BEFORE THE DEPARTMENT OF TRANSPORTATION

IN THE MATTER OF TRANSPORTATION INFRASTRUCTURE: NOTICE OF REVIEW OF POLICY, GUIDANCE AND REGULATION	**)** **)** **)**	**DOCKET NO. OST-2017-0057**

COMMENTS OF THE CONSUMER FEDERATION OF AMERICA

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The Consumer Federation of America[1] appreciates the opportunity to provide the Department of Transportation (DOT) with guidance in its efforts to improve the regulatory process. Throughout its 50 years of existence, CFA has been a vigorous and continuous participant in the process of setting regulations to improve the efficiency of energy-using consumer durables and lower the cost of energy borne by consumers.[2] Transportation fuels that are the sources of energy most directly affected by DOT regulations are a major household expenditure, representing over 3 percent of total expenditures, one of the 6 largest subcategories listed in the consumer expenditure survey.[3]

To guide the DOT, we have prepared and attached two Appendices. Appendix A (*Pocketbook Savings, Macroeconomic Growth and Other Public Benefits of Fuel Economy Standards*) is an analysis of the forty-year history of fuel economy standards.[4] Appendix B (*An Analysis of Consumer Savings and Automaker Progress on the Road to 2025 CAFE Standards*), looks at the vehicles which manufacturers have had a chance to make fuel economy improvements, those being totally revised in 2017, comparing the price and fuel efficiency of these vehicles with their 2011 counterparts, the year before the new standards were implemented.

CONSUMER POCKETBOOK AND MACROECONOMIC BENEFITS

As discussed in Appendix A, the starting point for the DOT consideration of regulatory reform and relaxation must be a recognition of the remarkable benefits that the fuel economy standards have provided for consumers and nation.

[1] The Consumer Federation of America is an association of more than 250 nonprofit consumer groups that was established in 1968 to advance the consumer interest through research, advocacy, and education.

[2] The CFA website (http://consumerfed.org/issues/energy/) provides links to 140 pieces of testimony and reports published in the past ten years dealing with the efficiency of energy-using consumer durables divided roughly equally between appliances and vehicles.

[3] https://www.bls.gov/cex/22016/midyear/quintile.pdf. Adding in fuel economy standards, which are governed by a structure of legal authority and administrative rules similar to that affecting appliances doubles the level of household expenditures and makes regulatory reform one of the largest consumer pocketbook issues for the Trump or any administration.

[4] Mark Cooper, 2017, *Pocketbook Savings, Macroeconomic Growth and Other Public Benefits of Energy Efficiency Appliance Standards: Benefit-Cost Analysis of Four Decades of Rules Shows they have Delivered Trillions of Dollars of Economic Value to Consumer and the Nation*, Consumer Federation of America, July.

Fuel economy standards adopted prior to 2008 have resulted in extremely large consumer savings and benefits

- consumer pocketbook savings of $2.1 trillion and
- macroeconomic benefits of $1.3 trillion.
- With costs of less than $500 million, the benefit-cost ratio for consumer pocketbook savings over 4-to-1 and for the macroeconomic benefit is close to 3-to-1.
- The total benefit cost ratio, without environmental, public health and other benefits, is close to 7-to-1.

The analysis of pocketbook savings for gasoline put the impact at the household level at savings of $20,000. Over 35 years, the savings work out to about $600 per household per year.

The report notes that 2008-2016 was a particularly active period of standards writing because the courts found that federal agencies had missed their statutory deadlines for updating rules and the Energy Independence and Security Act (EISA) of 2007 rebooted the fuel economy standards for vehicles. The present period, including standards that are not being reviewed at present will result in:

- consumer pocketbook savings of close to $500 billion and
- macroeconomic benefits of over $300 billion, with light duty vehicles accounting for seven-eighths of those gains.
- Environmental, public health and other benefits are about $120 billion.
- With costs just under $120 billion, the overall benefit of about $900 billion are over eight times the cost.
- Combining benefits of past and present standards, standards have provided over $4 trillion in savings, with less than $600 million in costs, for an overall benefit cost ratio of about 7-to-1.

Future benefits expected under the current law and administrative approach that appear to be at risk of rollback, or refusal to adopt have been estimated to be

- over $400 billion in pocketbook savings and
- $260 billion in macroeconomic benefits, for a total of close to $700 billion.
- Environmental, public health benefits and other benefits would add almost $200 billion for a total close to $900 billion.
- The projected cost is just over $125 billion, for a benefit cost ratio over 7-to-1.

THE LEGAL AND ANALYTICAL FRAMEWORK

This background of remarkable success should encourage the DOT to use restraint in changing a highly effective policy approach. Moreover, the Department of Transportation's

efforts to reduce regulatory burdens are constrained by laws.[5] This regulatory reform/relaxation proceeding cannot repeal and must be bound by three sets of laws.

- The laws of policy enacted by Congress that set goals and Executive Orders that define the implementation path for agency action.
- The laws of economics that drive the benefits and costs of regulations.
- The laws of physics that link the consumption of fossil fuels and the emissions of pollutants as waste products.

The DOT is obligated under existing law and executive orders to adopt regulations that:

- strive to deliver the maximum energy savings that are technically feasible and economically practicable.

The calculation of net benefits must

- take all benefits and costs into account, within the constraints of technologies that are feasible and practicable,
- be evaluated with discount rates ranging from 3% to 7%, and
- be quantified, if possible, but,
- where quantification is impossible or uncertain, qualitative evaluations are to be made.

This legal approach is perfectly consistent with the dominant framework of welfare economics.[6] The cornerstone of the policy that was laid forty-years ago is that there are numerous, persistent and substantial imperfections that afflict the market for energy efficiency. The aspiration of Congress and the guidance of the executive branch have established an institutional structure that has served the public and national interest by establishing reasonable and important goals and directing market forces to achieve those goals in the least-cost manner possible.

By statue and regulatory practice, the standards set by the DOT have been well-crafted to ensure their effectiveness. They take a "command-but-not control" approach that sets a performance standard but affords the manufacturers of energy-using consumer durables freedom and flexibility to meet the standards. They are technology and product neutral, setting moderately aggressive and progressive targets that are responsive to the needs of consumers and producers. For the past decade they have been attribute based, which means they better accommodate consumer preferences and afford manufacturers greater flexibility, They unleash market forces of competition and innovation around the standard, which explains why compliance costs have repeatedly, almost invariably, been well below the estimates made by regulators and far below the bloated cost estimates of industry.

[5] Section II discuses all three of these constraints on agency action. Section II-A discusses the legal aspect.
[6] Id., Section II-B discusses the economic analytic framework.

AUTOMAKER RESPONSE TO HIGHER STANDARDS

As described in Appendix B,

- 27% (21) of the "all-new" vehicles introduced in 2017 actually cost less than their 2011 version and got 1-10 MPG better fuel economy.
- When calculating 5 years of fuel costs, nearly half of these 2017 vehicles cost less to buy and fuel than their 2011 counterparts.
- 58 of the 79 vehicles increased in price, however;
- 15% (12 of 79) had fuel savings that offset the entire price increase
- 52% (41 of 79) had fuel savings that offset the increased cost of fuel economy technology
- 6% (5 of 79) were more expensive in 2017 but their fuel economy stayed the same or decreased from 2011.
- Looking at the cost/benefit average for these 79 all-new models—the added cost of fuel economy averaged $320 per vehicle and will save the buyer an average of $946 putting $626 back into consumer pocketbooks.
- 70 percent of the "all-new" 2017 vehicles had a CAFE-compliant trim, compared to 41 percent of the "all-new" 2015 vehicles.
- A record breaking 6 vehicles that are compliant all the way to MY 2025.
- In looking at all of the 2017 models, "gas guzzlers" getting below 14 MPG is a miniscule 0.4% in 2017, down from 8.5% in 2011.
- A record 78% of the "all-new" light duty trucks had a CAFE compliant trim for 2017. Percentage-wise, trucks beat cars for CAFE compliance in 2017.
- 15 of the 17 manufacturers improved their CAFE compliance rate from 2015 to 2017.
- Comparing the sales figures for 2016 SUVs and light duty trucks with the 2011 models, those that increased the fuel efficiency by over 10% sold nearly 20% more vehicles than those with a less than 10% increase in fuel efficiency.

These statistics (with the exception of the 2016 SUV/truck data) clearly indicate that the car companies are fully capable of meeting the CAFE standards and they are able to do so with great savings for consumers. Rolling back the standards at this point would not only hurt America's already financially beleaguered consumers, but they would hamper vehicle sales and put U.S. car companies at a distinct competitive disadvantage to the Asian carmakers who will meet the standards. As has been proven during the first 5 years of the reinvigorated standards program, automotive engineers are fully capable of meeting the very standards agreed to in 2012 and consumers save money in the process. Rolling back the standard would be costly, counterproductive, and harmful to America's competitive position in the now global auto marketplace.

CONSUMER ATTITUDES TOWARD FUEL ECONOMY AND STANDARDS

In mid-July 2017, CFA commissioned its tenth national random sample public opinion poll in the past ten years dealing the public support for fuel economy standards. In that decade, we have been through three presidents and a gasoline price roller coaster, but one thing has remained constant, public support for fuel economy standards. Given the tumultuous times, the strength and consistency of public support is a testament to the importance and power of this policy.

In the most recent survey, increasing federal fuel economy standards for cars and light duty trucks to 42 MPG by 2025 is supported by 79% of respondents in a recent national survey commissioned by the Consumer Federation of America (CFA); eighteen percent oppose this increase. These results reinforce public support for preserving the higher standards which the Administration is reconsidering. There is also legislation pending in Congress to weaken them. 68 percent of Republicans support this increase in standards.

The survey was conducted for CFA by ORC International, which interviewed a representative sample of 1,008 American adults by landline or phone on July 13-16. The margin of error for the survey is plus or minus three percentage points.

One reason for the widespread support of higher standards is that a large majority (79%), of those intending to purchase a motor vehicle in the future, think that the vehicle's fuel economy is important in the purchase of their next vehicle. In part, this concern may reflect their belief that gas prices will rise in the future. When asked to guess the price of gasoline in five years, the average price given by all respondents was $3.90. Today's average price is only $2.27.

Another reason for the support for fuel economy standards is the fact that the public recognizes the broader impact of fuel consumption. Over the years we have asked about the public's concerns about three issues – environment (climate change), mid-East imports (with implications for economic and political vulnerability), and future prices (which impact not only consumer pocketbooks, but also the economy).

Three-fifths of all respondents said they had strong concerns about climate change, Mideast oil, or gasoline prices. Each of these can be said to have an externalities aspect to it. Another one-seventh expresses some concern about one of these. Combined, three quarters of respondents express a concern about one of these.

Each of these has a significant relationship to the extent to which these concerns are related to the level at which fuel economy will be an influence in the next vehicle purchase decision. Concern about fuel economy has a statistically significant relationship to support for standards. Climate change has a statistically significant relationship to support for standards.

