but few are willing to rule out sustained prices at the lower end of NHTSA's previous sensitivity range—or at least substantially lower prices than what regulators previously assumed.[6]

Although the focus of this study is to reevaluate the net benefits of CAFE standards under lower oil prices, we also updated an important parameter: the social cost of carbon (SCC), which will change between NHTSA's original analysis and the midterm review. The SCC drives the second largest benefit of CAFE standards—the value of reduced greenhouse gas emissions, which contribute to climate change. The year after NHTSA finalized its rule, the Obama administration updated its interagency estimates of the SCC for use across all federal agency regulatory analyses, increasing the projected global cost of each additional emitted ton of carbon dioxide.[7]

We modified NHTSA's model by varying both the fuel price and the SCC to recompute the expected net benefits from planned MY 2022–2025 standards. We assumed that low oil prices would persist for some years before prices reverted to the original agency forecast, considering two values for the low oil price—$50/bbl, roughly the average price of West Texas Intermediate (WTI) crude oil over the summer of 2015, and $75/bbl, an intermediate value roughly halfway between the peak and trough of oil prices over the last year and a half. We also incorporated the 2013 SCC projections, which are about 50 percent higher than the figures used by NHTSA in its 2012 analysis.

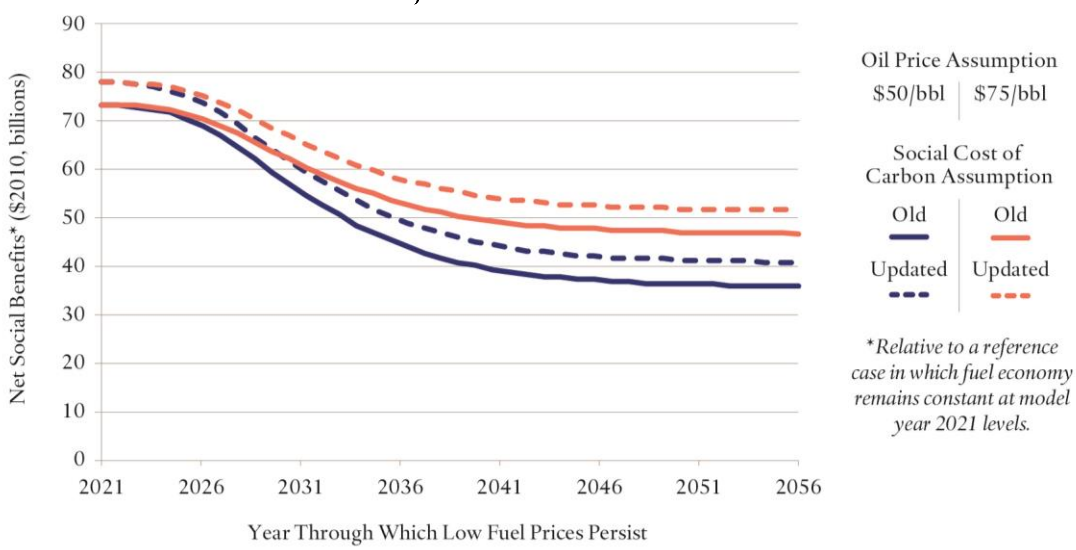
Figures 3 and 4 summarize the results. Net benefits from MY 2017–2025 and MY 2022–2025 CAFE standards persist regardless of how long the oil price is depressed for, and the updated SCC figures restore part of the benefits lost owing to lower oil prices. (Other costs and benefits from CAFE standards, such as increased congestion, do not change significantly as a result of lower oil prices.) That net benefits remain positive is not surprising: NHTSA's original calculation yielded a three-to-one ratio of benefits to costs, creating a large buffer for change.

Figure 3. Net Benefits of MY 2017–2025 CAFE Standards When Fuel Prices Are Low, Before and After Inclusion of New SCC Projections



Source: Authors' analysis based on NHTSA model.

Figure 4. Net Benefits of MY 2022–2025 CAFE Standards When Fuel Prices Are Low, Before and After Inclusion of New SCC Projections



Source: Authors' analysis based on NHTSA model.

LOW OIL PRICES REDUCE REQUIRED STRINGENCY OF STANDARDS TO MAXIMIZE NET BENEFITS

Although the current CAFE standards appear to deliver positive net benefits even in a lower-oil-price world, they may not be set at the correct level to maximize those net benefits. In the midterm review, policymakers should use marginal cost-benefit analysis, which involves determining whether marginally tightening or loosening the standards might increase net benefits, to determine whether current standards are set at a level that maximizes net benefits.

