

A Review of Consumer Benefits from Corporate Average Fuel Economy (CAFE) Standards

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Executive summary

New vehicle fuel efficiency and emission standards – the CAFE (Corporate Average Fuel Economy) standards for model years 2017-2025 – will save consumers thousands of dollars over the lifetime of new cars and trucks, while also cutting back on pollution, creating jobs, and reducing our dependence on oil.

As a result of CAFE standards, our analysis shows consumer can expect to save about \$7,300 in fuel costs and a net savings of over \$4,600 over the lifetime of new vehicles. The estimated cost increase for new light-duty vehicles to meet the 2025 standard is less than \$2,000; small increases for financing, taxes, and maintenance are also factored into the net savings. Since improved efficiency will save about \$700 every year at the gas pump, the increased vehicle price pays for itself in about three years. If financed with a car loan (as most purchases are), consumers begin saving the very first month of ownership as the gas savings outweigh the increased CAFE-related loan costs, and increase their savings over the life of the car.

By driving more fuel-efficient cars, Americans will save approximately 30 billion gallons of gasoline each year by 2025. The net benefits, compared to the previously enacted standards for 2016, have been estimated between \$326 billion and \$451 billion over the lifetime of the new vehicles. Moreover, most evaluations of the new CAFE standards have relied on conservative estimates of gas prices; the EPA/NHTSA projections assume that consumers will pay \$3.87 by 2025, with only small increases in most years of the vehicle's lifetime. At higher prices, consumers would save more money. Based on our sensitivity analysis, we found that even under lower gas prices and higher-than-estimated technology costs, there would be net benefits to consumers over the lifetime of the new vehicles.

Fuel economy standards deliver benefits beyond the fuel savings. The 2025 standards call for carbon emissions per mile to be half the level of 2010 cars. EPA/NHTSA estimated that greenhouse gases will be reduced by nearly 2 billion metric tons of carbon dioxide-equivalent over the life of vehicles model years 2017-2025. Other air pollutants that result from gasoline refining and combustion will be reduced as well.

Decreasing oil consumption also creates jobs and helps insulate our economy against global oil price spikes. In place of spending money on gasoline, consumers will have more money to spend on cars and other goods and services. Reducing oil consumption brings economic security benefits as well, reducing our consumption of a product subject to both large price fluctuations and a long-term trajectory of increasing prices. The innovation spurred by the CAFE standards will help U.S. auto companies stay competitive on a global scale, and will create jobs in manufacturing and other sectors of the U.S. economy.

Because of the wide range of benefits from the new fuel standards, they generally enjoy broad support, including from automakers, auto workers, and small business, environmental, and consumer groups. However, some economists have assumed that consumers are already saving as much fuel as they want to, and have issued analyses that calculate the costs but ignore the fuel-saving benefits of CAFE standards. Unsurprisingly,

these reports find that it would be a bad deal for consumers to pay the costs, but get none of the major benefits of the standards. In the real world, it is crucial to recognize that the benefits to consumers of fuel-economy standards greatly exceed the costs.

Other opponents of CAFE standards have raised a few other criticisms, none of which withstand careful examination:

- Do the benefits of CAFE standards depend on unrealistically high gas prices? No – the EPA/NHTSA projections of significant net benefits are based on conservative price scenarios, assuming gas prices starting below today's levels, and rising only slowly in the future. At higher gas prices, fuel economy is worth even more to consumers. Even in our "low gas price" case, with gas prices remaining slightly below today's actual level through 2035, we found there would be net benefits to consumers.
- Will there be huge increases in new vehicle prices? Careful analysis by EPA and NHTSA estimated an average increase of roughly \$1,800 per light-duty passenger vehicle as a result of the new CAFE standards. Since several vehicles on the market in 2012-2013 already meet the 2025 standards, it appears possible to comply using existing technology. Much higher cost estimates, included in some criticisms of the CAFE standards, have been based on extreme, poorly supported extrapolations.
- Will consumers be unable to get loans for new vehicles? Because the price increases will be small relative to the price of new vehicles, the impact on auto loans, if any, is unlikely to be significant. One alarming projection exaggerated the debt burdens on consumers by assuming a continuation of debt levels from 2008-2009, the worst years of the recent financial crisis – even though household debt has already dropped below those levels.
- Are fuel-efficient vehicles unsafe? This question has been extensively studied by NHTSA, finding that the new CAFE standards are unlikely to affect vehicle safety. Much more important is the trend toward simultaneous improvements in fuel economy and safety that has occurred in recent years. Changes in vehicle design and safety-enhancing technology are likely to continue to improve vehicle safety.

Consumers are increasingly recognizing the benefits of fuel-efficient vehicles; a recent Consumer Reports survey found fuel economy to be the most important factor in purchasing a new automobile. Also guiding consumers' decisions is the fact that technology is rapidly advancing, making fuel-efficient cars more affordable. The average fuel economy of light vehicles sold has increased each year for the past five years (EPA 2012) and is now at an all-time high. Despite high gasoline prices, purchases of new cars and light trucks were 13% higher in 2012 than in 2011, while fuel economy improved by 5%. CAFE standards will spur further innovation and bring additional fuel savings to consumers.

1. Introduction

Imagine a new federal regulation that will save you thousands of dollars, while also cutting back on pollution, strengthening American industry, creating jobs, and reducing our oil consumption.

Actually, you don't have to imagine it: new fuel efficiency and emission regulations – the updated CAFE (Corporate Average Fuel Economy) standards for new cars and trucks – will do just that. Detailed studies by the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) have documented the benefits of CAFE standards; other analysts and organizations have weighed in with additional evaluations.

This report reviews the benefits of the CAFE standards, and addresses some of the common fears and misconceptions about the effects of the new rule. There are three parts to our discussion.

- First, we summarize previous savings estimates for the CAFE standards and develop an estimated range of net savings to consumers, assuming possible changes in compliance costs and gasoline prices. Under any reasonable assumptions, the new CAFE standards achieve significant benefits for consumers. At the same time, the standards reduce greenhouse gas emissions and other pollutants, create jobs in the auto industry and elsewhere, and help to protect us from high and volatile oil prices.
- Next, we address the economics of CAFE standards as seen in the academic literature, which often compares fuel economy standards unfavorably to gasoline taxes. Whatever its abstract, theoretical merits, adoption of widespread increases in gasoline taxes in order to improve fuel economy is unlikely to occur in the immediate future. Contrary to some academic claims, a fuel standard is generally an effective and feasible policy to reduce gasoline consumption and carbon emissions.
- Finally, we address specific criticisms of the new CAFE standards that have appeared in recent reports, including fears of very large costs of compliance, projections of increasing difficulty in financing car purchases, and claims that more fuel-efficient cars will be unsafe. In each case, we find these criticisms to be unwarranted. Costs of compliance with the regulations are modest; effects on financing are correspondingly small; and the standards are expected to have almost no effect on highway safety, if anything causing a (very small) *reduction* in highway fatalities.

The bottom line: the average consumer will come out far ahead after this new policy is fully implemented.

2. Benefits from CAFE Standards

The new CAFE standards mandate reductions in emissions that are often described as requiring new cars and light trucks to reach an average of 54.5 mpg by 2025.¹ Since some of the emission reductions can be achieved by other measures such as improved air conditioning systems, it is more likely that new vehicles will average an EPA-rated 46-47 mpg in 2025.² This leads directly to the principal benefit to consumers: a substantial reduction in gasoline usage and corresponding savings at the gas pump. This section focuses on quantifying net savings to consumers and outlines other benefits from the new standards.