We find that the difference between those who are concerned about these three issues are much more likely to support standards. Any level of concern triggers the commitment to purchase more fuel efficient vehicles and support for standards. Aamong those who express great concern about one of the three issues, we find that over three-quarter say fuel economy will be very important in their next vehicle purchase, which is two and a half times as high as those

who express no concern about any of the three. Those with moderate concern fall between these two extremes. Similarly, two thirds of those who express a strong concern about one of the three issues strongly support fuel economy standards, which is more than twice the percentage of support among those who do not express any strong concerns. Again, those who express moderate concerns fall between the two.

CONCLUSION AND RECOMMENDATIONS

President Reagan set the institutional structure to implement all rules, including fuel economy standards, just six years after the legal foundation was enacted. Presidents Clinton and Obama refined that framework with the goal of improving it, within the constraints of law and past practice. Those Executive Orders still govern the process.

The courts and Congress took note of and acted to correct the failure of DOT to adopt beneficial regulation. In many respects, the Trump Administration cannot legally impair this regulatory process. However, even where it can make changes legally, it should proceed with great care because the result would likely be to impose massive, unnecessary costs on consumers and the economy.

Regulatory reforms that relax the burden on businesses will violate the law and well-established policy and practice; if they do not achieve maximum energy savings while balanced with maximum et benefits enjoyed by consumers and the nation. Such counter-productive "reforms" should not be implemented.

Agencies that refuse to adopt or delay the release of rules that increase net benefits because they cannot find two other rules to repeal, will also violate the law and established practice. The law requires the Department of Transportation to act in the public interest, independently of other rules that might have become obsolete.

In sum, regulatory reform should earn its keep the old-fashioned way, by increasing, on a case-by-case basis, the net benefit of energy efficiency measures that raise consumer pocketbook savings and help to grow the economy.

APPENDIX A

POCKETBOOK SAVINGS, MACROECONOMIC GROWTH AND OTHER PUBLIC BENEFITS OF FUEL ECONOMY STANDARDS:

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I. INTRODUCTION

A. THE LEGAL CONTEXT OF REGULATORY REFORM OF FUEL ECONOMY STANDARDS

The Request for Information (RFI) issued by the Department of Transportation (published in the Federal Register on June 8, 2017) is among the first to contemplate fundamental changes in the approach to regulation in America under the Trump Administration.[1] As such, it demands a broad view of the process and how it has functioned in the past. The RFI recognizes that the recent Executive Orders on Regulatory Reform are laid atop the underlying statutes and Executive Orders in force that must be honored.[2] Executive Orders cannot repeal or redefine the Congressional intent of the authorizing statutes, they can only seek to improve the process by which the executive branch exercises the will of the Congress. Moreover, while Executive Orders can supplant earlier orders, great care should be taken in altering regulatory practice that has been successful and stood the test of time.

In the case of the Department of Transportation (DOT) fuel economy standards, there is a remarkable record of success that must provide the context for and restrain efforts to reform the regulatory process. Over the course of more than forty years, with careful statutory goals and guided by a Reagan-era Executive Order whose principles remain in force to give strong guidance to the regulatory review process, Department of Transportation regulations have yielded trillions of dollars of direct pocketbook benefits to consumers and indirect economic and environmental benefits to the nation. The consideration of reform of Department of Transportation regulation must be informed by that remarkable track record of success.

That review must consider both the benefits and costs of standards, not because the deregulatory executive order says so (which it now DOTs),[3] but because the underlying statutes guided by Executive Orders have always required a full and careful benefit-cost analysis. Federal law not only imposes deadlines and requires benefit-cost analysis, but also requires that the conclusions be reasonably related to the facts before the agency.[4] Federal law constrains executive actions in other ways, requiring cooperation between federal and state agencies, and giving states a right to independent action under the American approach to federalism.

In this analysis, we offer guidance to the Department of Transportation's regulatory reform effort that builds on the track record and the legal context.

Triggered four decades ago by the oil price shocks of the 1970s, the use of standards to promote energy efficiency has enjoyed a remarkable degree of bipartisan and public support.[5] This support stems in large measure from the obvious benefit of efficiency. [6] Efficiency standards deliver massive pocketbook savings to consumers that helps to grow the economy. [7] The national security, public health and environmental benefits are substantial too, but much smaller than the direct consumer and indirect economic benefits.

In this paper we analyze the past, present and future impact of fuel economy standards on consumers and the economy using very conservative assumptions and conclude that they have produced, are producing and are likely to continue to produce massive public benefits. The long history of consumer benefits from and support for energy efficiency standards and this huge

consumer stake in continuing to develop these standards make it clear that this is one of the biggest consumer pocketbook issues that the DOT and the current administration will deal with. Regulatory reform that threatens to stymie the implementation and enforcement of current fuel economy standards or the continued development of fuel economy standards would impose harm on the public.

The rule of law requires an agency to reach decisions that reflect a reasonable interpretation of the evidence on the record before it. The impact of policy on consumer pocketbooks and public support for consumer-friendly policies is important evidence. Our public opinion polling data shows that consumers overwhelmingly support efficiency standards.[8] Our economic analysis, summarized below, explains why they are right to do so – these standards have saved and continue to save consumers vast sums.

B. OUTLINE

Given the long history of support for efficiency standards, the strong record of positive results, and the unprecedented nature of recent attacks on standards,[9] this paper presents a comprehensive overview of why and how benefits have been consumer-friendly for over four decades. Given the extensive conceptual and analytic framework we have presented in regulatory proceedings,[10] papers,[11] and research reports[12] over the past decade, this paper presents a brief overview of the analytic framework, but focuses on the quantitative evaluation of a full accounting of benefits and benefits.

Section II explains the legal and analytic terrain on which regulatory reform must operate. It first describes the legal context, then offers an economic explanation of why performance standards work so well to save consumers money and grow the economy, particularly when applied to energy efficiency. It concludes with a brief review of public support for fuel economy standards reflected in national public opinion polling over the past decade.

Section III describes the traditional approach to benefit-cost analysis prepared by regulatory agencies under their authorizing statutes and the Executive Orders in force. It discusses why there is a systematic tendency for regulatory agencies to overestimate the cost of compliance with well-designed performance standards.

Section IV describes the economic growth effects that inevitably flow from well-designed performance standards and argues that they should be included in any comprehensive cost-benefit analysis. We develop and use extremely conservative rules of thumb and show the impact they would have on the bottom line evaluation of efficiency standards.

Section V presents a comprehensive view of the benefits of standards, emphasizing that measures of the benefit that ignores market imperfections should not be the basis for evaluating policy effects.

Section VI describes the quantitative methodology and discusses the estimates of costs and benefits of past, present and future fuel economy standards. It provides a new perspective in two ways. First, it introduces a consistent set of definitions and evaluations across the full range of efficiency standards. Second, it examines the benefits and costs from five points of view.

We examine past standards, generally in the period from the 1980s to 2007, to establish the baseline impact of efficiency standards in which we are not debating projections but looking at actual performance.

We analyze present standards, generally in the period 2008-2016. While there are still uncertainties here, the initial effect of the standards can be seen. Although we rely on the agency regulatory and technology impact assessments, real world effects support the conclusion that the effects have been positive.

We examine pending standards for the current period, 2017- forward. These involve many of the standards that the Trump Administration is seeking to delay, roll back, or repeal. Although they rest on agency documents, the decision to adopt these standards is based on the evidentiary record. Under the process of the Administrative Procedure Act the Trump Administration faces the challenge of reaching a different conclusion either by reinterpreting the record before the agency or by building a new record that reaches a contrary conclusion. Either way, the existing record poses a significant challenge to the new administration.

We consider future standards and the potential for consumer benefit from continued development of standards. Many of the authorizing statutes tell the agencies to adopt standards that achieve maximum practicable economic benefits within the bounds of technological feasibility. Some have timelines for the development of standards. This creates an impetus for the continuous development of standards that are in the public interest, as technology advances. In fact, many of the standards adopted by the Obama Administration were required by the courts because the prior two administrations had failed to execute the statutes responsibly. Moreover, Congress passed a major piece of legislation – the Energy Independence and Security Act of 2007 (EISA), which compelled auto and fuel economy standards to be adopted.

We also offer a separate "pure externalities view" of standards that includes macroeconomic, environmental, public health, and other externality benefits. While we believe the direct consumer pocketbook benefits should be included in the benefit-cost analysis, this "pure externalities view" allows us to estimate the benefit-cost ratio of factors that are not reflected in the market transaction and, therefore, are based on indisputable market imperfections and failures that are corrected by standards.

II. THE LEGAL, ANALYTIC AND PUBLIC OPINION FOUNDATIONS OF BENEFIT-COST ANALYSIS OF FUEL ECONOMY STANDARDS

Because concerns about energy consumption were magnified by the energy price shocks of the 1970s, there is an extremely large and rich literature on why there is a significant and persistent "efficiency gap."[13] While the impetus to setting standards for energy consumption of durable goods was the urgent effect of price shocks on the economy and national security (both of which can be considered, "externalities" of energy consumption), engineering-economic analysis identifies numerous attractive opportunities to invest in energy saving technologies that cost less than the savings they generate. This literature offers a conceptual explanation based on the observation that there are imperfections on both the supply and demand sides of energy markets that lead producers to underinvest in energy efficiency and consumers to demand less efficiency than is economically justified.

That literature also contains hundreds, if not thousands, of peer-reviewed and published empirical studies of the actual and potential energy savings across a broad range of goods. It contains numerous comparisons of policy instruments in which performance standards repeatedly turn out to be among the most effective tools for addressing these market imperfections when they take a "command but not control," approach.[14]

Because the old price shocks had a massive impact on the U.S., the issue has been prominent for a long time, with recent environmental concerns reinforcing its continuing importance. As a result, efficiency has received a great deal of policy, political and polling attention. This Section discusses the decision making terrain of fuel economy standards

A. LAW AND REGULATORY PRACTICE

Law EPCA, 1975, EISA, 2007

The contemporary, substantive requirements for setting standards began at 42 U.S.C. Part A of Title III of the Energy Policy Conservation Act, signed into law in 1975. This Section established the Corporate Average Fuel Economy (CAFE) standards for automobiles. Congress designated the initial targets for three years. The Secretary of Transportation is then authorized to set standards that achieved the maximum feasible average fuel economy until 1985. In doing so, the Secretary must balance a number of factors. Standards must be technically feasibility, economically practicable, take into account other standards and the need to save energy.

The Energy Independence and Security Act of 2007 restarted the CAFÉ program and added a requirement for attribute-based standards.

Executive Orders

E.O. 12291 (Reagan, 1981)

Less than a month into the Reagan Administration, Executive Order 12291 outlined the principles and practices to govern the evaluation and promulgation of rules and standards. Although these were modified slightly by later presidents, the basic structure has remained the

same. Since the law was quite new when Reagan took office and few standards had been written, his executive order essentially established the practice.