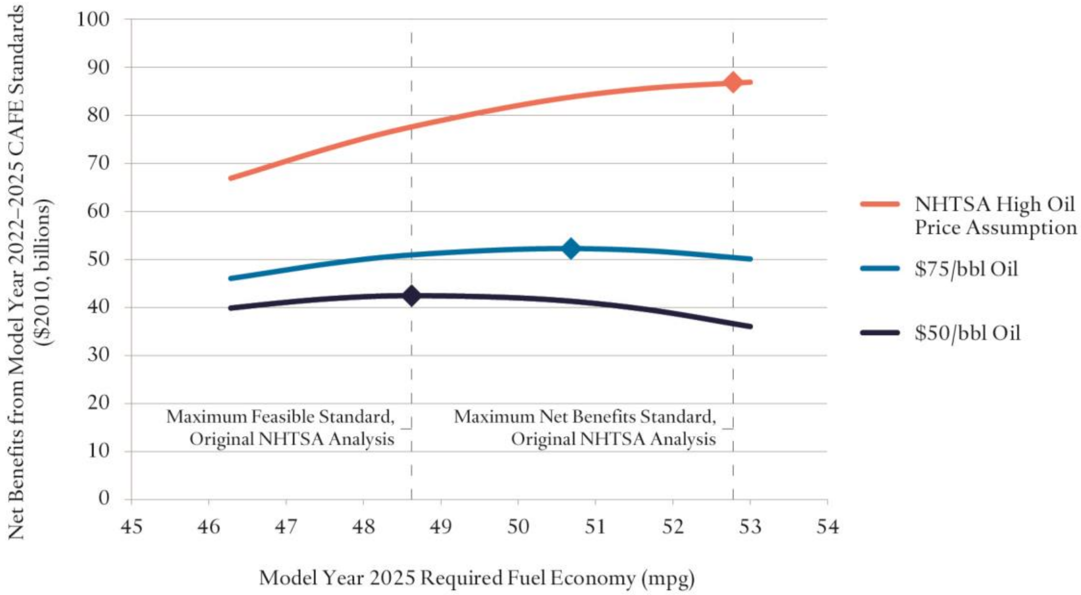
When NHTSA conducted its 2012 analysis, it did not set standards at the level that would have maximized net benefits, opting instead for a less stringent level that, in the agency's determination, represented the maximum feasible rate of annual fuel economy escalation. The "maximum feasible" criterion comes from the 2007 law under which NHTSA derived its authority to increase CAFE standards, and should therefore guide policy, since executive branch guidance directs agencies to maximize net benefits "unless a statute requires another regulatory approach."[8] NHTSA interpreted maximum feasibility as a "tipping point" beyond which per-vehicle cost increases and technological constraints would risk "significantly adverse economic consequences" to the United States.[9]

In the original NHTSA analysis, the maximum feasible level of CAFE standards was below the level that would maximize net benefits. Under NHTSA's expectation of high oil prices, a MY 2025 standard of 52.8 mpg would have maximized net benefits but breached the threshold of maximum feasibility. As a result, from MY 2022 to MY 2025, the current CAFE fleet-wide mileage standard will instead increase from 40 mpg to 49 mpg.

However, as figure 5 shows, the net-benefit-maximizing standard is less stringent in a lower-oil-price environment. In fact, under sustained oil prices of $50/bbl, the standard that would maximize net benefits is about the same as NHTSA's maximum feasible standard, whereas in a sustained $75/bbl environment, a slightly stricter 51 mpg standard for MY 2025 would maximize net benefits. The latter finding remains true even if the SCC is not updated; for a sustained $50/bbl price, though, reverting to the old SCC would reduce the net-benefit-maximizing standard to 48 mpg. (In these estimates, we vary the standard in 2025 and assume that standards rise by the same amount each year from 2022 to 2025 to reach that level. Further details are in the appendix.)

If regulators conclude that compliance costs—most importantly the cost of more efficient vehicles—will exceed NHTSA's original assumptions, the net-benefit-maximizing standard could drop below current standards. As evident from figure 5, net benefits do not change much as one varies CAFE stringency near the current standards. Small alterations to cost-and-benefit assumptions could therefore have a large impact on the net-benefit-maximizing standard. In fact, if compliance costs for every 1 mpg rise in standards were to increase by 10 percent, the net-benefit-maximizing standard would fall below the current MY 2025 mileage target in both the $50/bbl and $75/bbl oil price scenarios. This implies that the agency should strive for as complete a picture as possible of costs and benefits when it updates its analysis for the midterm review.

Figure 5. Required Fleet-wide CAFE MY 2025 Standard Stringency to Maximize MY 2022–2025 Net Benefits Under Different Oil Price Assumptions



Note: Figure assumes sustained low oil prices and updated SCC. MY 2025 targets are assumed to be achieved through constant annual percentage mileage improvements over MY 2022–2025.

Source: Authors' analysis based on NHTSA model.

A Fuller Picture of Oil Market–Related CAFE Costs and Benefits

Policymakers who merely update the existing cost-benefit model with new data will not get a full picture of the costs and benefits of CAFE standards. The standards deliver oil market-related benefits beyond fuel savings that will persist even at low oil prices, several of which have been highlighted by recent oil market developments. Agency regulatory impact analysis should be modified to include these benefits in order to paint a fuller picture of CAFE's societal value. There may be other costs and benefits that policymakers should add or revisit, but this paper focuses on these because they are related specifically to oil market dynamics.