A. Fuel Savings

The meaning of the new CAFE standards for consumers is clear: large net savings. The slightly increased cost of a new car pays for itself in gas savings in about 3 years, if you buy the car with cash. If you take out a car loan, the gas savings are greater than the slight increase in your loan payments from the very beginning. This assumes that you drive an average amount, and that gas prices rise only very slowly from present levels.³ If you drive more than average, or gas prices rise more rapidly, the breakeven point comes sooner, even if you pay cash for the car.

Specifically, the 2017-2025 CAFE standards are expected to increase the average cost of a new vehicle purchase by about \$1,800 (at 2010 prices),⁴ and to add a little bit to insurance and maintenance costs: \$48 in the first year, declining to \$33 in the eighth year.⁵ If you take out a five-year loan to buy the vehicle, you'll pay \$452 per year for five years, plus the insurance and maintenance costs.⁶

The estimated gas savings from improved fuel efficiency are \$705 in the first year, declining gradually (because older cars are driven fewer miles, on average) to \$510 in the eighth year.⁷ Add up the gas savings over the years, and they outweigh the purchase costs plus insurance and maintenance early in the fourth year.⁸ With a loan, the gas savings are almost \$200

¹ "Part II Environmental Protection Agency. Department of Transportation: National Highway Safety Administration: 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards. (Final rule)." Federal Register 77:199 (October 15, 2012) p. 62627.

² Ibid. pp. 62641. Table I.2.

³ Ibid. p. 62716.

⁴ Ibid. p. 62665. For complex bureaucratic reasons, EPA and NHTSA are required to calculate these costs slightly differently; to err on the side of caution, we are using the higher, EPA figure. Use of NHTSA's somewhat lower figure (p.62660) would lead to an even more favorable evaluation of CAFE standards. See p.62667 for a discussion of the differences between EPA and NHTSA cost estimates.

⁵ Final rule, p. 62925.

⁶ These figures come from EPA and NHTSA 2012a, pp. 650-652, and are all expressed in 2010 dollars. To convert to 2012 prices, add 6% to all the costs and savings cited here.

⁷ "Final rule, p. 62926.

⁸ Ibid. p. 62631. Simply adding the costs and savings, without discounting, would show breakeven just before the end of the third year. Since EPA and NHTSA discount future costs and savings, they estimate breakeven early in the fourth year.

greater than the loan payment, insurance, and maintenance in each of the first five years. After the third year if you paid cash, or after the end of the five-year loan if you financed the car, you'll continue to save hundreds of dollars each year at the gas pump.

Total savings for the nation as a whole will be of great value, in terms of economic, environmental, and national security. By driving more fuel-efficient cars, we will burn less gasoline; the annual savings will be more than 170 billion gallons by 2025.⁹ EPA and NHTSA, in analyzing the final rule for the new CAFE standards, estimate the benefits from gross fuel savings at \$7400 over the lifetime of one vehicle bought in 2025 with net savings of \$5000.¹⁰ The cumulative effect of CAFE standards from model years 2011 to 2025 is estimated to save consumers \$1.7 trillion in gasoline expenditures.¹¹

Several other groups have studied the fuel savings from these standards, reporting results for different time periods but using the EPA and NHTSA assumptions as a basis. The Consumer Federation of America (CFA) estimates total savings of \$500 billion over the useful lives of the new vehicles—similar to those estimated by the EPA/NHTSA.¹² For a vehicle meeting the 2025 standards, they estimate a cumulative savings of \$800 by the fifth year and \$3000 by the tenth year.¹³ The Natural Resources Defense Council (NRDC) estimates annual net savings of over \$68 billion in 2030.¹⁴ Taking a longer view, the Union of Concerned Scientists (UCS) estimates that a vehicle purchased in 2025 will save \$8000 compared to a vehicle meeting the 2010 standards.¹⁵

Many fuel-efficient vehicles are available today, including a number of models that already comply with the 2025 standards; the purchase of fuel-efficient models is often quite cost-effective. In Consumer Reports' cost comparison, two of these vehicles, the Toyota Prius C and the Lexus CT 200h, scored best in class for ownership costs annualized over five years.¹⁶ Other highly efficient vehicles, such as the Toyota Camry Hybrid, Volkswagen Passat TDI, and Hyundai Sonata Hybrid had among the lowest ownership costs in the family sedan class.¹⁷

We performed a sensitivity analysis based on the EPA/NHTSA analysis in order to gauge possible ranges of net savings for a typical consumer financing a new vehicle through a five-year car loan (see Appendix for detailed methodology and results). We used the final Annual Energy Outlook 2012 forecasts for gasoline prices,¹⁸ with assumptions that both these forecasted gas prices and the additional technology costs for compliance might vary up or down 20% from the baseline. The highest range of consumer savings would occur if gas prices were higher and technology costs were lower than the baseline assumptions. As with

⁹ Final rule, pp. 62657. Table I-9.

¹⁰ Ibid. p. 62631. The two figures, \$7400 gross savings and \$5000 net savings, represent calculations of the present value of future benefits at discount rates of 3%.

¹¹ "Driving Efficiency: Cutting Costs for Families at the Pump and Slashing Dependence on Oil," p. 7.

¹² Mark Cooper, "The Consumer Benefits of the Proposed Fuel Economy Standards," January 2012, p. 4.

¹³ Ibid. p. 2.

¹⁴ Luke Tonachel, NRDC report: "Relieving Pain at the Pump." May 2, 2012. p. 6.

¹⁵ Union of Concerned Scientists, "Protecting Consumers from Pain at the Pump," August 2012.

¹⁶ Consumer Reports, "What that car really costs to own". August 2012.

¹⁷ Ibid.

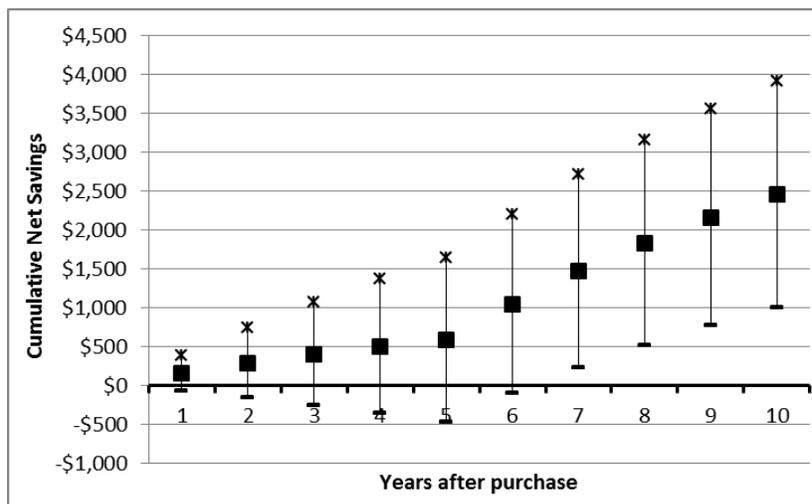
¹⁸ This is a slight update from the EPA/NHTSA report, which relied on AEO 2012 Early Release data.

the EPA/NHTSA estimates, our estimates are based on a comparison of a car complying with the 2025 CAFE standard to one complying with 2016 CAFE standard (see Appendix for further detail).