Sec. 2. General Requirements. In promulgating new regulations, reviewing existing regulations, and developing legislative proposals concerning regulation, all agencies, to the extent permitted by law, shall adhere to the following requirements:

(a) Administrative decisions shall be based on adequate information concerning the need for and consequences of proposed government action;

(b) Regulatory action shall not be undertaken unless the potential benefits to society from the regulation outweigh the potential costs to society;

(c) Regulatory objectives shall be chosen to maximize the net benefits to society;

(d) Among alternative approaches to any given regulatory objective, the alternative involving the least net cost to society shall be chosen; and

(e) Agencies shall set regulatory priorities with the aim of maximizing the aggregate net benefits to society, taking into account the condition of the particular industries affected by regulations, the condition of the national economy, and other regulatory actions contemplated for the future.

Sec. 3. Regulatory Impact Analysis and Review.

(a) In order to implement Section 2 of this Order, each agency shall, in connection with every major rule, prepare, and to the extent permitted by law consider, a Regulatory Impact Analysis. Such Analyses may be combined with any Regulatory Flexibility Analyses performed under 5 U.S.C. 603 and 604.

(b) Each agency shall initially determine whether a rule it intends to propose or to issue is a major rule, provided that, the Director, subject to the direction of the Task Force, shall have authority, in accordance with Sections l (b) and 2 of this Order, to prescribe criteria for making such determinations, to order a rule to be treated as a major rule, and to require any set of related rules to be considered together as a major rule.

(c) Except as provided in Section 8 of this Order, agencies shall prepare Regulatory Impact Analyses of major rules and transmit them, along with all notices of proposed rulemaking and all final rules, to the Director as follows:

(1) If no notice of proposed rulemaking is to be published for a proposed major rule that is not an emergency rule, the agency shall prepare only a final Regulatory Impact Analysis, which shall be transmitted, along with the proposed rule, to the Director at least 60 days prior to the publication of the major rule as a final rule;

(2) With respect to all other major rules, the agency shall prepare a preliminary Regulatory Impact Analysis, which shall be transmitted, along with a notice of proposed rulemaking, to the Director at least 60 days prior to the publication of a notice of proposed rulemaking, and a final Regulatory Impact Analysis, which shall be transmitted along with the final rule at least 30 days prior to the publication of the major rule as a final rule;

(3) For all rules other than major rules, agencies shall submit to the Director, at least 10 days prior to publication, every notice of proposed rulemaking and final rule.

(d) To permit each proposed major rule to be analyzed in light of the requirements stated in Section 2 of this Order, each preliminary and final Regulatory Impact Analysis shall contain the following information:

(1) A, description of the potential benefits of the rule, including any beneficial effects that cannot be quantified in monetary terms, and the identification of those likely to receive the benefits;

(2) A description of the potential costs of the rule, including any adverse effects that cannot be quantified in monetary terms, and the identification of those likely to bear the costs;

(3) A determination of the potential net benefits of the rule, including an evaluation of effects that cannot be quantified in monetary terms;

(4) A description of alternative approaches that could substantially achieve the same regulatory goal at lower cost, together with an analysis of this potential benefit and costs and a brief explanation of the legal reasons why such alternatives, if proposed, could not be adopted; and

(5) Unless covered by the description required under paragraph (4) of this subsection, an explanation of any legal reasons why the rule cannot be based on the requirements set forth in Section 2 of this Order.

E.O. 12866 (Clinton, 1993)

President Clinton replaced Reagan's executive order, but as the following text shows, his Executive Order 12866 kept the essential elements of the approach in place. In terms of the analysis below, it rendered the review more flexible and encouraged greater reliance on market forces. It introduced the concept of performance standards and called for careful review across all standards.

Section 1. Statement of Regulatory Philosophy and Principles.

a. The Regulatory Philosophy. Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

b. The Principles of Regulation. To ensure that the agencies' regulatory programs are consistent with the philosophy set forth above, agencies should adhere to the following principles, to the extent permitted by law and where applicable:

1. Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.
2. Each agency shall examine whether existing regulations (or other law) have created, or contributed to, the problem that a new regulation is intended to correct and whether those regulations (or other law) should be modified to achieve the intended goal of regulation more effectively.
3. Each agency shall identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.
4. In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction.
5. When an agency determines that a regulation is the best available method of achieving the regulatory objective, it shall design its regulations in the most cost-effective manner to achieve the regulatory objective. In doing so, each agency shall consider incentives for innovation, consistency, predictability, the costs of enforcement and compliance (to the government, regulated entities, and the public), flexibility, distributive impacts, and equity.
6. Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.
7. Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.

8. Each agency shall identify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt.
9. Wherever feasible, agencies shall seek views of appropriate State, local, and tribal officials before imposing regulatory requirements that might significantly or uniquely affect those governmental entities. Each agency shall assess the effects of Federal regulations on State, local, and tribal governments, including specifically the availability of resources to carry out those mandates, and seek to minimize those burdens that uniquely or significantly affect such governmental entities, consistent with achieving regulatory objectives. In addition, as appropriate, agencies shall seek to harmonize Federal regulatory actions with related State, local, and tribal regulatory and other governmental functions.
10. Each agency shall avoid regulations that are inconsistent, incompatible, or duplicative with its other regulations or those of other Federal agencies.
11. Each agency shall tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.
12. Each agency shall draft its regulations to be simple and easy to understand, with the goal of minimizing the potential for uncertainty and litigation arising from such uncertainty.

E.O. 13563 (Obama, 2011)

The Obama Executive Order extended earlier orders by emphasizing efforts to achieve results at least costs and transparency.

Improving Regulation and Regulatory Review
Section 1. *General Principles of Regulation.*

(a) Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation. It must be based on the best available science. It must allow for public participation and an open exchange of ideas. It must promote predictability and reduce uncertainty. It must identify and use the best, most innovative, and least burdensome tools for achieving regulatory ends. It must take into account benefits and costs, both quantitative and qualitative. It must ensure that regulations are accessible, consistent, written in plain language, and easy to understand. It must measure, and seek to improve, the actual results of regulatory requirements.

(b) This order is supplemental to and reaffirms the principles, structures, and definitions governing contemporary regulatory review that were established in Executive Order 12866 of September 30, 1993. As stated in that Executive Order and to the extent permitted by law, each agency must, among other things: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

(c) In applying these principles, each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. Where appropriate and permitted by law, each agency may consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts.

The pedigree, longevity and success of this law and administrative practice create a formidable institutional structure that deserves a great deal of respect and deference. As a result, energy performance standards enjoy a remarkable degree of public and bipartisan support.[15]

B. THE IMPORTANCE OF RIGOROUS BENEFIT-COST ANALYSIS

Benefits and Costs

The principles that the laws and executive orders teach should be familiar to and learned by anyone who has taken Economics 101. Proper cost benefit analysis must include careful consideration of costs and benefits. In fact, an introductory economics text written by John B. Taylor,[16] who holds prestigious named appointments at Stanford University and the conservative Hoover Institute and who served as an Under Secretary of the Treasury in the George W. Bush administration,[17] defines cost benefit analysis as follows:

> Cost-Benefit Analysis: an appraisal of a project based on the costs and benefits from it.[18]

A more advanced text on *The Economics of Regulation and Antitrust,*[19] calls it benefit-cost analysis and explains the obvious need to include costs and benefits as follows:

> From an economic efficiency standpoint, the rationale for a benefit-cost approach seems quite compelling. At a very minimum, it seems reasonable that society should not pursue policies that do not advance our interests. If the benefits of a policy are not in excess of the costs, then clearly it should not be pursued, because such efforts do more harm than good. Ideally, we want to maximize the net gain that policies produce…
>
> The requirement that benefits exceed costs for sound regulatory policies has also given rise to a simple shorthand. The ratio of benefits to costs, or the benefit-cost ratio, must exceed 1.0 for a policy to be potentially attractive. This requirement serves as the minimum tests for policy efficacy, as our overall objective should be to maximize the spread between benefits and costs.[20]

The recent OMB advice letter calls for careful cost-benefit analysis. [21] The challenge as always will be to ensure that agencies do not engage in "fuzzy math." The threat of "fuzzy math" is nothing new and the APA takes a pragmatic approach to evaluating whether the agency decision is consistent with the record before it. The remainder of this section discusses the rationale for implementing standards to reduce the efficiency gap and describes the key elements that must be included in the benefit cost calculation to avoid "fuzzy math."

Market Imperfections

The cornerstone of the cost benefit justification for standards is the potential to produce a benefit. If the marketplace is performing well, it is difficult to justify policy intervention. If it not performing well for any variety of reasons, policy interventions in the market can improve market performance. Viscusi, et al., present an overarching observation as the starting point for this analysis.

> "If we existed in a world that functioned in accordance with the perfect competitive paradigm, there would be little need for antitrust policies and other regulatory efforts. All markets would consist of a large number of sellers of a product, and consumers would be fully informed of the product's implications. Moreover, there would be no externalities present in this idealized economy, as all effects would be internalized by the buyers and seller of a particular product.
>
> Unfortunately, economic reality seldom adheres very closely to the textbook model of perfect competition. Many industries are dominated by a small number of large firms. In some instances, principally the public utilities, there may even be a monopoly…
>
> Not all market failures stem from actions by firms. In some cases, individuals can also be contributing to the market failure."[22]

The key elements of this analytic framework were put into place a quarter of a century ago in Executive Order 12866 and they remain in effect today. They have stood the test of time because they further the goals enacted by Congress and comport with the precepts of economic analysis. The empirical evidence with respect to energy efficiency indicates is that there is a significant failure of the market to produce optimum results. The recent literature, which has been reviewed in many recent proceedings, shows that there is a massive efficiency gap and there are numerous, well-documented market imperfections that lead to underinvestment and under-supply of energy saving technologies in consumer durable and commercial equipment markets.

Societal failures, like the national security implications of energy imports, were often the starting point for the consideration of policies to intervene in the market. Environmental externalities were another early and obvious market failure. The study of the market for energy efficiency has yielded many other sources of imperfections. We have documented and discussed these at great length in comments, as well as papers and reports. Table II-1 summarizes the intersection of our broad analysis of imperfections in the market for energy efficiency and the empirical evidence we have reviewed in hundreds of studies.

C. Performance Standards, An Effective "Command-But-Not- Control" Approach

Even with well-documented market imperfections, there is no guarantee that the standards will deliver the benefits they claim. The design of standards is important.