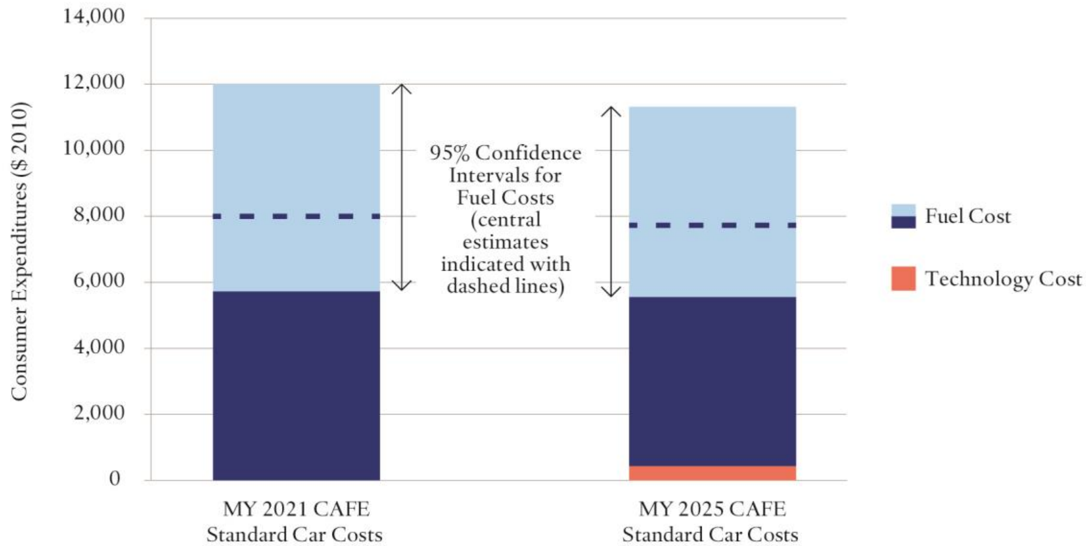
BENEFIT #1: INSURANCE VALUE FROM REDUCING UNCERTAINTY

People dislike uncertainty and are typically willing to pay to reduce it. CAFE standards reduce uncertainty of fuel expenditures, a benefit that is distinct from expected reductions in fuel spending. However, the OMB guidance for cost-benefit analysis explicitly warns agencies that "you should in general assume 'risk neutrality' in your analysis." This guidance may be generally sensible, particularly when a policy has no clear effect on uncertainty, but this is not such a case. Specifically, because most of the CAFE standards' benefits to society are aggregated from individual consumer benefits, the agency should correctly quantify how not only fuel savings but also protection from oil price uncertainty increase consumer welfare.

Consider matters from the point of view of a single consumer of a MY 2025 passenger car. In figure 6, the left bar represents the lifetime fuel expenditures of a consumer who buys a car from a manufacturer that was not required to increase fuel economy beyond MY 2021 standards. The dashed lines denote the range of uncertainty in his future fuel expenditure, derived by using futures markets' estimates of long-term oil price uncertainty as of September 2015.[10] The right bar describes the same consumer's expenditures if his car's manufacturer is required to comply with escalating CAFE standards after MY 2021 through MY 2025. This consumer will pay more for his vehicle. However, the resulting uncertainty in fuel expenditure is lower, evident from the smaller box enclosed by dashed lines.

This figure is meant as an illustrative schematic. Although there is a small difference in the expected or average lifetime future expenditure between the two cases, the uncertainty in future expenditures is less in the right bar, leading to similar low-consumer-cost cases and markedly different high cost cases—if oil prices increase, the right-hand scenario could result in over $1,000 less in future expenditures.

Figure 6. Lifetime Incremental Expenditures of an Individual Buyer of a MY 2025 Passenger Car, Depending on Whether the Car Meets CAFE MY 2021 or MY 2025 Standards



Note: Incremental expenditures include fuel costs and technology costs to increase fuel economy; future expenditures are discounted at an annual rate of 7 percent, NHTSA's estimate of an individual consumer's discount rate.

Source: Energy Information Administration.

How much might this reduction in the risk of very high payments actually be worth to consumers? Researchers have been able to estimate this value—the "risk premium"—by measuring individuals' "risk aversion," or desire for certainty in financial outcomes.[11] Applying an estimate of risk aversion consistent with multiple reports in the academic literature, we determined that a consumer driving a MY 2025 car might value a reduction in risk through improved fuel economy at around 20 percent of the fuel savings benefit that NHTSA's model ascribes to the consumer (details in the appendix).

One might argue that consumers do not actually place any value in reducing uncertainty—the proof might be that consumers make decisions every day to buy vehicles that expose them to considerable fuel price risk. Indeed a similar criticism is often leveled at NHTSA for assuming that consumer fuel savings from driving more fuel-efficient vehicles are actually valuable to consumers—why are CAFE standards necessary to make consumers buy vehicles that they should demand anyway if the future fuel savings are in fact valuable?[12] (This is sometimes referred to as the "energy paradox.")