Our analysis projects a cumulative net savings by year 10 of between \$1100 and \$4100 depending on gas price and technology cost variability. A typical consumer purchasing a 2025-compliant vehicle through a car loan would break even (i.e. their gross savings in gas costs would outweigh their additional vehicle purchase costs) immediately in the first year in the base and high gas/low technology cost cases. Even under our “low gas price” case, which assumes higher technology costs than EPA and NHTSA estimated, and gas prices that remain well below today’s level through 2035, consumers would breakeven at 7 years and experience cumulative net benefits thereafter.¹⁹

Of course, most cars will be on the road for years to come in all cases. The average age of the U.S. fleet continues to rise--recently reaching 11 years. Consumers will continue to reap positive net benefits of increased fuel economy as long as their cars are on the road, well beyond the ten years shown in Figure 1. Under the assumptions outlined above, we estimate the present value (using a 3% discount rate) of lifetime net savings at \$2700 to \$6600 per vehicle.²⁰

Figure 1: Estimate of Cumulative Net Savings per Vehicle from 2025 CAFE Standard (\$2010, discounted at 3%)



High (x), base (■), and low (-) estimates of cumulative savings per vehicle

Sourced by: EPA/NHTSA, AEO 2012, Synapse Energy Economics (see appendix)

¹⁹ EPA and NHTSA also evaluated the option of purchasing a car with cash, concluding that a typical customer would breakeven after 3.2 years (using 3% discounting). With loan financing, the purchase costs are spread over several years, allowing earlier – in fact, immediate – breakeven.

²⁰ The midpoint of our estimate is \$4650 which is very close to EPA and NHTSA’s lifetime net savings estimate of \$5000 (using 3% discounting). These differ slightly because we used the updated AEO 2012 final gasoline price forecasts which are more conservative than the AEO 2012 Early Release forecasts.

Even if a consumer decides to sell her vehicle prior to the break-even point, she will likely enjoy the higher residual (resale) value that is associated with greater fuel economy.²¹

B. Other benefits

There are many other benefits associated with the CAFE standards that are worth mentioning:

- **Reduction in greenhouse gas emissions:** Perhaps the most important environmental benefit is the avoidance of CO₂ emissions from burning fuel. U.S. cars and light trucks account for more than 23 percent of total U.S. greenhouse gas emissions annually (EPA and NHTSA 2011), so reductions in our vehicle emissions are important for global climate protection. NRDC estimates a reduction of nearly 300 million metric tons annually in 2030; similarly, the White House estimates 6 billion metric tons will be avoided over the lifetime of the CAFE standards (NRDC 2012, White House 2011).
- **Protection from price volatility:** Gasoline prices have historically been volatile and will most likely continue to be so. Fuel efficiency will insulate consumers from gas price shocks in the future and the uncertainty and personal finance problems they cause.
- **Improvements for U.S. car industry:** Fuel economy standards in the European Union and Japan are even more aggressive than the new CAFE standards (ICCT 2012). For the U.S. car industry to remain competitive, it will have to compete on fuel economy globally. According to Alan Mulally, CEO of Ford, "in the last few years, fuel efficiency has become the number one reason to buy."²² Fuel economy improvements have been coupled with other advances in technology that have enhanced features and improved performance. Raising fuel economy standards provides certainty and reduces risk for automakers to increase investments in efficient technologies and forge new partnerships that will deliver greater value to consumers.
- **Job impacts:** When consumers save money on gasoline, they shift more of their spending to more labor-intensive goods and services, including goods made in the U.S. that would have gone towards oil, much of which is produced overseas and employs fewer people per dollar spent than other goods and services.²³

²¹ Fuel economy is an important factor in determining Kelley Blue Book's residual value ratings. See Joni Gray, . "Kia Brand Most Affordable in KBB.com's 5-Year Cost of Ownership Ranking." *AutoTrader.com*. 2013.

²² Interview on CBS This Morning. <<http://www.cbsnews.com/video/watch/?id=7422080n>>.

²³ Robert Pollin, James Heintz, and Heidi Garrett-Peltier, "The Economic Benefits of Investing in Clean Energy," Political Economy Resource Institute (PERI) at the University of Massachusetts, Amherst http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/green_economics/economic_benefits/economic_benefits.PDF. June 2009. p. 28.

Ceres estimates that from \$152 billion in fuel savings in 2030, \$59 billion will be spent on vehicles and \$93 billion on other consumer goods and services. (Ceres 2011). Two recent reports estimate the job impacts from this effect and from increased innovation in the automobile sector. The BlueGreen Alliance estimates 570,000 new jobs by 2030 (including 50,000 in automobile manufacturing) (Blue Green Alliance and ACEEE 2012). A study by Ceres projects a similar range of impacts for one of their scenarios: 484,000 new jobs by 2030 (including 43,000 in automobile manufacturing) (Ceres 2012).

C. Cost-benefit analysis

EPA and NHTSA have produced estimates of the costs and benefits of the 2025 CAFE standard. From the point of view of the consumer, comparing only the increase in the average cost of a more fuel-efficient car versus the fuel savings, the new rule is a clear winner. The average new vehicle upfront cost is expected to increase by less than \$1800. The consumer’s fuel savings, in comparison, are worth \$5700 (at a 7 percent discount rate) or \$7400 (at a 3 percent discount rate)—a net savings of \$3900 to \$5600, respectively. As noted above, the increased cost of the vehicle pays for itself in fuel savings in less than four years, if bought in cash, or immediately, if bought with a car loan.

From the point of view of the public as a whole, the balance of benefits versus costs is even more favorable. Assigning values to the reductions in greenhouse gas emissions and other environmental impacts, the total benefits become even greater than the consumer fuel savings alone. EPA estimates the lifetime present value of the program as follows:²⁴

Program costs	\$150 billion (increased costs of vehicles)
Fuel savings	\$475 billion
All other benefits	\$126 billion
Net benefits	\$451 billion (fuel savings + other benefits – program costs)

About half of the “all other benefits” are due to greenhouse gas reductions; the remainder includes reductions in other air pollutants, the value of spending less time in refueling vehicles, and a small estimated benefit for reduced dependence on oil imports (\$0.185 per gallon).

²⁴ Final rule, p. 62629. This estimate uses a 3 percent discount rate. Net benefits are also substantial at a 7 percent discount rate, and under a variety of changes in assumptions, although the exact numbers differ.

3. Real fuel standards vs. theoretical economies

A number of academic economists have written about fuel standards, sometimes reaching relatively negative or critical conclusions. Some economists compare fuel efficiency standards unfavorably to gasoline taxes, arguing that fuel use and emissions could be reduced at much lower cost to society through a tax. Some economists also maintain that since consumers already could choose to spend more than they do on fuel-efficient vehicles, they must not place a high value on fuel savings; by taking this idea to an extreme, some analyses effectively ignore the benefits of reduced fuel costs from CAFE standards.²⁵ Such analyses could be seen as descriptions of an imaginary, textbook economy, in which there is no political obstacle preventing discussion of tax increases, and consumers make perfectly informed decisions about every choice offered in the marketplace. In the real world, however, fuel tax increases are an unlikely policy option in the near term, however “efficient” they may be in theory. And consumers do not always have the information, time, or resources to calculate the benefits from every choice; as a result, regulations such as CAFE standards can yield valuable benefits that would not be achieved via the marketplace alone.

A. Is a gasoline tax better than a fuel standard?

Academic critics of CAFE standards typically point to the gasoline tax as a more economically efficient means of reducing gas usage and resulting greenhouse gas emissions. Andrew Kleit, for instance, argued that we should adopt a gasoline tax instead of CAFE standards, since the tax would achieve the same savings at one-fourteenth of the cost to society (Kleit 2004).²⁶ David Austin and Terry Dinan likewise estimated that a gasoline tax could achieve the same reduction in fuel as a fuel standard, at much lower cost (Austin and Dinan 2005).