Viscusi, et al., go on to describe several attributes of regulation that improve its efficacy, stating that "performance-oriented regulation," "give firms some discretion in terms of the means of their compliance," "utilization of unbiased estimates of benefits and costs," and "avoid… regulation of prices and production."[23] This observation is often repeated with respect to energy efficiency performance standards. Other key characteristics that the literature identifies as making for effective standards that promote innovation, in addition to flexibility, include certainty of standards, progressive moving targets, and elimination of information asymmetry.[24]

> There is a lot of empirical evidence that energy savings measures often provide an effective, cost-efficient approach to reducing greenhouse gas emissions, while generating co-benefits on employment and competitiveness…

Well-designed regulation that is strict in ambition, but flexible in implementation would point companies to the problem of inefficiencies, trigger information gathering, reduce uncertainty and create a market push within an overall level-playing field. Compliance to regulation will lead to greater innovation (cleaner technologies, processes) as key means to reduce inefficiency, which will lead to environmental benefits, hence lower overall costs. Moreover, cost savings can (but do not always) lead to partial or full offset of regulatory compliance and innovation cost and hence increase overall competitiveness.[25]

TABLE II-1: SCHOOLS OF THOUGHT AND MARKET IMPERFECTIONS

Traditional	Transaction Cost/Institutional	Endemic Imperfections
Externalities	Search and Information	Asymmetric Info
Public Goods & Bads	Imperfect information	Agency
Basic Research/Stock of Knowledge	Availability	Adverse selection
Network Effects	Accuracy	Perverse incentives
Learning-by-Doing & Using	Search cost	Lack of capital
Localization	Bargaining	
Industry Structure	Risk & Uncertainty	Political Power & Policy
Imperfect Competition	Liability	Monopoly/lack of competition
Concentration	Enforcement	Incumbent power
Barriers to Entry	Fuel Price	Institutional support
Scale	Sunk costs	Inertia
Cost structure	Hidden cost	Regulation
Switching costs	High Risk Premia	Price
Technology-Innovation	Incomplete Markets	Aggregate, Avg.-cost
Economics		Allocating fuel price volatility
R&D	Behavioral	Permitting
Investment	Motivation & Values	Lack of commitment
Marketing	Non-economic	
Bundling: Multi-attribute	Influence & Commitment	
Cost-Price	Custom	
	Social group & status	
Limit impact of price	Perception	
	Bounded Vision/Attention	
	Prospect/ Risk Aversion	
	Calculation.	
	Bounded Rationality	
	Limited ability to process info	
	Heuristic decision making	
	Discounting difficulty	

Source: Framework developed in Comments of the Consumer Federation of America, Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Environmental Protection Agency 40 CFR Parts 86 and 600, Department of Transportation 49 CFR Parts 531,633, 537, et al., November 28, 2009. Most recent update, including climate change literature available in Mark Cooper, 2017, The Political Economy of Electricity: Progressive Capitalism and the Struggle to Build a Sustainable Power Sector, (Praeger), Chapter 7 and Appendix II for a more recent comprehensive review.

In an earlier analysis, CFA explained that well-crafted performance standards exhibit a "command but not control" approach to deliver consumer benefits at least cost. These standards

work best when they embody six principles, as described in Table II-2,[26] because they unleash market forces in pursuit of the goal.

TABLE II-2: ATTRIBUTES OF EFFECTIVE, COMMAND BUT NOT CONTROL STANDARDS

Long-Term: Setting an increasingly rigorous standard over a number of years that covers several redesign periods fosters and supports a long-term perspective. The long term view lowers the risk and allows producers to retool their plants and provides time to re-educate the consumer.

Product Neutral: Attribute based standards accommodate consumer preferences and allow producers flexibility in meeting the overall standard.

Technology-neutral: Taking a technology neutral approach to the long term standard unleashes competition around the standard that ensures that consumers get a wide range of choices at that lowest cost possible, given the level of the standard.

Responsive to industry needs: The standards must recognize the need to keep the target levels in touch with reality. The goals should be progressive and moderately aggressive, set at a level that is clearly beneficial and achievable.

Responsive to consumer needs: The approach to standards should be consumer-friendly and facilitate compliance. The attribute-based approach ensures that the standards do not require radical changes in the available products or the product features that will be available to consumers.

Procompetitive: All of the above characteristics make the standards pro-competitive. Producers have strong incentives to compete around the standard to achieve them in the least cost manner, while targeting the market segments they prefer to serve.

Sources: Testimony of Dr. Mark Cooper, Director of Research, Consumer Federation of America, on "Midterm Review and an Update on the Corporate Average Fuel Economy Program and Greenhouse Gas Emissions Standards for Motor Vehicles," Before the *Committee on Energy and Commerce Subcommittee on Commerce, Manufacturing, and Trade Subcommittee on Energy and Power*, U.S. House of Representatives, September 22, 2016.

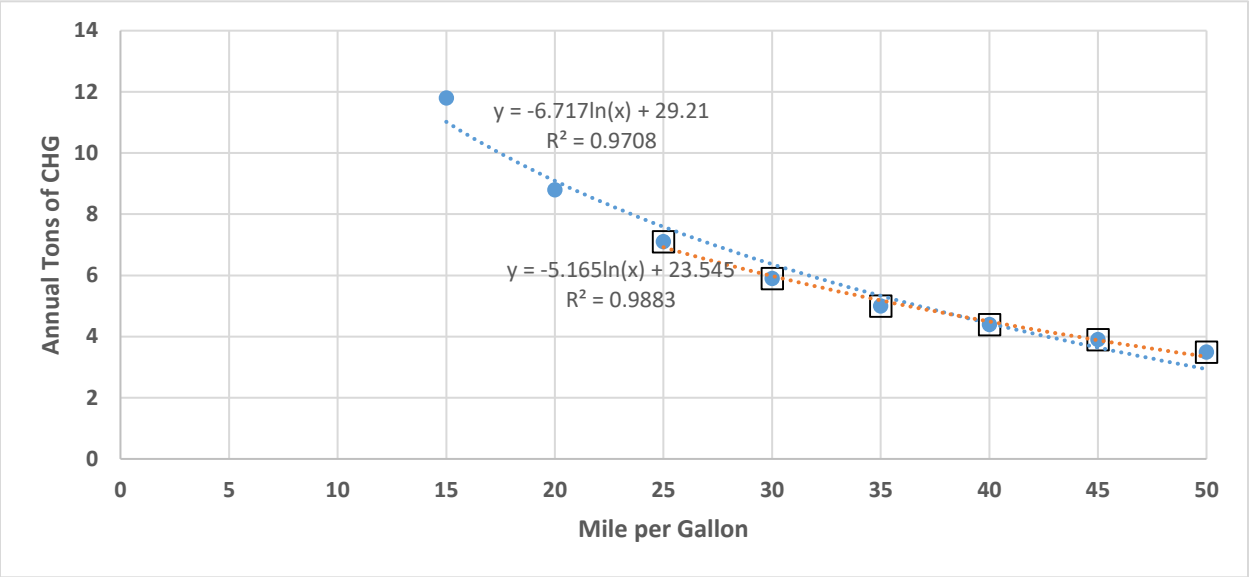
D. TRADITIONAL EXTERNALITIES: ENVIRONMENTAL, PUBLIC HEALTH AND OTHER IMPACTS

The history and broad framework of energy efficiency standards directly raises another important issues, as the Viscusi, et al., discussion highlights. There are a number of effects that can be considered externalities because they do not enter into individual consideration in consumer and producer transactions. One such externality that is grounded in the laws of physics is particularly important.

Because of the physical relationship between energy consumption and pollution emissions, one of the clear impacts of efficiency standards, whether instituted for energy, environmental, or public health reasons, is a reduction in pollution. The reduction of carbon emissions receives a great deal of attention today. The benefits of the reduction of emissions of non-carbon pollutants (e.g. SOX, NOX, particulates) are also important, have long been recognized, and the value of these is subject to less controversy.

As we pointed out long ago in our work on the Clean Cars program,[27] the near perfect correlation between the emission of pollutants and consumption of petroleum products in vehicles creates a powerful and inevitable connection between environmental protection and consumer pocketbook savings (See Figure II-1). The same is true for other fossil fuels used directly by consumers or to produce electricity. The amount of pollution associated with electricity consumption will depend on the mix of resources used to generate it, and as reliance on fossil fuels declines, so too will the amount of pollution reduction, but the least-cost and most effective approach to reduction of emissions remains improving energy efficiency.[28] The least cost approach to emission reductions is to improve the efficiency of vehicles and appliances by reducing their energy consumption. All the agencies involved in setting standards, EPA, NHTSA, DOT, be they emissions, appliances, or fuel economy are required to consider this economic benefit.

FIGURE II-1: THE NEAR PERFECT CORRELATION OF GREENHOUSE GAS EMISSIONS AND FUEL ECONOMY



Source: EPA, *Sources of CO_2 Emissions for a Typical Household*, www.fueleconomy.gov/feg/climate.shtml

This physical relationship makes the adoption of pollution reduction unique in writing environmental standards to regulate pollution because the avoided cost of energy consumption are direct and immediate pocketbook benefits of the standard. Congress' broad language on benefits and the executive orders that seek maximum benefit reflect the fact that neither branch of government has the power to repeal or override the laws of nature. Viewed in this way, it can be argued that the consumer pocketbook savings are an inevitable, unintended consequence (an externality) of the reduction in pollution, which are not considered in the transaction.

E. PUBLIC CONCERN ABOUT POLICY, RECOGNITION OF THE IMPORTANCE OF INCREASING FUEL ECONOMY AND SUPPORT FOR FUEL STANDARDS

The economic success mentioned above and analyzed below and the legal and analytic frameworks provide a firm foundation for the adoption and continued development of fuel economy standards. This foundation rests on a strong base of public support, which we have been measuring regularly and briefly discuss in this section.

Public Opinion about Standards in Mid-2017

In mid-July 2017, CFA commissioned its tenth national random sample public opinion poll in the past ten years dealingwith the public support for fuel economy standards.[29] In that decade, we have been through three presidents and a gasoline price roller coaster, but one thing has remained constant, public support for fuel economy standards. Given the tumultuous times, the strength and consistency of public support is a testament to the importance and power of this policy.

In the most recent survey, increasing federal fuel economy standards for cars and light duty trucks to 42 MPG by 2025 is supported by 79% of respondents; just, eighteen percent

oppose this increase. These results reinforce public support for preserving the higher standards which the Administration is reconsidering. There is also legislation pending in Congress to weaken them. Yet, 68 percent of Republicans support this increase in standards.

One reason for the widespread support of higher standards is that a large majority (79%), of those intending to purchase a motor vehicle in the future, think that the vehicle's fuel economy is important in the purchase of their next vehicle. In part, this concern may reflect their belief that gas prices will rise in the future. When asked to guess the price of gasoline in five years, the average price given by all respondents was $3.90. Today's average price is only $2.27.

Another reason for the support for fuel economy standards is the fact that the public recognizes the broader impact of fuel consumption. Over the years we have asked about the public's concerns about three broad energy policy issues – environment (climate change), mid-East imports (with implications for economic and political vulnerability), and future prices (which impact not only consumer pocketbooks, but also the economy).

Three-fifths of all respondents to the 2017 survey said they had strong concerns about climate change, Mideast oil, or gasoline prices. Another one-seventh expresses some concern about one of these. Combined, three quarters of respondents express a concern about one of these.

Each of these has a significant relationship to the extent to which these concerns are related to the level at which fuel economy will be an influence in the next vehicle purchase decision (See Figure II-2). Concern about fuel economy has a statistically significant relationship to support for standards. Climate change has a statistically significant relationship to support for standards.