NHTSA methodically addresses this criticism. It cites extensive literature showing that consumers likely miscalculate or undervalue fuel savings due to "loss aversion," or exaggerated worry over potential losses compared to equivalent gains.[13] This sort of consumer behavior, the agency contends, does not reflect underlying value to consumers because overvaluation of losses before a perceived risky bet does not persist once the financial outcome of that bet is clear. And just to be thorough, NHTSA's sensitivity analysis also explores the possibility that its cost-benefit analysis has overvalued future consumer benefits by 100 percent.

Applying similar logic to consumer desire and willingness to hedge against uncertainty, it is reasonable to assume that actual consumers may not appreciate the incremental decrease in risk that comes from purchasing a more efficient, but also more expensive, vehicle. In other words, risk aversion—the preference for certainty over uncertainty that is a genuine economic component of underlying consumer value—is being suppressed by loss aversion, the overvaluation of losses that muddles consumers' calculation of their future welfare. Moreover, even if a particular consumer were to factor in a risk premium, he might justifiably fail to trust a subsequent buyer of his vehicle in the used-car market to do the same, and thus the new car buyer would still undervalue the risk premium component of lifetime vehicle ownership cost. It would therefore be consistent for NHTSA to include a risk benefit along with a fuel savings benefit while subjecting both to a sensitivity analysis that varies consumers' valuation of those benefits.

By including a risk premium estimate in their review of CAFE standards, regulators can shape administrative guidance governing future regulatory impact assessments to more sensibly value risk. Indeed, following the original rulemaking for the MY 2017–2025 CAFE standards, NHTSA's decision to value fuel savings despite the "energy paradox" has been cited by OMB in its guidance to count benefits that are not supported by consumer behavior.[14] NHTSA can again influence the way the government more generally measures costs and benefits by more accurately valuing risk.

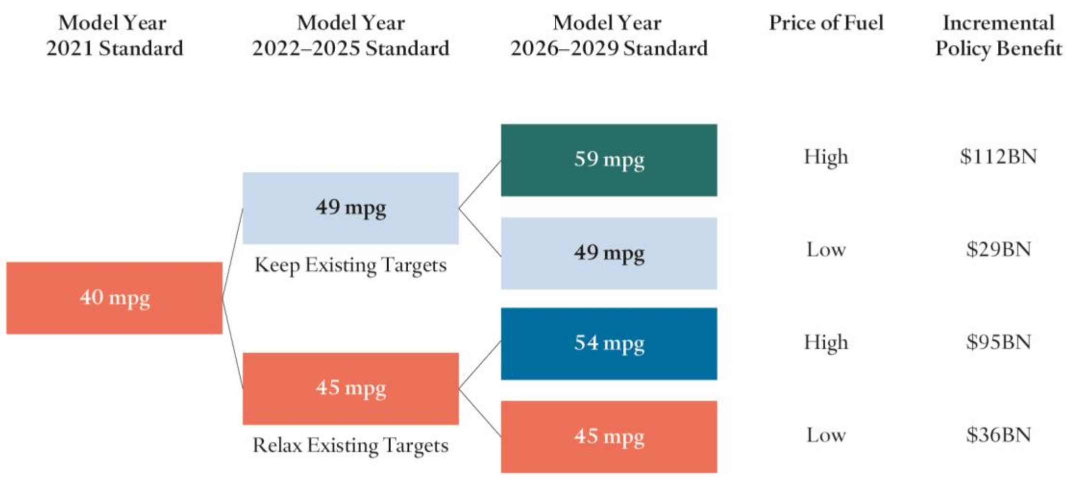
BENEFIT #2: OPTION VALUE OF FURTHER STANDARD ESCALATION

The net present value analysis conducted by NHTSA in its regulatory impact analysis leaves out another potentially important benefit—the value of the "option" to escalate standards to a higher level in the event of fuel price increases that justify more stringent standards. Imagine that from 1986 through 2000, CAFE standards for passenger cars had risen to 40 mpg rather than stagnating at 27.5 mpg. That would have given policymakers the option of prudently raising fuel economy standards during the 2000s to levels far higher than what was possible starting from a 27.5 mpg base in response to rising prices—a shift that might have yielded substantial net benefits. In practice, though, pursuing far higher standards during the 2000s was not practical because of limits to how quickly fleet-wide fuel economy can be improved. Low fuel economy standards from 1986 to 2000 effectively eliminated certain options for improving U.S. security and reducing U.S. emissions beyond 2000—and higher ones would have yielded a valuable option.

Aggressive fuel economy standards through 2025 would yield a valuable option as well, and tools are available for quantifying it. Real options analysis, a variant of the framework used to value financial options, is increasingly prevalent in the business world as an alternative to the sort of net present value (NPV) analysis that U.S. regulators use. There is a growing set of case studies in which NPV analysis finds a project unsuitable for investment while option analysis finds it worthwhile.[15] In essence, real options analysis assigns a value to an investment that has the prospect of upside gains if the investment then leads to further investment under a set of possible future conditions.