These arguments deserve attention, perhaps as part of a long-run process of re-evaluation of general resistance toward fuel taxes. As economists have always argued, taxing something, such as gasoline, can be an efficient method for reducing its use. Yet the federal gasoline tax has remained at 18 cents for over 15 years (and does not adjust for inflation);²⁷ it seems reasonable to assume that there will be no significant increases in the near future. For now, reduction in gasoline use and associated emissions will be achieved via non-tax policies – such as CAFE standards. To criticize or dismiss standards as theoretically inferior to gas taxes amounts to a backdoor defense of the status quo.

Some economists have recognized the political obstacles to use of taxes. Soren Anderson and colleagues argued that “in countries such as the United States, standards appear to be more acceptable to the public, and hence more practicable, than high fuel taxes,” and that fuel standards “may actually be progressive, as their direct impact is on new vehicles, which

²⁵ Andrew N. Kleit, "Impacts of Long-Range Increases in the Fuel Economy (CAFE) Standard." *Economic Inquiry* . 42.2 (2004). pp. 280-281.

²⁶ It should also be noted that the Kleit study was funded by General Motors, which has a pecuniary interest in shifting costs to drivers as opposed to requiring investments in its own fleet.

²⁷ EIA Petroleum Marketing Monthly Explanatory Notes.

<<http://www.eia.gov/petroleum/marketing/monthly/pdf/enote.pdf>>, p. 153

are disproportionately consumed by higher-income families” (Anderson et al 2011) as opposed to gasoline taxes, which can be regressive.

Moreover, the policy choice between a gasoline tax increase and fuel standards is a false one since these policies are not mutually exclusive. Tsvetan Tsvetanov and Kathleen Segerson showed that “policymakers could potentially achieve greater social welfare by using the two instruments as complements” (Tsvetanov and Segerson 2011). In fact, if a gasoline tax were instituted then consumers would save even more with fuel standards, since the cost of a gallon of gas would increase.

B. Are consumers already doing enough to save fuel without CAFE?

Some economists also claim that CAFE standards are inefficient because consumers are said to be well-informed and doing plenty about fuel efficiency on their own. Thus Austin and Dinan, in addition to advocating a gasoline tax, asserted that window stickers with mileage information on new cars are “sufficient to allow consumers to make informed decisions about fuel economy,” and that “the existing average [combined federal and state gas tax of] 41 cents/gallon already provides consumers with an incentive to pursue new-vehicle fuel economy.”²⁸

Taking that notion to an extreme, some economists have analyzed the costs of CAFE standards without counting any of the benefits of fuel savings – since, if consumers cared about fuel savings, they would already be doing more of it: “In the absence of any externality, the marginal value of the use of a gallon of gas equals its price, and there is no public benefit from reducing the consumption of gasoline” (Kleit 2004).²⁹ Implementing that approach, Kleit measured the benefits from fuel savings solely in terms of avoided externalities (environmental impacts), valued at a mere 26 cents per gallon (Kleit 2004).³⁰ Other research, assuming that consumers are already making well-informed decisions about fuel economy, has compared costs and benefits of CAFE standards without counting consumer savings on fuel costs – and as a result, has concluded that stronger standards impose sizeable net costs on consumers (Austin and Dinan 2005; Klier and Linn 2012).

This may seem like an esoteric branch of academic theorizing – except that it is often taken as authoritative in policy debate. A New York Times columnist, for example, recently relied on such analyses of CAFE standards, ignoring the enormous consumer benefits from fuel savings, to argue that by some calculations, “raising fuel-economy standards is more costly than climate change itself.”³¹ That is, the costs of CAFE standards, assuming that they have no benefits of any value except the reduction in CO₂ emissions, exceed some (not all)

²⁸ David Austin and Terry Dinan, “Clearing the Air: The Costs and Consequences of Higher CAFE Standards and Increased Gasoline Taxes.” *Journal of Environmental Economics and Management*. 2005 p. 579

²⁹ Kleit study, pp. 280-281

³⁰ Kleit study, p. 281

³¹ Eduardo Porter, “Taxes Show One Way to Save Fuel.” *New York Times* 11 September 2012. Cites Austin & Dinan and Kleit studies.

estimates of the climate damages caused by those emissions. Of course, when the consumer benefits (fuel savings) are included, CAFE standards are a net benefit to all, and reduce carbon emissions at no extra cost.³² Indeed, in NHTSA's cost-benefit analysis, the savings on fuel costs constitutes the lion's share of overall benefits and are ten times as valuable as the economic benefits of reducing CO₂ emissions.³³

The dismissal of consumer benefits rests on the assumption that consumers are already making the best possible choices, and could not possibly benefit from a regulatory change. This ignores the very real, important barriers that consumers are faced with in making economic decisions.

Idealized, rational consumers, as imagined in economic textbooks, will discount the benefits and costs of any complex purchase (i.e. estimate a net present value), just as an investor would in making a financial decision. However, we know that this is generally not the case. Consumers can be tempted to buy products that are cheaper at the time of purchase, even if they are more expensive in the long run (Tsvetanov and Segerson 2011). This short-sighted behavior comes from what is referred to as "hyperbolic discounting"—inconsistently discounting between time periods. Tsvetanov and Segerson claimed that consumers making purchases of energy-intensive products tend to "undervalue future gains from energy-efficient products" (Tsvetanov and Segerson 2011).

Businesses are also susceptible to similar limitations, sometimes failing to invest in efficiency even when it would increase their profits (Decanio 1998).³⁴ Moreover, it can be difficult to disentangle the costs of fuel economy when purchasing a car because it is buried (along with all other features) in the base price (Brown 2001). And even if consumers were to know the true costs of fuel economy at the time of purchase, "properly trading off energy savings versus higher purchase prices involves comparing the time-discounted value of the energy savings with the present cost of the equipment—a calculation that can be difficult for purchasers to understand and compute" (Brown 2001).

Knittel concluded that CAFE standards "can play a useful role" as a second-best policy, and "can, in principle, raise welfare." Anderson et al agreed, claiming that "if there are large climate and energy security benefits from cutting fuel use, and a significant market failure associated with fuel economy decisions, then standards can be welfare improving." Indeed, CAFE standards help consumers overcome some of the barriers to upgrading fuel economy. Consumers do not always have enough information on the value of fuel economy, are not accustomed to calculating net present values, and should not be expected to run complex benefit-cost tests before making ordinary purchases. Consumers generally do seek to save money on their purchases, when the opportunities to do so are clear to them. Regulations, such as CAFE standards, that help people save money are promoting consumers' own long-term goals rather than enforcing additional burdens on them.

³² Final rule, pp. 62631 and 62658-9.

³³ Ibid. pp. 62658-9.

³⁴ Stephen J. Decanio. "The Efficiency Paradox: Bureaucratic and Organizational Barriers to Profitable Energy-Saving Investments." *Energy Policy*. 26.5 (1998). pp. 445-446, 451.

4. Critiques of CAFE: Too good to be true?

Several critics of the new CAFE standards have raised objections to the analysis supporting the new rules, including a response from the National Automobile Dealers Association (NADA 2012), and a recent report from Representative Darrell Issa, chair of the House Committee on Oversight and Government Reform (U.S. House Committee on Oversight and Government Reform 2012). Four key issues are raised in these critiques: the choice of fuel price projections; costs of compliance with the new standards; potential constraints on the ability of consumers to finance new car purchases; and safety concerns about smaller, fuel-efficient vehicles. In each case, the criticisms appear to be mistaken.