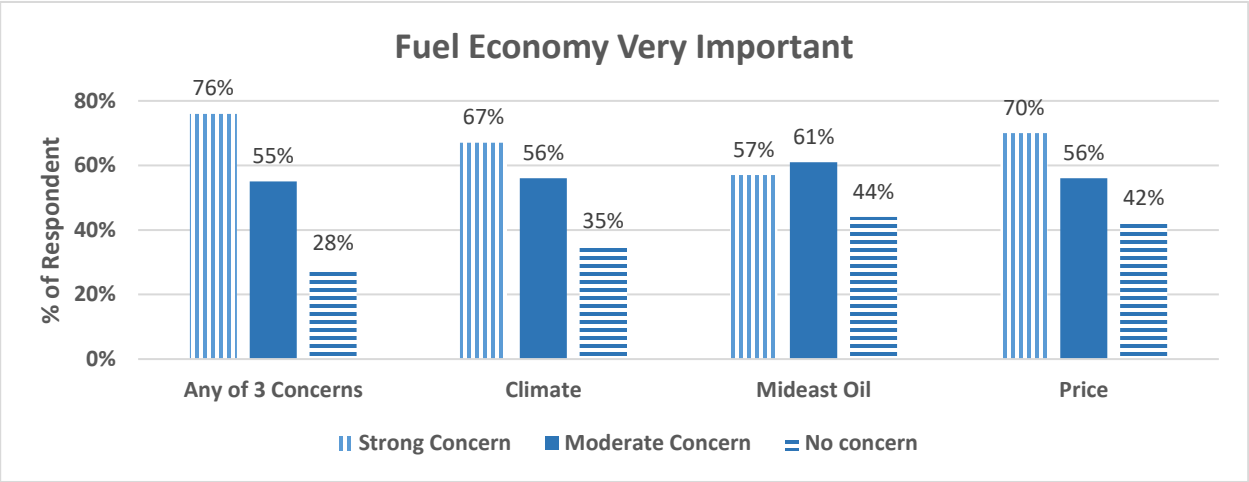
We find that the difference between those who are concerned about these three issues are much more likely to support standards. Any level of concern triggers the commitment, but the stronger the concern, the stronger the commitment. As shown in Figure II-2, among those who express great concern about one of the three issues, we find that over three-quarter say fuel economy will be very important in their next vehicle purchase, which is two and a half times as high as those who express no concern about any of the three. Those with moderate concern fall between these two extremes. Similarly, two thirds of those who express a strong concern about one of the three issues strongly support fuel economy standards, which is more than twice the percentage of support among those who do not express any strong concerns. Again, those who express moderate concerns fall between the two.

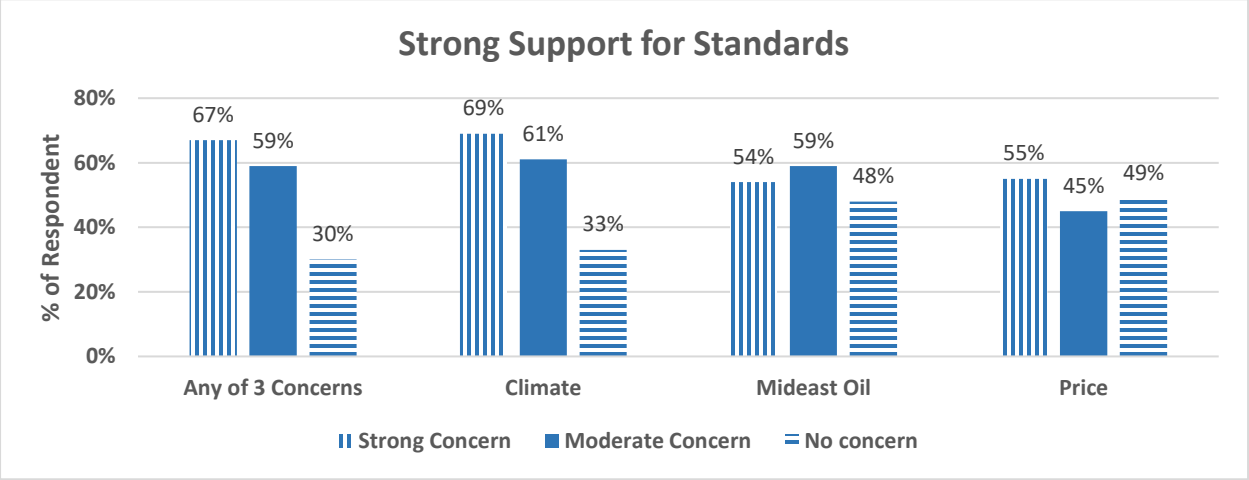
Long Term Support for Fuel Economy Standards

The durability of this support for standards is reflected in our earlier polls. In April 2007 we asked about legislation "that would require auto manufacturers to increase their new car fuel mileage by about one mile per gallon a year for ten years.[30]

- Support for the increase stood at 81%.

FIGURE II-2: EXTERNALITY CONCERNS AND ATTITUDES TOWARD FUEL ECONOMY





Source: CFA, ORC, national random sample public opinion poll, July 2017

We followed that up with a question that pointed out that the cost of vehicles would go up, but be completely offset by lower costs for less gasoline consumption (although we could have stated that there would be substantial net savings).

- Support for the increases stood at 73%.

In September 2007, we asked about support for the broad goals of EISA in a question that began with fuel economy but also mentioned greater reliance on renewables and ethanol.

- Support for the legislation stood at 84%.

We followed that up with a question that laid out the arguments for passage (lower consumer spending on energy, dependence on imports, and global warming emissions) and against (rising prices and lost jobs).

- Support for the legislation stood at 75%.

After the passage of EISA we shifted our questioning to the level of standards being considered in rulemakings.

In March 2008, we asked consumers about the U.S. oil situation (share of global reserves and level of consumption) and split the sample. We noted that regulations were being considered to increase fuel economy from 25 mpg to 35 mpg by 2016 and asked about support for raising that target to 50 mpg by 2025. Among those who gave correct answers to the questions on the U.S. oil situation,

- Support for the increase stood at 73%.

Among those who did not give correct answers, without being provided the correct information,

- Support for the increase was 65%.

After correct information was provided,

- support for the increase rose to 69%.

In September 2010, we asked about a much larger increase, in addition to going from 25 mpg to 35 mpg by 2016, we asked about going to 60 mpg by 2025.

- Support for the increase stood at 59%.

In May 2012, we shifted to evaluating the standard that had been adopted for 2025, with the lab test goal of approximately 55 mpg.

- Support for the standard stood at 74%.

In April 2013, we repeated the survey question.

- Support for the standard stood at 85%.

In June 2014, we again surveyed on the proposed standard.

- Support for the standard stood at 83%.

The previous surveys relied on the laboratory miles per gallon estimates used in the regulatory documents, but the economic analysis of the CAFE standards and the EPA stickers on vehicles have always relied on the estimated on-road mileage that consumers are likely to see. As the mpg increases, the difference between the lab tests and on-road mpg grows. In our recent surveys we have shifted to using the on road numbers, since that is more familiar to consumers.

In our April, 2016 survey we shifted to the projected on-road mileage of about 42 mpg.

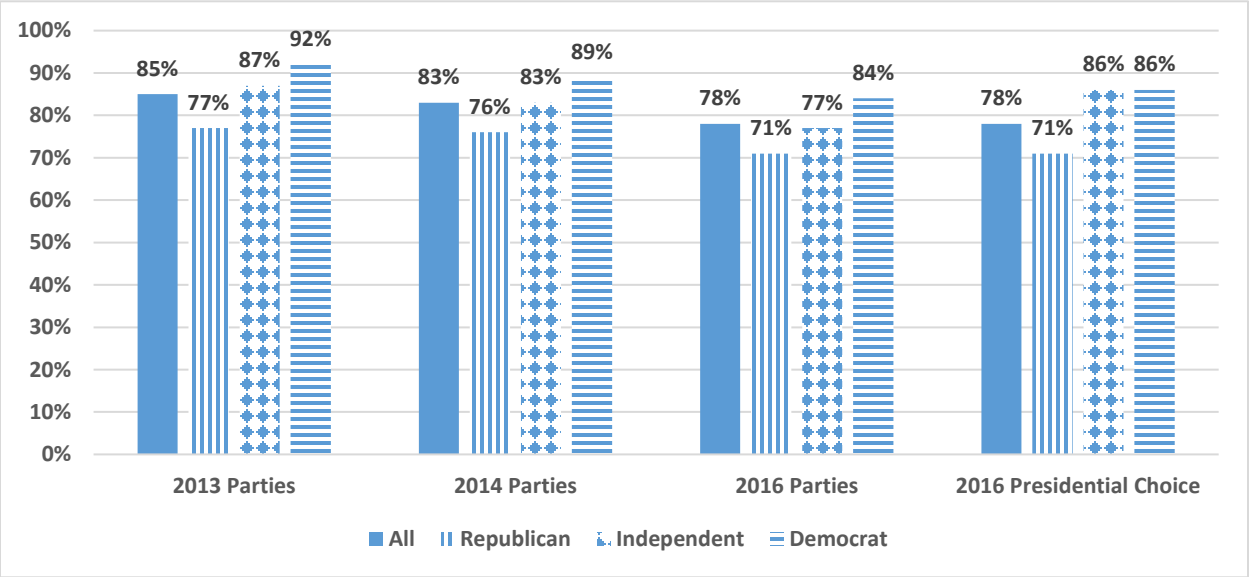
- Support for the standard stood at 81%.

The December 2016 survey analyzed above also reflects this change.

- Support for the standard stands at 76%.

We have occasionally analyzed the issue of support across the political spectrum. The results were similar in the past few years. A large majority supports the standards across the political spectrum with a slight decline in support in recent years, as shown in Figure II-3.

FIGURE II-3: SUPPORT FOR THE CURRENT STANDARD



Source: CFA commissioned public opinion polls conducted by ORC.

III. THE BENEFIT-COST ANALYSIS OF FUEL STANDARDS

A. COSTS AND THE TENDENCY TO DECLINE

The starting point of the analysis is the costs of standards, which has received a great deal of attention from the opponents of standards.[31] Interestingly, they have used the costs estimated by the agencies in their technical and regulatory analyses, with a 3% discount rate. We believe this is the appropriate basis for the analysis, but it is only the starting point.

The costs presented by the agencies are an appropriate starting point because the agencies tend to spend an immense amount of time analyzing these costs, including technology and maintenance. They do not just accept the high costs suggested by industry or the low costs put forward by efficiency advocates. They do independent analysis of costs, frequently engaging in engineering (tear down) studies and reviewing the technical literature, as well as numerous reports from the National Research Council of the National Academy of Sciences.[32] Although, as discussed below, the regulatory agencies still tend to overestimate costs because they do not fully reflect the dynamic, cost-reducing effects of market forces and market-driven innovation, their cost estimates are the best place to start and anchor the analysis.

For the analysis of the costs of past (older) standards, the studies used below end to look to actual market data to estimate costs rather than projections of costs. This may rely on manufacturer price data, consumer expenditure data, or econometric (hedonic) estimates.