To see how large option value might be compared with other benefits of CAFE standards, consider a potential outcome of the midterm review that concludes that under sustained low oil prices of $50/bbl, the net-benefit-maximizing level of CAFE standards is less stringent than the current targets. Instead of using the current methodology, though, regulators could apply an option value framework. The schematic in figure 7 illustrates a simple, stylized real options analysis framework for policymaker decisions in the CAFE midterm review. The left third of the schematic depicts the current state of affairs, in which manufacturers must abide by existing standards through MY 2021 (when the fleet-wide standard is 40 mpg). Subsequently, in the middle third, policymakers have the option to either conform to the existing escalation schedule for the MY 2022–2025 standards, culminating in a 49 mpg fleet-wide standard, or relax the rate of standard escalation in light of lower oil prices and lower the target—in this example, to 45 mpg in MY 2025. The implication of this choice, in the right third of the schematic, is then the set of options that policymakers have to set standards for the next automotive design cycle in 2026–2029. If policymakers have escalated standards to 49 mpg by MY 2025, having invested in an "option," they can then capitalize on the option in the final period. This enables them to enact the toughest standards—approximately 59 mpg by maintaining the previous rate of CAFE standard escalation—if warranted by their best estimates of future oil prices and other costs and benefits. However, if policymakers have rejected the option and only imposed a 45 mpg standard for MY 2025 vehicles, then in the final period, the maximum feasible escalation of the standards will be to approximately 54 mpg, achieved by implementing the rate of standard escalation originally proposed for MY 2022–2025. In this framing, the higher the chance of higher fuel prices in the future, the higher the option value of retaining current MY 2022–2025 standards.

Figure 7. CAFE Standard Escalation Options Depending on Policymaker Choices in the Midterm Review



Note: In the midterm review, policymakers can choose to authorize the proposed standards for MY 2022–2025 or relax the current rate of escalation of standards. Depending on that decision and new information about fuel prices, policymakers can then choose to escalate or maintain the standards for the subsequent vehicle design cycle (2026–2029).

Source: Authors' analysis based on NHTSA model.

In this scenario, if high oil prices do not materialize in the future, the net-benefit-maximizing level of CAFE standards will remain at 45 mpg. If policymakers have escalated standards to 49 mpg by MY 2025, it will likely be impossible to reduce them to 45 mpg in the subsequent planning cycle—statutory guidance to maintain standards at maximum feasible levels would preclude relaxing the level of the standards. However, in the bottom branch of the figure, if low oil prices persist, policymakers who had relaxed the rate of CAFE standard escalation could now maintain the standards at the benefit-maximizing level of 45 mpg. Therefore, under low oil prices, rejecting the option and relaxing the rate of standard escalation produces higher net benefits. The option is valuable only if the increase in benefits under high oil prices, weighted by the probability of high prices, outweighs the probability-weighted cost of the option that is lost if low oil prices persist.

Assuming even odds that the oil price forecast stays low or increases, the numbers in this example do indeed justify purchase of the option, even though simple NPV analysis would support the bottom route in figure 7 as the midterm review's guidance for automakers in MY 2022–2025. (This remains true even if the odds of reverting to high prices are only 30 percent.) Investing in an option and escalating standards to 49 mpg in MY 2025 can yield much higher benefits if oil prices increase later on. In this example, choosing stricter standards in the midterm review is expected to result in $5 billion of additional benefits compared with choosing weaker ones (and if the low oil price was $75/bbl instead of the $50/bbl we simulated, the option value would be $4 billion of additional benefits). To put this in context, this figure is about 10 percent as large as the fuel savings benefits simulated in this example from the MY 2022–2025 standards in the low-oil-price environment, relative to MY 2021 levels. This means that in a midterm review deliberation over whether to stay the course with strict MY 2022–2025 standards even if the standard calculation reveals that a less stringent option has higher net benefits than the current standard, including option value could point to a more stringent standard that maximizes net benefits. Once they consider option value, policymakers might conclude that relaxing the standards would be bad policy.

BENEFIT #3: U.S. FUEL SAVINGS THROUGH MONOPSONY POWER

Lower domestic fuel consumption can decrease the world oil price because the United States is a major oil consumer. In addition to consuming fewer gallons of fuel and saving money on those gallons, then, CAFE helps Americans save money on the gallons of fuel they still do consume. This is referred to as a monopsony benefit and is often included in policy analyses.

Analysis conducted by the Oak Ridge National Laboratory (ORNL) in 2009 in support of CAFE policy development concluded that the U.S. monopsony benefit ranges from $0.077 to $0.397 per gallon of reduced fuel consumption and is most likely to be $0.233 per gallon saved (all figures in 2010 dollars).[16] Modifying these estimates for a world in which oil costs $75/bbl or $50/bbl and U.S. imports are substantially lower than anticipated in 2009 points to monopsony benefits of approximately $0.15 per gallon saved and $4 billion total saved by CAFE standards. This would increase total net benefits by 7 to 9 percent (13 to 16 percent under the high estimate of the monopsony benefit). Although the ORNL results depend on ten-year projections of oil prices, the study assumed conditions that resemble those of the current oil market. ORNL used an average oil price of $68/bbl, which is sufficiently close to current prices and their projected behavior to justify using the ORNL numbers for an order-of-magnitude sizing of the monopsony benefit. However, because EIA's projections of import levels through 2040 are around 33 percent lower than those assumed in the ORNL study and the value to the United States of lower oil prices depends on how much foreign oil the United States purchases, the ORNL monopsony estimates must be proportionately scaled down.