A. Do CAFE benefits depend on unrealistic gas price assumptions?

In a word, no. The Issa report suggested that the benefits of the proposed standard depend on gasoline costing as high as \$5 - \$6 per gallon.³⁵ In fact, the EPA/NHTSA calculations discussed above used the reference case price projection from the Energy Information Administration's *Annual Energy Outlook 2012 Early Release*, which projects gasoline prices in 2025 at \$3.87 per gallon with small increases in most years of the vehicle's lifetime.³⁶ If anything, the EPA/NHTSA gasoline price assumption seems low, relative to current and recent prices. Of course, if gasoline prices turn out to be higher than EPA and NHTSA assumed, the benefits to consumers of fuel-efficient vehicles will be even greater than the estimates described above. As our calculations demonstrate, there are substantial benefits to consumers even if gas prices fall well below today's levels.

B. How much will vehicle prices increase?

EPA and NHTSA developed detailed, disaggregated estimates of the costs of compliance with the new standards, about \$1,800 to the total cost of a new light duty vehicle in 2025 (EPA and NHTSA 2011). The NADA and Issa reports peg estimates much higher, between around \$3,000 and \$12,000 per vehicle, but these estimates conflate multiple iterations of CAFE standards, as well as suffer from other flaws.

This is a complex question, with costs varying for individual vehicles. At present, some fuel-efficient vehicles are actually cheaper than gas guzzlers, while other models sold as gas-savers are not worth the extra money.³⁷ There are more than twelve models (not including fuel cell and CNG, which are only available for lease, and not including 2013 models, such as the Tesla Model S) that meet or exceed the 2025 standards with current (2011 or 2012 model year) powertrain designs, including midsized cars from Ford, Lincoln, Hyundai, Nissan, and Toyota.³⁸ Another nine models are close, already meeting the standards up to 2022, including several pickup trucks from Chevrolet and GMC, and SUVs from Toyota and Lexus.³⁹

³⁵ Rep. Issa quotes business sources stating that at such prices, consumers would become much more interested in alternative, fuel-saving automotive technologies, which is undoubtedly true. This does not, however, refute the EPA/NHTSA calculation that consumers will benefit even at lower gasoline prices.

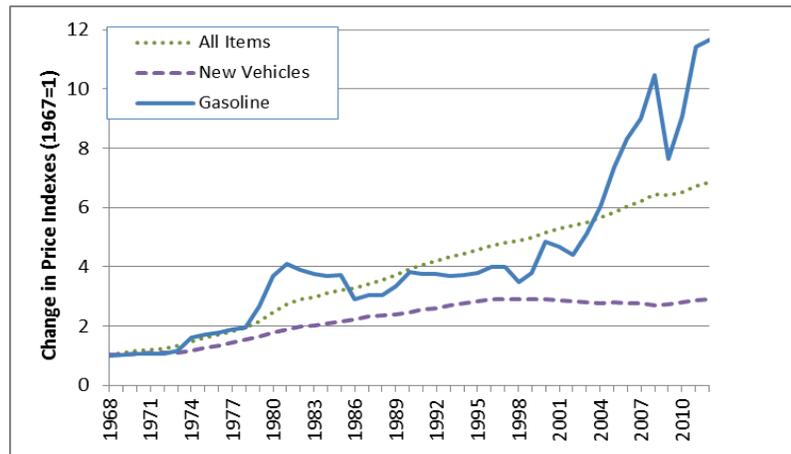
³⁶ Final rule, p. 62627.

³⁷ Mike Quincey, "ConsumerReports.org: Consumer News." *Are the High-MPG Versions of the Chevrolet Cruze, Ford Focus, and Honda Civic Worth the Money?*. Consumer Reports, 29 May 2012. Web.

While electric and alt-fuel vehicles can be part of a manufacturer’s path to compliance, the MY 2017-2025 standards can primarily be achieved by improvements in gasoline-powered vehicles.⁴⁰ Thus it appears possible to comply with the standards using existing technology, casting doubt on the very high estimates of the costs of compliance. NADA’s high-end estimate for 2025 compliance, more than \$12,000 per vehicle, is in part based on the claim that EPA underestimated costs of compliance with a different regulation by a factor of 2 to 5, and might somehow have erred by the same amount in this case. Cost estimation is far from an exact science and often relies on industry-provided data with the result that executive agencies often overestimate, rather than underestimate compliance costs.⁴¹ EPA and NHTSA’s cost estimates are conservative in that they do not rely on any technological breakthroughs over the next thirteen years, which may very well occur especially as more research dollars are dedicated to efficient technologies.

Over the long run, the costs of new vehicles have risen more slowly than inflation, while the price of gasoline, especially in the last decade, has exceeded overall inflation (see Figure 2). These trends make fuel-efficient vehicles an increasingly attractive choice for consumers.

Figure 2: Price Indexes for Gasoline, New Vehicles, and All Items



Source: Compiled by Synapse based on data from the Bureau of Labor Statistics

Innovation has reduced vehicle costs in the past, a trend that seems likely to continue. No such opportunities to reduce gasoline costs are in sight. In the past, consumers, on average,

<<http://news.consumerreports.org/cars/2012/05/video-are-the-high-mpg-versions-of-the-chevrolet-cruze-ford-focus-and-honda-civic-worth-the-money.html>>.

³⁸ Environmental Protection Agency. Assessment and Standards Division: Office of Transportation and Air Quality . (Final) *Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*. 2012.

<<http://www.epa.gov/oms/climate/documents/420r12016.pdf>>.

³⁹ Environmental Protection Agency. (Draft) *Regulatory Impact Analysis: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*, EPA-420-D-11-004. November 2011. Table 3.12-1.

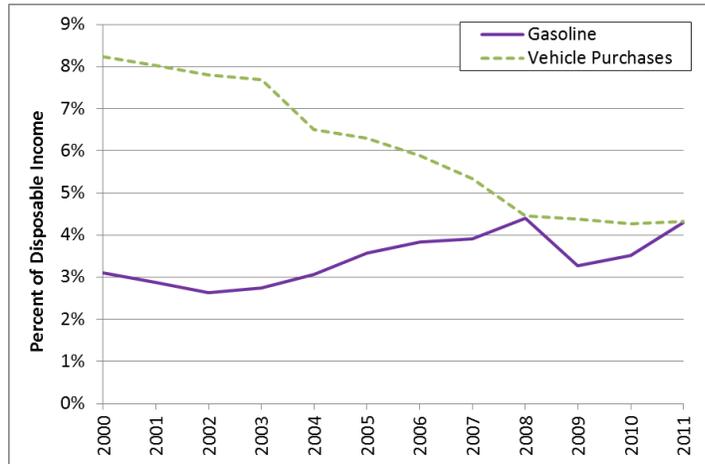
⁴⁰ *Ibid.*, p. 3-93.

⁴¹ Executive Office of the President of the United States, “2011 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities.” pp. 64-65.

<http://www.whitehouse.gov/sites/default/files/omb/inforg/2011_cb/2011_cba_report.pdf>.

spent more on new vehicle purchases than on gasoline, but that has been changing in the past decade. As shown in Figure 3, each now accounts for roughly 4 percent of after-tax income.

Figure 3: Spending on New Vehicles and Gasoline



Source: Compiled by Synapse with calculations from the BLS Consumer Expenditure Survey.