In this section, we argue that the strong evidence of overestimation of cost should be recognized in the cost benefit analysis. We recognize that the agencies run multiple scenarios to test the sensitivity of the results to assumptions and frequently apply Monte Carlo statistical tests to assess the likelihood of outcomes. But with strong historical evidence and well-documented economic processes that explain a persistent and systematic pattern, the pattern demands more than just Monte Carlo sensitivity treatment. The outcome is more likely than a random disturbance.

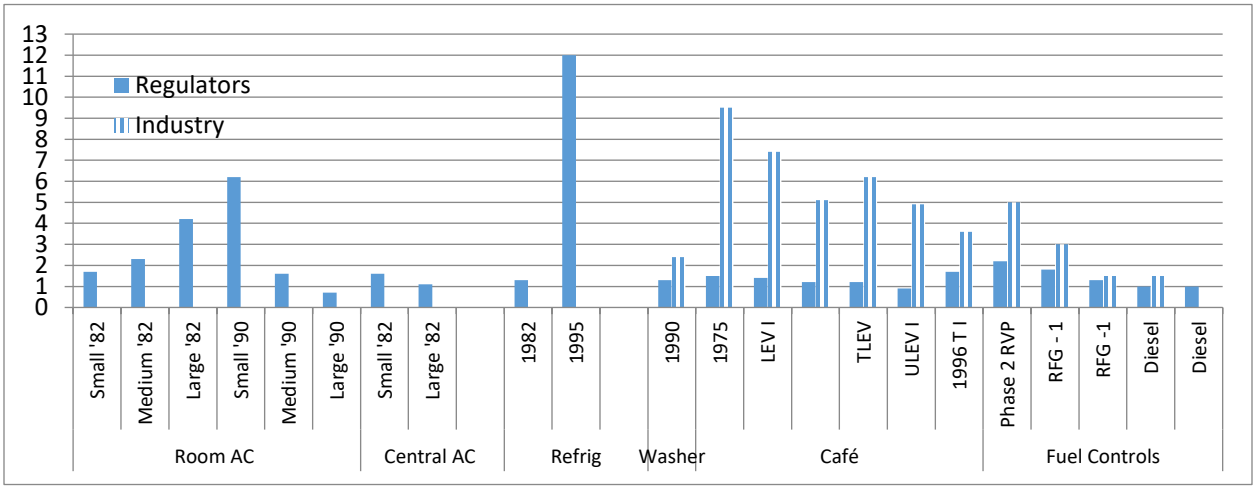
Empirical Evidence of Cost Declines

The consumer pocketbook benefits discussed above are the heart of the evaluation. A key factor that affects the benefit-cost analysis that is not fully included in the agency evaluations involves the tendency for costs to decline. The agencies' tear down analyses endeavor to capture the development of technologies and they have applied learning curves to project cost declines, but the market has proven more dynamic than they estimate.

Policies to reduce the efficiency gap, like performance standards, will improve market performance. By overcoming barriers and imperfections, well-designed performance standards will stimulate investment and innovation in new energy efficient technologies. A natural outcome of this process will be to lower not only the level of energy consumption, but also the cost of doing so. The efficiency gap literature addresses the question of how "learning curves" will affect the costs of new technologies as they are deployed. There are processes in which producers learn by experience to lower the cost of new technologies dramatically.

Figure III-1 shows the systematic overestimation by regulators of the cost of efficiency improving regulations in consumer durables. The cost for household appliance regulations was overestimated by over 100% and the costs for automobiles were overestimated by about 50%. The estimates of the cost from industry were even father off the mark, running three times higher for auto technologies.[33] Broader studies of the cost of environmental regulation find a similar phenomenon, with overestimates of cost outnumbering underestimates by almost five to one with industry numbers being a "serious overestimate."[34]

FIGURE III-1: THE PROJECTED COSTS OF REGULATION EXCEED THE ACTUAL COSTS: RATIO OF ESTIMATED COST TO ACTUAL COST BY SOURCE

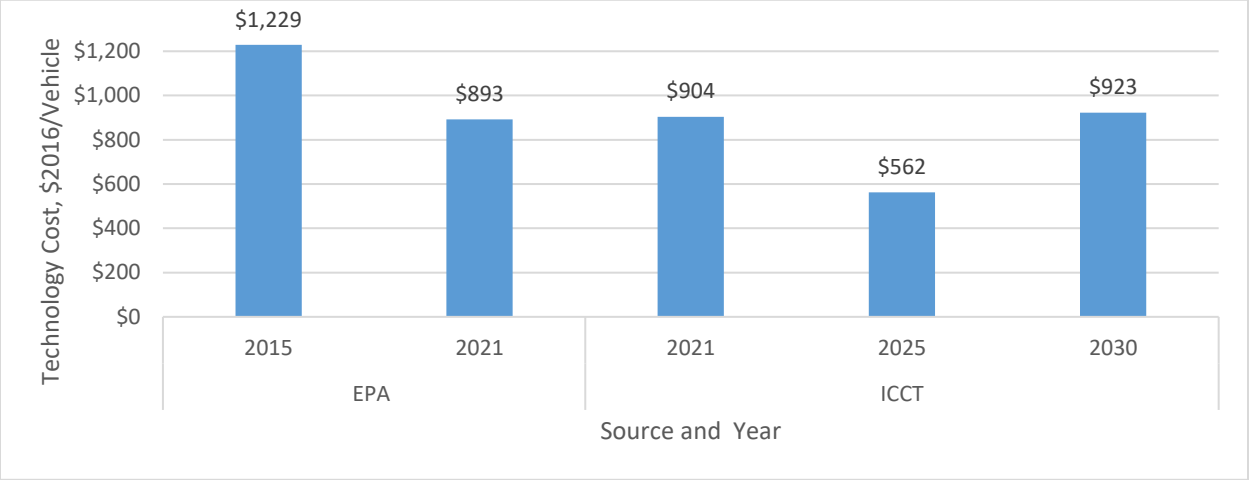


Sources: Winston Harrington, Richard Morgenstern and Peter Nelson, "On the Accuracy of Regulatory Cost Estimates," *Journal of Policy Analysis and Management* 19(2) 2000, *How Accurate Are Regulatory Costs Estimates?,* Resources for the Future, March 5, 2010; ; Winston Harrington, *Grading Estimates of the Benefits and Costs of Federal Regulation: A Review of Reviews,* Resources for the Future, 2006; Roland Hwang and Matt Peak, *Innovation and Regulation in the Automobile Sector: Lessons Learned and Implications for California's CO_2 Standard*, Natural Resources Defense Council, April 2006; Larry Dale, et al., "Retrospective Evaluation of Appliance Price Trends," *Energy Policy* 37, 2009.

EPA's analysis of the National Program demonstrates that this process is continuing to operate with respect to fuel economy standards, as shown in Figure III-2. EPA found that a technology that had not even been considered is likely to have a substantial penetration, driving costs down by over 25%. Looking forward, a recent study from the International Council on Clean Transportation projects an additional 25% decline in the cost of compliance. This is consistent with the broad pattern of earlier research. There may be several factors, beyond an upward bias in the original estimate and learning in the implementation that produce this result, including pricing and marketing strategies.[35]

While the very high estimates of compliance costs offered by the auto manufacturers can be readily dismissed as self-interested political efforts to avoid regulation, they can also be seen as a worst case scenario in which the manufacturers take the most irrational approach to compliance under an assumption that there is no possibility of technological progress or strategic response. A simulation of the cost of the 2008 increase in fuel economy standards found that a technologically static response was 3 times more costly than a technologically astute response.[36]

FIGURE III-2: COST OF EFFICIENCY TECHNOLOGY CONTINUES TO DECLINE



Sources: Environmental Protection Agency and National Highway Traffic 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, Table I-128. Environmental Protection Agency, *Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Emission Standards under the Midterm Evaluation,* January 2017, Table ES-1. International Council on Clean Transportation, *Efficiency Technology and cost Assessment for U.S. 2025-2030 Light-Duty Vehicles,* March 1017, Table 2.

Explanations for the Overestimation of Costs

These findings of declining cost are not merely descriptive. Several analyses have introduced controls for quality and underlying trends using regression techniques. The findings are affirmed in these more sophisticated analyses. With such strong evidence of costs far below predictions by regulators who undertake engineering analysis, many authors have sought to identify the processes that account for this systematic phenomenon. For both vehicles and appliances, a long list of demand-side and supply-side factors that could easily combine to produce the result has been compiled.

On the supply-side, a detailed study of dozens of specific energy efficiency improvements pointed to technological innovation.[37] A comprehensive review of *Technology Learning in the Energy Sector* found that energy efficiency technologies are particularly sensitive to learning effects and policy.[38] This was attributed to increases in R&D expenditures, information gathering, learning-by-doing and spillover effects. Increases in competition and competitiveness also play a role on the supply side. A comparative study of European, Japanese and American automakers prepared in 2006, before the recent reform and reinvigoration of the U.S. fuel economy program, found that standards had an effect on technological innovation. The U.S. had lagged because of the long period of dormancy of the U.S. standards program and the fact that the U.S. automakers did not compete in the world market for sales, (i.e. it did not export vehicles to Europe or Japan).[39]

While the supply-side drivers of declining costs are primarily undertaken by manufacturers, a number of demand side effects are also cited, which are more the direct result of policy. Standards create market assurance, reducing the risk that cheap, inefficient products will undercut efforts to raise efficiency. Economics of scale lead to accelerated penetration, which stimulates and accelerates learning-by-doing. The effects of demand stimulus through

macroeconomic stimulus also grows demand and accelerates innovation. Experiencing increasing economies and declining costs in an environment that is more competitive, leads to changes in marketing behaviors.

The Cost of Increasing Fuel Economy

Estimating the cost of increasing fuel economy has been a matter of great debate for decades. As noted above, empirical analyses that look at actual costs show that regulators overestimate the cost by a factor of two and automakers overestimate it by much more than that.

David Greene, one of the leading expert on fuel economy recently conducted a review of the literature in which he concluded that an estimate of 27% of increased, or about $150 for every mile per gallon improvement was too high. He gave two reasons for this.[40] First, backward looking analysis of cost increases that included used vehicles (as his analysis did), were double counting the cost of increasing fuel economy because the sellers of vehicles were capturing a significant part of the capitalized value of better fuel economy equal to about 20% of the estimated cost of efficiency) in their sales price. This factor alone would lower the estimate to 21.6% of the increase in price or about $120 for each 1 mile improvement in the MPG. Second, real world experience showed that there was a learning process in which costs fell as automakers gained more experience with increasing fuel economy. He suggested that 2% per year was a reasonable estimate. Over the redesign cycle of vehicles (e.g. five years) this learning rate would lower the cost by about 10%. Thus, one might argue that the appropriate numbers would be about 20% per year and $108 dollars per MPG, as shown in Table III-1.