NHTSA cited monopsony benefit figures in its CAFE analysis and then proceeded to exclude any monopsony benefits from its cost-benefit calculation. The agency argued that counting climate change mitigation, a global benefit, alongside the monopsony benefit, a domestic one, would be inconsistent. But the monopsony benefit should be included because it is more consistent with legislators' intent in mandating fuel economy standards in the first place. Considering the global benefits of climate change mitigation should be an exception, rather than the rule, when evaluating the costs and benefits of national policies.[17]

Conclusion and Recommendations

Escalating fuel economy requirements from MY 2011 to MY 2016, after two decades of fuel economy stagnation, have helped reduce national gasoline consumption even as total vehicle miles traveled has increased.[18] The currently scheduled standards for MY 2017–2025 would continue this trend, further reducing U.S. oil dependence and greenhouse gas emissions. CAFE standards are far from perfect, but given political constraints on alternative policy tools, they are a sensible policy instrument as currently conceived.

The steep decline in oil prices last year might reorient CAFE standards from an escalating path to a stagnant one. In principle, this may be the optimal economic decision if the agency determines that compliance costs will be much higher than previously anticipated. Absent such a shift, though, current standards remain justified even if policymakers expect sustained $50/bbl oil prices.

The optimal level of CAFE standards will be sensitive to small changes in projected costs and benefits, so agencies should strive to capture the fullest picture of the consequences of CAFE standards. During the midterm review, they should incorporate previously excluded benefits, including insurance, option, and monopsony value, all of which apply in a low-oil-price environment. These benefits, coupled with updated values for the increased environmental benefits from CAFE standards, will provide a more accurate long-term assessment of the standards and mitigate the risk of weakening standards that might actually deliver net benefits to the United States.

Endnotes

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Appendix

1. MODELING BENEFITS WITH LOW OIL PRICES

NHTSA's Final Regulatory Impact Analysis of MY 2017–2025 CAFE standards provides an inventory of benefits and costs for the "Preferred Alternative," or the chosen escalation trajectory for CAFE standards, relative to a scenario where standards are not escalated beyond MY 2016. These costs and benefits were calculated by NHTSA under an assumption of high and rising fuel prices. Our goal was to recalculate the benefits corresponding to fuel expenditure savings and reduced greenhouse gas emissions in a lower-oil-price environment for new vehicle fleets under the increasingly stringent MY 2022–2025 CAFE standards, compared with a baseline case in which MY 2021 standards are held constant through MY 2025. It was beyond the scope of this paper to rebuild the entire NHTSA model. We instead modified the intermediate numerical results that NHTSA published in order to reflect new assumptions used in this paper (most notably lower oil prices). To explain these modifications, the following are defined:

P is the price of fuel.

VMT is the total fleet vehicle miles traveled in a year.

FI is the fleet average fuel intensity (measured in gallons per mile).

C is the total fleet fuel consumption in a year.

η is the elasticity of vehicle miles traveled with respect to the price per mile (i.e., $\eta = \frac{\Delta VMT}{\Delta(P \cdot FI)}$). NHTSA estimates its central value at 0.10.

SCC is the Social Cost of Carbon in a given year.

Furthermore, the following subscripts that qualify the terms above are defined:

L, M, H are subscripts corresponding to a low ($50/bbl), medium ($75/bbl), and high (NHTSA original assumption) fuel price scenario, respectively. (In subsequent equations, we will use the L subscript to describe results for lowering the oil price from NHTSA's original assumption, but the subscript M can be interchanged for L in all of these equations to derive results when considering a lower oil price of $75/bbl rather than $50/bbl).

i refers to the Model Year of the new vehicle fleet.

j refers to a calendar year over which we are computing a quantity, e.g., VMT.

2010, 2013 are subscripts that are applied to the SCC to refer to the corresponding version of the U.S. Government Interagency Working Group projections for the social cost of carbon.

We aimed to recompute the values of the fuel savings and CO_2 benefits in a low-oil-price environment for each of the passenger car and light truck fleets. (CAFE standards are actually stratified even within car or truck fleets by wheelbase size, but we did not have the requisite information to analyze the standards at that granularity.) We began by allocating NHTSA's projection for reduced fuel consumption (measured in gallons) as a result of CAFE standards for a particular model-year new vehicle fleet into each of the forty years following the model year, encompassing the expected lifetime of that model-year fleet. We performed this allocation proportional to the average VMT that a car or truck is expected to incur in each of those forty years, divided by its lifetime average VMT (NHTSA provides lifetime VMT profiles for an average car and truck). Therefore, for each set of car and truck fleets, we can write:

$$\Delta C_{H,i,j} = \Delta(VMT_{H,i,j} FI_{H,i,j}) \tag{0}$$

Now we update NHTSA's fleet mix—ratio of passenger cars to trucks—assumption of 66 percent cars with the actual fleet mix today, approximately 45 percent cars (see Bureau of Economic Analysis, Auto and Truck Seasonally Adjusted Sales Figures, 2015), assuming that today's fleet mix is the best available indicator of the future fleet mix. To do so, we modify the fuel savings in each of the car and truck fleets based on the adjusted number of cars and trucks in the fleet. To take the example of the passenger car fleet, we can use subscripts *old* and *new* to denote the NHTSA fleet mix assumption and a new fleet mix assumption, respectively. We can then find the new fuel savings:

$$\Delta C_{new,H,i,j} = \left(\#cars_{new,i,j} - \#cars_{old,i,j}\right) \frac{VMT_{H,i,j}}{car} FI_{CAFE_i} + \Delta C_{old,H,i,j} \tag{1}$$

Unlike the fuel price and SCC assumptions, updating the fleet mix did not materially change net benefits, changing them under low oil prices by less than 3 percent. Therefore, for visual simplicity, we have not displayed the effect of the fleet mix update in figure 3 in the main text. Hereafter, we drop the subscript *new* and proceed based on saved fuel consumption computed under the new fleet mix figure. Assuming constant elasticity of VMT with respect to cost of driving per mile, if the fuel intensity of a fleet stays constant but the fuel price drops,* we can write:

$$VMT_{L,i,j} = \left(\frac{P_{L,j}}{P_{H,j}}\right)^{\eta} VMT_{H,i,j} \tag{2}$$

This enables us to transform the fuel savings (in gallons) from the high-fuel-price case to the low-fuel-price case, via:

$$\Delta C_{L,i,j} = \left(\frac{P_{L,j}}{P_{H,j}}\right)^{\eta} \Delta C_{H,i,j} \tag{3}$$

* To convert our oil price assumptions into fuel prices, we used the results of a linear regression relating Brent oil prices to U.S. retail gasoline prices (EIA methodology here).

In making this statement, we have assumed that the fuel intensity of vehicles does not change when considering a lower fuel price, all else (i.e., stringency of CAFE standards) held equal. Although CAFE standards may themselves cause changes in the fleet mix, we decided not to project a decrease in the ratio of cars and trucks any further than the current 45 percent share of the fleet accounted for by passenger cars because this is close to the historical lower limit for passenger car penetration.

Next, we determined the monetary savings in fuel expenditures (FSB, short for Fuel Savings Benefit) in a low-oil-price environment by multiplying the saved consumption by the lower fuel price:

$$FSB_{L,i,j} = \Delta C_{L,i,j} P_{L,j} \tag{4}$$

For each model-year new vehicle fleet and calendar year, we also calculated the value of reduced greenhouse gas emissions, updating the values used in the original NHTSA analysis. To do so, we drew on the 2013 U.S. Government Interagency Working Group projection for the social cost of carbon (SCC, measured in dollars per ton of CO_2) in the particular year of interest, which updated the 2010 Working Group projections. We used the new figure and the saved fuel consumption in a low-oil-price environment to modify the NHTSA projection of the monetary value of reduced CO_2 emissions (*REB*, short for Reduced Emissions Benefit):

$$REB_{L,i,j} = \frac{\Delta C_{L,i,j}}{\Delta C_{H,i,j}} \frac{SCC_{j,2013}}{SCC_{j,2010}} REB_{H,i,j} \tag{5}$$

Finally, we aggregated the new benefits over each calendar year for each model-year fleet of cars and trucks, discounting benefits at the social discount rate (δ) of 3, to compute the total benefits from fuel expenditure savings and reduced greenhouse gas emissions in a low-oil-price environment:

$$(FSB_L + REB_L)_{Total} = \sum^{cars,trucks} \sum_{i=MY2022}^{MY2025} \sum_{j=i}^{i+40} \frac{FSB_{L,i,j} + REB_{L,i,j}}{(1+\delta)^{(j-i)}} \tag{6}$$

To compute the remaining benefits (i.e., other than FSB and REB, which together are nearly 90 percent of total benefits), we multiplied the remaining benefits by the change in the quantity each benefit depends on (for example, lower particulate emissions depend proportionally on gallons of fuel consumed). We performed similar operations for any costs that were dependent on quantities that should change with lower oil prices, like fuel consumption and VMT. We assumed that technology cost to achieve higher fuel economy would not be changed by a lower-oil-price environment. Because the mid-term review will cover MY 2022–2025 standards, we isolated the net benefits of those standards by subtracting the projected net benefits under a reference scenario in which MY 2021 standards were frozen for MY 2022–2025. To compute the net benefits in the baseline scenario for each of the model years from 2022 to 2025, we computed the net benefits in MY 2021 in a low-oil-price environment as above and accounted for the specific NHTSA oil price assumptions and SCC values corresponding to the lifetime of that model year's fleet.