C. Will consumers be unable to get loans for new vehicles?

NADA also argued that the increased vehicle costs caused by the proposed standards will make large numbers of potential buyers ineligible for car loans.⁴² Theoretically, some consumers on the margin of qualifying for a loan might have debt-to-income ratios that exceed conventional criteria for creditworthiness, and might therefore be denied loans that they would have otherwise qualified for in order to buy a new car. Clearly, if a significant portion of new car buyers could not afford the new efficient fleet, they could not reap the benefits of improved fuel economy. However, NADA has exaggerated the magnitude of this effect. First, the inflated costs of compliance, discussed above, inflate the size of the loans needed to buy new cars.

Second, NADA implies that the *average* cost increase would be uniformly added to the least expensive vehicles,⁴³ which is very unlikely to occur. Automakers want to maintain entry-level price points to develop brand loyalty and would not load the cheapest vehicles with all the most advanced and expensive fuel-saving technology.

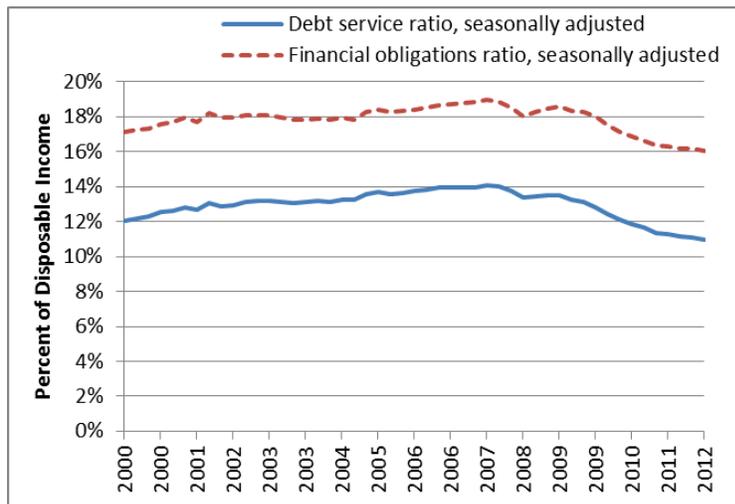
⁴² National Automobile Dealers Association public comments on EPA/NHTSA docket numbers NHTSA–2010–0131 and EPA–HQ–OAR–2010–0799: 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas (GHG) Emissions and Corporate Average Fuel Economy (CAFE), p. 7. <http://www.nada.org/NR/rdonlyres/8B40CD5C-9721-4D9D-93E7-B51DDB34F8CB/0/CAFE_GHG_COMMENTS_2152012.pdf>.

⁴³ Ibid. p. 4-5 (exhibit C).

Third, NADA exaggerated the debt burdens on consumers, by relying on data from 2008-2009, and assuming that debt-to-income ratios of those years will continue into the future.⁴⁴ Those years' ratios, however, reflected debts at the peak of the recent financial crisis. Since 2008-2009, consumer debt has been decreasing, as U.S. consumers have been "de-leveraging" themselves by paying down debt and not borrowing as much as before.

Figure 4 shows two measures of debt reported by the Federal Reserve Board.⁴⁵ The household debt service ratio estimates the required payments on outstanding mortgage and consumer debt, divided by disposable (after-tax) personal income. The financial obligations ratio adds auto lease payments, rent, homeowners' insurance, and property tax payments. Both measures have fallen since 2009, and are now below their 2000 levels. Thus eligibility for new loans, measured by debt-to-income ratios, should be higher than in 2008-2009.

Figure 4: Household Debt and Financial Obligation



Source: Compiled by Synapse with data from the Federal Reserve Board

In addition, saddling consumers with inefficient vehicles that have high operating costs does not help them lower their debt-to-income ratio. Saving thousands of dollars on gasoline expenses helps consumers pay down debt, pay for other household expenses, or even save for another car.

Fourth, some lenders already recognize that lower operating costs lower the risk of default on a loan and offer better loan terms for efficient vehicles.⁴⁶ Automakers want to sell these vehicles and lenders want to finance them—the market incentives align to create new loan products that would provide lower risk loans for higher value vehicles.

⁴⁴ National Automobile Dealers Association (Wagner, David, Paulina Nusinovich, and Esteban Plaza-Jennings), "The Effect of Proposed MY 2017-2025 Corporate Average Fuel Economy (CAFE) Standards on the New Vehicle Market Population" February 13, 2012. p.55. <http://www.nada.org/NR/rdonlyres/8B40CD5C-9721-4D9D-93E7-B51DDB34F8CB/0/CAFE_GHG_COMMENTS_2152012.pdf>.

⁴⁵ Downloaded from The U.S. Federal Reserve Board. *Household Debt Service and Financial Obligations Ratios*. 2013. <<http://www.federalreserve.gov/releases/housedebt/>>.

⁴⁶ U.S. Bank and several credit unions (including Everence, DCU, and VSECU) offer lower interest rates for high efficiency vehicles.

Finally, NADA overstates the number of low-income consumers who are actually in the new vehicle market. A statistical study published in 2003 found that the average annual income of new car buyers was \$70,000, compared to \$48,000 for used car buyers (Paskiewicz 2003). The latest consumer expenditure survey data from the Bureau of Labor Statistics tells a similar story: in 2011-2012, the two-thirds of households with incomes under \$70,000 spent more on used vehicles than new ones.⁴⁷ New vehicles accounted for 65% of all spending on vehicle purchases by consumers earning at least \$70,000, compared to 43% by consumers earning less than \$70,000. In fact, households of all income levels, spent more on gasoline than they did on either used or new vehicles.⁴⁸

NADA's analysis prioritizes theory over reality when it incorrectly places low-income consumers in its pool of assumed new car buyers and then counts them as excluded from the new car market when it raises vehicle prices by exaggerated amounts in its model.⁴⁹ In summary, NADA used dated loan qualification assumptions and misapplied them to an inflated new car market with overstated costs.

D. Are light-weight, fuel-efficient vehicles unsafe?

The Issa report emphasized concerns about safety, asserting that lighter-weight vehicles, required for improved fuel efficiency, are less safe.⁵⁰ However, the recent history of vehicle development evinces a trend of simultaneous improvements in fuel economy and safety. Vehicle design and safety-enhancing technology are likely to continue to improve vehicle safety, and emerging advances in active safety systems and vehicle-to-vehicle communication promise further benefits.⁵¹ In addition, the new standards are "footprint-based," meaning that each size of vehicle has its own proportionate fuel economy target; therefore, automakers need not change the size of the vehicle fleet in order to comply with the standards.

NHTSA addressed this safety issue in some detail, drawing on extensive earlier research. They found that correlations between vehicle weight and rates of fatalities are weak in general, and are not statistically significant for most vehicle classes. In isolation, lightweighting vehicles that are already small have been found to increase fatalities for that

⁴⁷ Calculated (including linear interpolation between income categories) from U.S. Bureau of Labor Statistics. *Consumer Expenditure Survey* (CES). July 2011 – June 2012. Tables 202 and 2301. <<http://www.bls.gov/cex/home.htm#publications>>. Downloaded on April 3, 2013..

⁴⁸ Calculated from U.S. Bureau of Labor Statistics. *Consumer Expenditure Survey* (CES). 3rd quarter 2011 through 2nd quarter 2012. Table 1202. <<http://www.bls.gov/cex/22012/midyear/income.pdf>>.

⁴⁹ National Automobile Dealers Association (Wagner, David, Paulina Nusinovich, and Esteban Plaza-Jennings) (NADA) 2012a. The Effect of Proposed MY 2017-2025 Corporate Average Fuel Economy (CAFE) Standards on the New Vehicle Market Population. February 13, 2012. p. 4. <http://www.nada.org/NR/rdonlyres/8B40CD5C-9721-4D9D-93E7-B51DDB34F8CB/0/CAFE_GHG_COMMENTS_2152012.pdf>.