TABLE III-1: HISTORICAL AND ENGINEERING ESTIMATES OF THE COST OF INCREASING MILEAGE

	Greene Literature Review	Simple Adjustment Approach	Greene Direct	EPA Final 2017- 2025	ICCT Estimate for 2025-2030 4.5%/year
Annual Cost	$213	na	$141	$97	$110
% of Total Cost Increase	27%	20%	18%	na	na
$/MPG	$150	$108	$99	$97	$86

Sources: David Greene and Jilleah G. Welch, *The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States*, Oak Ridge National Laboratory and the Energy Foundation, September 2016; David Greene and Jilleah G. Welch, *The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States*: *A retrospective and Prospective Analysis* Oak Ridge National Laboratory and the Energy Foundation, March 2017; Environmental Protection Agency and National Highway Traffic 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, Table I-128. Environmental Protection Agency, *Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Emission Standards under the Midterm Evaluation*, January 2017, Table ES-1. International Council on Clean Transportation, *Efficiency Technology and cost Assessment for U.S. 2025-2030 Light-Duty Vehicles*, March 1017, Table 2.

There is a third factor that is implicit in Greene's analysis. The distribution of the cost of vehicles is skewed. The much more expensive vehicles purchased by upper income households ae likely to include a larger amount of costs incurred to upscale the vehicles, rather than for fuel economy.

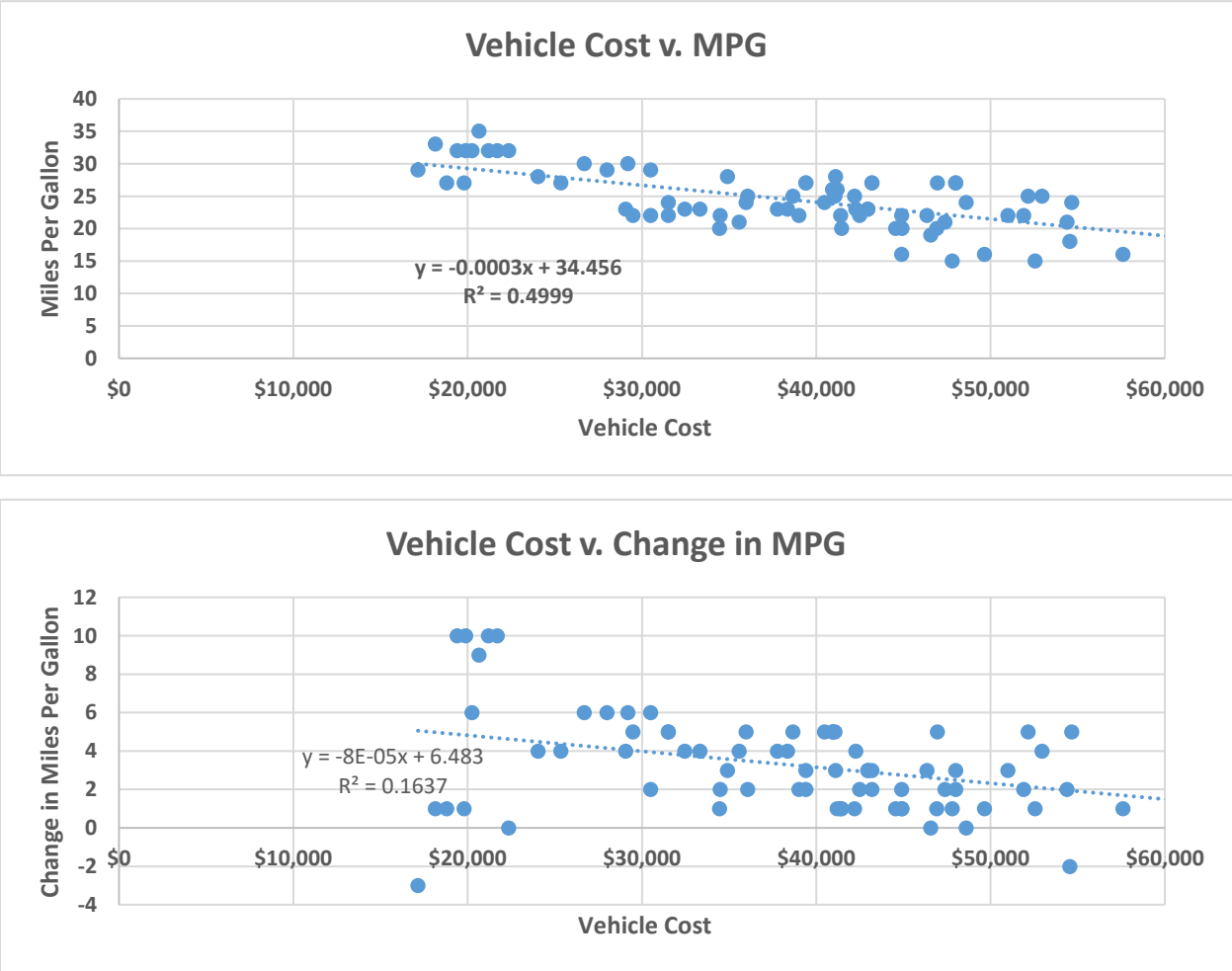
In a subsequent analysis Greene estimated the cost of improving fuel economy directly with an econometric model that corroborated the above concerns. The simple adjustment to a constant 20% of total cost moves the estimate much closer to the empirical evidence offered by

Greene, which suggests that costs that are about two thirds of the literature review—about 18% or $99/MPG.

EPA's analysis of the cost of the National Program currently yield an estimated cost for fuel savings that is similar, $97/MPG. This estimate reflects considerable technological progress over the early years of the National Program, which is consistent with the historical pattern. A recent study by the ICCT offers an estimate of going forward costs of improvement close to the rate of the national program (national program = 3.3%, ICCT = 4% per year). The ICCT study also includes continuing technological progress.

Moreover, our data on new models since the National Program emissions/fuel economy supports the key problem with using a simple percentage of the total cost of the vehicle to approximate the cost of improving fuel economy, as shown in Figure III-3. There is a strong, negative correlation (r = -.7) between the cost of a vehicle and the mileage and a moderate, negative correlation (r= -.4) between the cost of the vehicle and the change in mileage. A fixed percentage makes no sense

FIGURE III-3: VEHICLE COST AND MILEAGE



Source: Appendix B, attached.

In light of this analysis, we believe a cautious estimate of the cost of fuel economy improvements is $100/MPG improvement.

B. BENEFITS

Consumer Pocketbook Savings

In this analysis, we also accept the traditional agency approach to estimating consumer pocketbook savings as the primary benefit of the standards, using the 3% discount. When energy saving technology is added to energy using consumer durables or capital goods, the total amount of energy consumed declines. The decline in operating costs is larger than the capital cost increase, resulting in net pocketbook saving for consumers. As a general proposition, these benefits constitute the majority of the total benefits estimated by the agencies (two-thirds to four-fifths).

For studies of past (older) standards, analysts use actual market data on the energy consumption of the durable goods to calculate the annual savings. They then multiply by the average price of energy in each year (generally stated in constant, real terms) by the level of consumption. In the analysis that follows, all benefits are stated in 2106 dollars and discounted at 3%, to the extent possible.

Pass Through of Intermediate Costs

It is important to recognize that consumers are the primary beneficiaries of all efficiency standards, whether they apply to household consumer durables, or commercial/industrial energy consuming equipment. Just like any other cost, like wages or capital investment, the costs of energy are recovered by businesses from consumers in the prices they charge for goods and services that they sell.[41] We call this the "tooth fairy principle," since the tooth fairy does not pay for the energy consumed in the production and distribution of goods and services, consumers do.

Our analysis shows that the residential sector accounts for about half of the total revenue recovered for the production and delivery of transportation fuels.[42] In econometric studies, these intermediate goods costs are not counted separately, rather they are reflected in the final goods and services. In fact, because energy costs are intermediate, and therefore a cost that is bundled and hidden from consumers, standards may be more necessary in this area, since the ability of demand to influence the energy market is shrouded.[43]

C. THE DISCOUNT RATE

No matter how lofty the goal of policy, the use of the public's money (whether for increased costs for energy consuming durables or to administer programs) to achieve a goal must not only deliver a benefit above the cost, it should also deliver a return at least as large as it could have if put to other uses. This is the opportunity cost of capital which is operationalized as the discount rate in the cost-benefit analysis.

Discounting over long periods of time has the effect of reducing the present value of dollars spent or saved later. However, when costs are incurred and benefits enjoyed over a long

period, the benefit cost ratio is less affected than the total dollar amount. This is particularly true with standards that increase over time, since the marginal cost of later savings are assumed to increase in real terms. At year 15, a discounted dollar is worth $0.66 at 3%, while it is worth $0.38 at 7%. At year 30, which tends to be the time horizon for the analysis, it is worth $0.42 at 3% and $0.14 at 7%. Since later values have less impact, the average value over 30 years is close to the mid-point value, $0.63 at 3% and $0.32 at 7%.

We have frequently argued that the 3% discount rate is the correct discount rate from the consumer point of view. It is a good, perhaps somewhat high estimate of the opportunity cost of consumer capital. It is also one of the anchor points ordered by the Office of Management and Budget (OMB), making it available in all formal agency evaluations.

In this paper, all values are converted to $2016, with BLS Consumer Price Index. All values are discounted at 3%, to the extent possible. For present and near future values, the Technical Support Documents and Federal Register notices provide the basic analysis so only a slight adjustment for the based bear is necessary.

D. REBOUND EFFECT

The studies by regulatory agencies also include a rebound effect. That is, consumers use part of the increase in pocketbook disposable income to do things that consume energy. From the environmental or energy reduction point of view, this is a negative. Energy consumption or emissions of pollutants is more than the simple improvement in efficiency suggests. From the consumer point of view, this is a positive, not a negative. That is, the fact that consumers use some of increased disposable income on energy indicates that they are using it to increase their utility. The rebound numbers (recently put at 10%, which is too high), are embedded in the analysis, and we have accepted them rather than recalculate benefits. Therefore, the rebound effect provides a small (at most 10%) “margin for error” in favor of the standards that will raise the economic benefit-cost ratio because the increase in utility has been incorrectly subtracted from the energy savings.

IV. MACROECONOMIC GROWTH AS A POSITIVE EXTERNALITY OF WELL-DESIGN PERFORMANCE STANDARDS

In this section, we argue that one major externality has been present throughout the history of the energy efficiency standard setting process and should be recognized in rigorous cost benefit analysis. The macroeconomic stimulus that results from efficiency standards is a true externality, which Taylor broadly defined as "the situation in which the cost of producing or the benefits of consuming a good spill over onto those who are neither producing nor consuming the good."[44] These changes are invariably driven by the adoption of the rule and are not likely to be considered by the parties to the transaction.

A. CONCEPTUALIZING THE SOURCES OF MACROECONOMIC STIMULUS

The direct pocketbook savings of efficiency standards are the largest and most direct benefit of the standards, but this benefit has a second immediate and inevitable economic benefit. We have argued for at least a decade that the macroeconomic stimulus that results from shifting consumer spending from energy consumption to other goods and services is substantial. The academic literature supports the proposition that the higher multiplier on consumer disposable income results in an additional dollar of economic stimulus for each dollar of consumer savings.