2. MARGINAL ANALYSIS OF OPTIMAL RATE OF CAFE STANDARD ESCALATION IN A LOW-OIL-PRICE ENVIRONMENT

So far we have only recomputed the benefits in a new low-oil-price world associated with the NHTSA's Preferred Alternative trajectory of CAFE standard escalation. Ideally, one would recalculate the benefits for different trajectories of car and truck fleet mileage requirements for MY 2022–2025 in order to find the new optimal rate of escalation in a low-oil-price world. Therefore, we assessed the net benefits of alternative trajectories of varying stringencies. In each alternative trajectory, the mileage targets for the car and truck fleets began at the same value in MY 2021 as in the Preferred Alternative but then increased by a different, constant percentage throughout MY 2022–2025. Using numbers reported in NHTSA's regulatory impact analysis, we approximated a marginal analysis of these alternative CAFE trajectories.

2.1. Benefits

To estimate benefits of alternative trajectories, we modified the benefits of the Preferred Alternative by considering the effect of a different fuel economy standard in each of the model years from 2022 to 2025 on the various benefits. Following our previous strategy, we aimed to update the value of saved fuel consumption for cars and trucks in each model-year fleet and calendar year under new fuel economy standards. To explicate this, some subscripts for the Fuel Intensity term, FI, are defined:

> *NA* is "No Action," or the fuel intensity standard in MY 2021 that would persist if CAFE standards were not escalated beyond this level in MY 2022–2025.
>
> *PA* is Preferred Alternative, referring to the current schedule of CAFE standard escalation.
>
> *ALT* is some alternative CAFE standard escalation trajectory that we are interested in investigating in this marginal analysis.

We can then write the fuel savings in an alternative trajectory as a function of the fuel savings in the Preferred Alternative:

$$\Delta C_{ALT,H,i,j} = \left(\frac{FI_{NA,i}^{1+\eta} - FI_{ALT,i}^{1+\eta}}{FI_{NA,i}^{1+\eta} - FI_{PA,i}^{1+\eta}}\right) \Delta C_{PA,H,i,j} \tag{1}$$

Now we can follow the same procedure as above to compute all benefits for the combined car and truck fleets, under high and low oil prices. However, since we are now only interested in the MY 2022–2025 benefits (rather than MY 2017–2025 benefits that we had computed in preceding sections), we subtract the benefits that would have resulted from a baseline case in which MY 2021 standards were held constant for MY 2022–2025. We derived benefits in the baseline case by adjusting the MY 2021 benefits for changing NHTSA assumptions of fuel price in MY 2022–2025 as well as updating the values of the SCC for those years. By subtracting costs from benefits for a particular MY 2025 mileage target, we can estimate net benefits for different CAFE standard escalation trajectories under different oil price environment assumptions.

2.2. Costs

To estimate the technology component of costs, we fit the model year technology costs under the MY 2021–2025 mileage targets in the Preferred Alternative to an exponential best-fit curve for both car and truck fleets. This enabled us to predict the technology cost for each model-year fleet under each mileage target of the alternative trajectories. The non-technology components of costs (increased maintenance, congestion, accidents, and noise) scale proportionally to the increase in VMT caused by the alternative CAFE standards. Finally, as above, we aggregated car and truck fleets and subtracted the costs of a baseline scenario, in which MY 2021 standards were held constant through MY 2022–2025, from the costs of each alternative trajectory for MY 2022–2025.

3. CALCULATION OF THE CONSUMER RISK PREMIUM USING RISK AVERSION ESTIMATES

The first benefit that we argue is left out of the NHTSA analysis but may be substantial in magnitude is the insurance value to consumers from reducing the uncertainty in future fuel expenditures. To assess this benefit, we considered a buyer of a MY 2025 vehicle compliant with either MY 2021 or MY 2025 standards and estimated the welfare increase that would accrue to the buyer if he or she bought the more efficient, rather than the less efficient, vehicle.

To calculate the consumer risk premium from risk-aversion estimates in the academic literature, we formulated the distribution of future fuel savings from fuel economy improvements in the MY 2025 car less the expected fuel savings as a lottery. To construct an even-odds lottery that resembled the lotteries in the literature for which risk aversion has been estimated, we first determined the 25th and 75th percentiles of the lifetime fuel expenditure distributions for each car, using a lognormal distribution for fuel prices. The difference between the 25th percentile and 75th percentile fuel savings was the value of the lottery (in which there is a 50 percent chance of winning this value, and a 50 percent chance of receiving zero). We then use an absolute risk-aversion estimate from Guiso and Paiella (2008) of 0.01978 (they find identical figures for both an exponential and logarithmic utility function), which is within the range recommended by Babcock, Choi, and Feinerman [0.0002, 0.0462] to derive the risk premium, or the certainty equivalent, of the lottery.

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This Discussion Paper was made possible through the generous support of the Alfred P. Sloan Foundation.

The authors thank Sakshi Agarwal, Ken Gillingham, David Greene, James M. Lindsay, Ishan Nath, and three anonymous reviewers for valuable comments. They also thank the Alfred P. Sloan Foundation for its support of the CFR Project on Energy, Economics, and International Security. The Sloan Foundation takes no positions on policy issues.

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