⁵⁰ Staff Report. U.S. House of Representatives, 112th Congress, "A Dismissal of Safety, Choice, and Cost: The Obama Administration's New Auto Regulations" August 10, 2012. p. 5. <<http://oversight.house.gov/wp-content/uploads/2012/08/CAFE-Report-8-10-12-FINAL.pdf>>.

⁵¹ "Vehicle-to-Vehicle Communication Can Prevent Crashes: Smarter Cars that Talk to One Another are the Next Step in Auto Safety." ConsumerReports.org. April 2012. <<http://www.consumerreports.org/cro/magazine/2012/04/vehicle-to-vehicle-communication-can-prevent-crashes/index.htm>>.

category, but if lightweighting occurs in the larger vehicle classes, there could be overall safety benefits.⁵² NHTSA concluded that “any combination of mass reductions that maintain footprint and are proportionately somewhat higher for the heavier vehicles may well be safety-neutral or better as a point estimate and, in any case, may be very unlikely to significantly increase fatalities.”⁵³ Overall, the CAFE standards may cause a *very small decrease* in highway fatalities – a number that is not significantly different from zero.⁵⁴

Other factors affecting vehicle design and safeguards have much greater effects on highway safety, and they are making new vehicles safer, including: new standards for side airbags, electronic stability control, active safety systems, advances in crash force management, the use of advanced materials, shifting consumer preferences to smaller vehicles, and higher seat belt usage. Rapid advances and availability of active safety systems are taking hold and are likely to surpass passive safety measures in effectiveness. Modifications to larger vehicles to reduce damages to smaller vehicles in collisions have been significant, as have retirement of some poorly designed lightweight models sold in the past. These trends and developments are far more important than the effects of vehicle weight.

5. Conclusion

Consumers are increasingly recognizing the benefits of fuel-efficient vehicles; a recent Consumer Reports survey found fuel economy to be the largest factor in purchasing a new automobile.⁵⁵ In this survey, almost all of the respondents who claimed to value fuel efficiency named “lower fuel costs” as a motivation and a majority also said they were motivated by being “environmentally friendly/green.”⁵⁶

More consumers have also recognized the benefits of protecting themselves from gas price shocks and are taking advantage of the more efficient vehicles available from current fuel economy standards; the average fuel economy of light vehicle sold in the United States has increased each year for the past five years (EPA 2012). Despite high gasoline prices, purchases of new cars and light trucks were 13% higher in 2012 than in 2011, while fuel economy improved by 5%.⁵⁷ Also guiding consumers’ decisions is the fact that technology is

⁵² NHTSA, “Relationships Between Fatality Risk, Mass, and Footprint in Model Year 2000-2007 Passenger Cars and LTVs”. Final Report. August 2012. p. 3. <<http://www-nrd.nhtsa.dot.gov/Pubs/811665.pdf>>.

⁵³ Ibid. p. xiv.

⁵⁴ Ibid. p. 3.

⁵⁵ Consumer Reports, “Survey: Car shoppers want better fuel economy, here’s why”. Feb 4, 2013.

<<http://news.consumerreports.org/cars/2013/02/2013-car-brand-perception-survey-car-shoppers-want-better-fuel-economy-heres-why.html>>.

⁵⁶ “High gas prices motivate drivers to change direction: Nearly three-quarters of surveyed motorists would consider an alternative-fuel vehicle for their next car”. ConsumerReports.org. May 2012.

<<http://www.consumerreports.org/cro/2012/05/high-gas-prices-motivate-drivers-to-change-direction/index.htm>>.

⁵⁷ New vehicle sales from U.S. Bureau of Economic Analysis. Auto and Truck Seasonal Adjustment.

<http://www.bea.gov/national/xls/gap_hist.xls>. Fuel economy from University of Michigan Transportation Research Institute. Eco-Driving Index. Average sales-weighted fuel-economy rating (window sticker) of purchased new vehicles for October 2007 through April 2013. <http://www.umich.edu/~umtriswt/EDI_sales-weighted-mpg.html>.

rapidly advancing, making fuel-efficient cars more affordable. CAFE standards will spur further innovation and bring additional fuel savings to consumers.

Critics of CAFE standards have underestimated or ignored the positive impacts on consumers. Based on careful, independent analysis, we find that the new standards are an effective policy for reducing gasoline consumption and, therefore, saving consumers money. They also generate myriad benefits including protection from gasoline price volatility, increased innovation in the U.S. automobile industry, cleaner air, and reduced oil consumption. Over the next decade, we are likely to see a transformation in the auto industry in how they think about delivering value to consumers; thanks to CAFE standards, better fuel economy will be one of the biggest benefits of buying a new car.

Appendix: Methodology for Estimating Consumer Savings

This appendix explains how we calculated estimates of consumer savings under a range of assumptions. In each case we are estimating the savings per new vehicle that meets the final 2025 standards, compared to one that meets the (lower) standards for 2016 that were already in place.

The EPA and NHTSA Final Rule for CAFE standards in MY 2017 and beyond (i.e., the 2025 standards) were implemented to reduce fleetwide passenger and light-duty truck CO₂ emissions to a combined level of 163 grams/mile, half the level of a 2010 vehicle.⁵⁸ While this corresponds to an overall average fuel economy of 54.5 miles per gallon, actual standards are footprint-based: vehicles of different sizes have different compliance targets, with larger vehicles having slightly less stringent targets. Also, some improvements will reduce emissions rates without increasing fuel economy, such as reducing refrigerant leakage in air conditioning systems. After accounting for these factors, the Final Rule estimates a fleet-wide fuel economy of 47.4 mpg for new vehicles in 2025.⁵⁹

This analysis explores the impacts of gas price and vehicle technology cost changes on potential benefits resulting from this policy. We compare the estimated fuel economy of a 2025 vehicle based on the MY 2017-2025 standards (47.4 mpg) to one based on the 2016 standards (35.0 mpg). These published fuel economy levels are frequently above actual achieved on-road fuel economy; here we assume a fuel economy gap of 20%, consistent with NHTSA/EPA analyses. Our two comparison vehicles in this case achieve an on-road fuel economy of 37.9 mpg and 28.4 mpg.

Estimates of fuel savings are highly dependent on lifetime fuel use, which in turn depends on vehicle lifetime as well as vehicle miles traveled (VMT). Survival rates – that is, the fraction of the initial number of vehicles produced that are still operating in a given year – consistent with

⁵⁸ Final rule. p. 62627.

⁵⁹ Ibid. p. 62666.

EPA analysis are used here.⁶⁰ When a passenger vehicle is ten years old, 83% of the initial stock remains on the road.⁶¹

The forecast for VMT provided in the Technical Support Document to the rule is also used. These values were adjusted to account for future growth in VMT for both old and new cars and light trucks, as well as an adjustment factor to account for changes in driving patterns resulting from both fuel price changes and fuel economy changes. By multiplying the yearly survival rate by the yearly VMT, an annual survival-weighted VMT is determined.

Fuel costs are an important factor in potential savings from fuel economy; here we use the motor gasoline forecasts provided in the EIA's Annual Energy Outlook 2012. For high and low gas prices, we use values 20% above and below the forecast provided by AEO. Our analysis here could be viewed as conservative: even after recent slight declines, today's gasoline price (averaging \$3.48 per gallon in 2010 dollars⁶²) falls between our high gasoline sensitivity (starting at \$4 per gallon) and the reference case (\$3.31 per gallon) — all in 2010 dollars. The low gasoline price sensitivity is included not because it seems realistic, but to show that high gasoline prices are not needed for CAFE standards to yield savings. This simplified approach is not intended to be a detailed forecast of complicated crude oil markets, but instead to explore how substantially a range of changing gas prices could affect the economic implications of the CAFE standards. The gas price values used in this analysis are shown in Figure A-1.

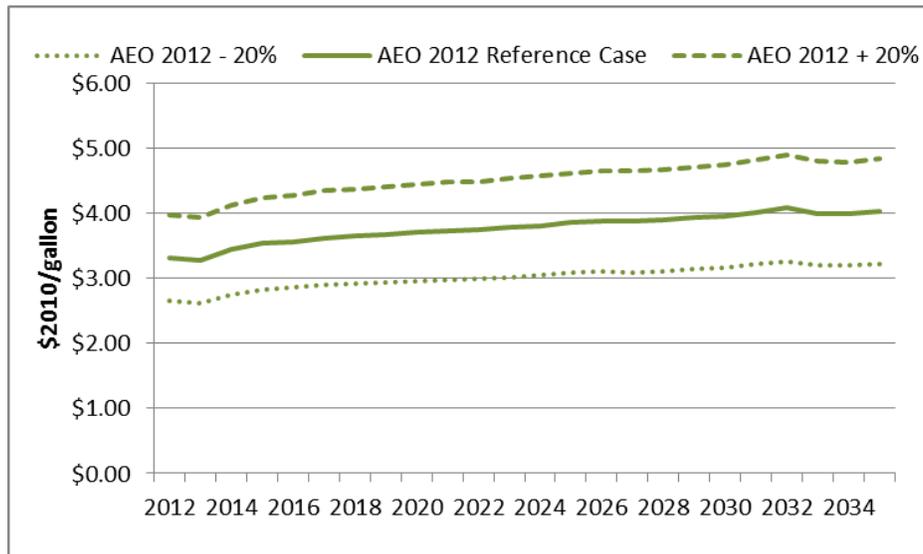
⁶⁰ Environmental Protection Agency and National Highway Traffic Safety Administration (EPA and NHTSA), "Joint Technical Support Document: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards". August 2012. p. 4-11.

<<http://www.epa.gov/otaq/climate/documents/420d11901.pdf>>.

⁶¹ Ibid.

⁶² U.S. Energy Information Administration, "Gasoline and Diesel Fuel Update". Downloaded on April 3, 2013. As of mid-March 2013, the average price for regular unleaded was \$3.70 in current (2013) dollars, which is equivalent to \$3.48 in 2010 dollars. <<http://www.eia.gov/petroleum/gasdiesel/>>.

Figure A-1: Gasoline Price Sensitivities

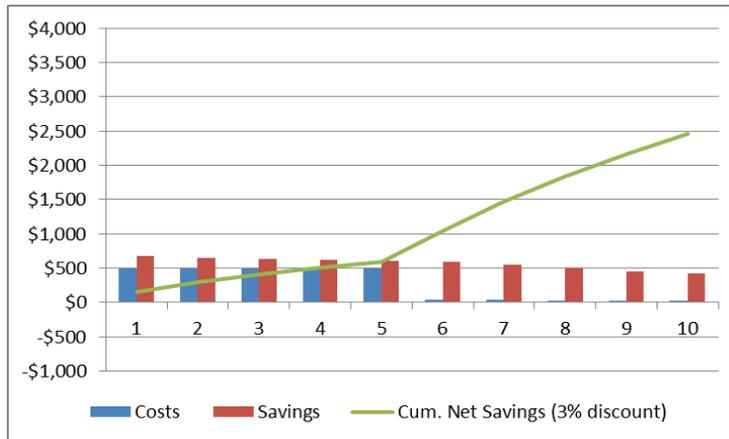


Source: AEO 2012

The level to which the CAFE policy affects vehicle prices is another important consideration. The EPA/NHTSA analysis of the policy did a thorough component-level analysis and projected incremental per-vehicle costs to be \$1800 for MY 2025 vehicles for the first year. Per vehicle costs will vary substantially from company to company. EPA and NHTSA analyze two options: payment through cash and five-year financing. We focus on the latter option, with consumer payments on the incremental expense assumed to be made over the course of a five-year car loan at an interest rate of 5%. The total costs over a five year loan period (including upfront costs, interest, taxes, insurance and maintenance costs) amount to nearly \$2500 in the base case. Similar to gas prices, we do a simple sensitivity of 20% above and below the project cost level--\$2000 in the low cost case and \$3000 in the high case.

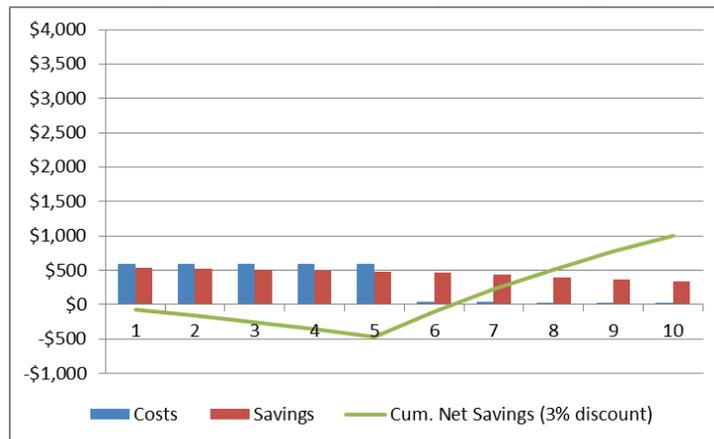
Figures A-2, A-3 and A-4 show the annual costs, gross savings and cumulative net savings (based on a similar chart in CFA 2012) for three cases: the base case with the projected technology costs from EPA/NHTSA and updated AEO 2012 gasoline price forecasts for 2025 through 2035, low gasoline prices with high technology costs (i.e. lower net savings than in the base case) and high gasoline prices with low technology costs (i.e. higher net savings than in the base case). The ranges of net savings in Figure 1 are based on the outcomes of these three cases.

Figure A-2: Net Savings in Base Case (\$2010)



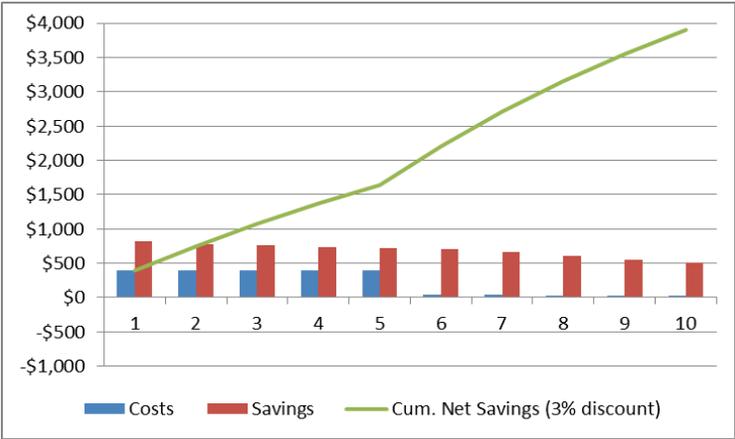
Source: EPA/NHTSA, AEO 2012, Synapse Energy Economics

Figure A-3: Net Savings in Low Gas Price/High Technology Cost Case (\$2010)



Source: EPA/NHTSA, AEO 2012, Synapse Energy Economics

Figure A-4: Net Savings in High Gas Price/Low Technology Cost Case (\$2010)



Source: EPA/NHTSA, AEO 2012, Synapse Energy Economics

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