This outcome reflects three effects. Direct and indirect growth comes from the economic activity (jobs) stimulated by the development and deployment of the energy saving technologies, which occurs directly in the new technologies and indirectly in the firms that supply new inputs for new technologies. Induced growth comes from the fact that the multiplier on energy spending is quite low compared to other activities. As disposable income is shifted from energy consumption to other goods and services, more economic activity is stimulated.

The literature on energy efficiency has a large body of research on the positive impact of reduced energy consumption on economic output. While the economic externalities of energy consumption originally entered the policy arena through the study of the negative recessionary impact of oil price shocks,[45] the positive impact of energy efficiency is becoming widely recognized and consistently modeled.[46] Importantly, the literature now goes well beyond the negative national security and environmental externalities, which are frequently noted in energy policy analysis. The macroeconomic effects of energy consumption and energy savings are important externalities of the efficiency gap.

The analyses cover a wide range of approaches. The qualitative analyses focus on very micro level impacts on individuals and utilities. For example, a recent analysis prepared for the OECD/IEA catalogued the varied positive impacts of energy efficiency, identifying over a dozen specific impacts, see Table IV-1. This list is replicated in several other qualitative analyses. Direct estimates of the non-economic benefits have been estimated at between 50% and 300% of the underlying energy bill savings.[47]

At a more macro and quantitative level, econometric models that use general flows of resources between economic activities have been used to assess the impact of increasing efficiency. In a sense, the coefficients in the macro models are representations of the

relationships in the economy through which the micro level effects flow. No matter the level or approach, the evidence strongly supports the conclusion that there is a positive impact.

TABLE IV-1: MULTIPLE BENEFITS OF ENERGY EFFICIENCY

Area of impact & Specific Benefits
Economic
Provider Benefit & Infrastructure
Energy Prices
Public Budgets
Energy Security
Macro-economic effects
Social
Health
Affordability
Access
Development
Job Creation
Asset Values
Disposable Income
Productivity
Environment
GHG Emissions
Resource Mgmt.
Air/Water Pollutants

Sources: Lisa Ryan and Nina Campbell, *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements* (International Energy Agency, Insight Series 2012), p. 25.

Utility System
Generation
Transmission
Distribution
Line Loss, Reserves
Credit & Collections
Demand Response
Price Effect
Reduced Risk
Avoided Regulatory Obligations & Costs
Reduced Terminations
Reduced Uncollectibles
Participant
Societal Risk & Security
Employment, Development
Productivity, Other economic
Health, Comfort, Bill Savings
O&M, Other resource Savings
Low Income Consumer Needs
Development
Employment
Property Values
Productivity
Societal Non-energy
Electricity/Water Nexus
Air quality
Water Quantity & Quality
Coal Ash & Residuals

Sources: James Lazar and Ken Colburn, *Recognizing the Full Value of Energy Efficiency* (Regulatory Analysis Project, September 2013), p. 6;

Benefit Type	Specific Benefit
Financial (other than energy cost savings)	Water and waste bill savings
	Reduced repaid and maintenance
	Increased resale value
	Improved durability
Comfort	Improved airflow
	Reduced drafts and temperature swings
	Better humidity control
Aesthetic	More attractive windows/appliances
	Less dust
	Reduced mold and water damage
	Protection of furnishings
	Dimmable lighting
Health & Safety	Improved respiratory health
	Reduced allergic reactions
	Lower fire/accident risk (from gas equipment)
Noise Reduction	Quieter equipment
	Less external noise intrusion
Education-related	Reduced transaction costs (knowing what to look for when purchasing equipment; ease of locating products)
	Persistence of savings
	Greater understanding of home operation
Convenience	Automatic thermostat controls]
	Easier filter changes
	Faster hot water delivery
	Less dusting and vacuuming
Other	Greater control over energy use/bills
	Reduced sick days
	Ease of selling home
	Enhanced pride
	Improved sense of environmental responsibility
	Enhanced peace of mind & responsibility for family well-being

Source: Jennifer Thorne Amann, 2006, *Valuation of Non-Energy Benefits to Determine Cost-Effectiveness of Whole-House Retrofit Programs: A Literature Review*, American Council for an Energy Efficient Economy, p. 8.

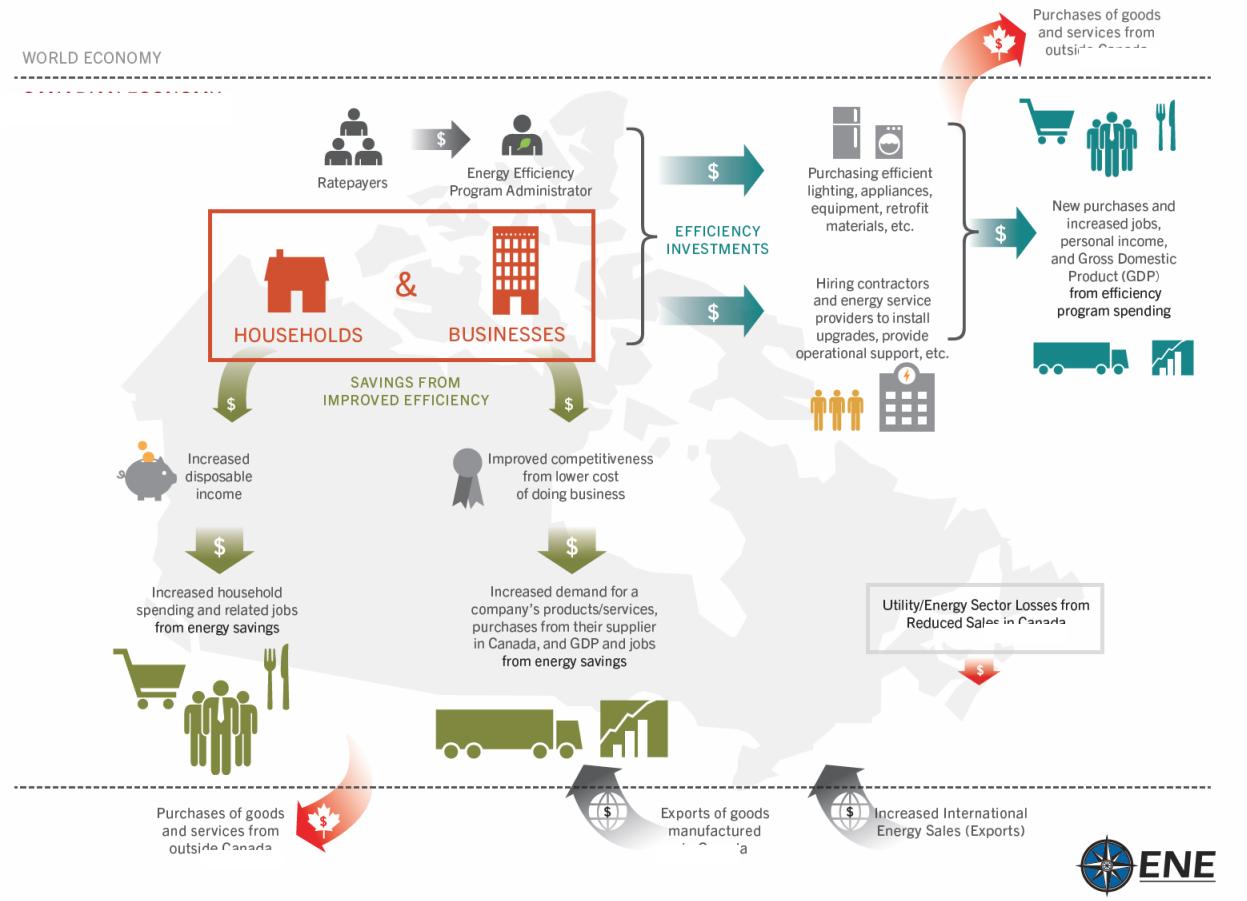
More Goods/Less Bads (in addition to waste & emission reduction)

Operation & Maintenance	Production
Engineering controls	Output
Cooling requirements	Performance
Facility reliability	Process cycles
Wear and tear	Product quality
Labor requirement	Production Reliability
Work Environment	**Other**
Protective equipment	Less liability
Lighting	Public image
Noise	Capital saving
Temperature controls	Space saving
Air quality	Worker Moral

Source: Ernst Worrell, et al., *Productivity Benefits of Industrial Energy Efficiency Measures*, U.S. EPA, December 4, 2001.

Figure IV-1 presents the conceptual framing that describes on of the more frequently used models – the REMI model, which has been repeatedly applied in the U.S. and Canada.

FIGURE IV-1: MACROECONOMIC IMPACT FROM INVESTING IN ENERGY EFFICIENCY



Source: ENE (Acadia Centre),

> Increasingly, research is showing that energy savings from energy efficiency improvements can deliver wider benefits across the whole economy such as increases in employment, GDP, trade balances, energy security, etc.…
>
> One way to look at the macroeconomic impacts is to separate them into:
>
> The cost and effects derived from investing in energy efficiency goods and services, and the effects derived from the energy savings (or reduced costs) from realizing an improvement in energy efficiency…
>
> Increased energy efficiency can lead to more competitive production for 'business consumers" or energy, while for final consumers increased efficiency mainly leads to a demand shift from energy consumption to other goods. For the consuming sectors, it is relatively straightforward to observe how investment in energy efficiency and energy savings can lead to increased spending and economic activity with second round effects such as employment, government revenue, and price effects (if other investment and spending is not crowded out). There are likely to be positive income effects, unless household wage demand increases as the labor supply becomes more competitive.[48]

> Additional investment increases demand in the short-run and reduces energy costs in the long-term. On a regional level, efficiency and renewable measures create additional value added and employment…
>
> Due to the cost-efficiency of measures, additional expenditures and investment will not crowd out other investments or consumption. Energy savings and the decrease in energy costs are fully accounted for in the model…
>
> The direct effect comes from consumption of durable energy efficient goods, but there is a large indirect effect from additional consumption due to energy savings. The reallocation from energy expenditures leads to more employment. Employment rises significantly in the construction sector in industry, adding to the consumption effect.[49]

B. QUANTITATIVE ESTIMATES

In 2010, NHTSA noted one of the important externalities of reduced consumption, the downward pressure on prices, is a consumption externality. Derived from an auto standard, it provides a comprehensive discussion of the macroeconomic benefits that we find in all efforts to apply these models. "Lower prices allow for additional purchase of investment goods, which, in turn, lead to a larger capital stock. These price reductions also allow higher levels of government spending while improving U.S. competitiveness thus promoting increased exports relative to the growth driven increase in imports. As a result, GDP is expected to increase because of this rule.[50]

The EPA reviewed the literature on the macroeconomic impact of reduced energy consumption.[51] It ran econometric models driven by the pocketbook savings. The analysis models three effects on impacts of the rule that trigger adjustments in the economy – increased cost for vehicles, decreased consumption of gasoline, and a reduction in the price of petroleum. It DOTs not model the impact of reduced pollutions (carbon and non-carbon) or other changes (like reduced fueling time). It found a very substantial multiplier effect increasing the GDP by just under 1%, or $340 billion, by 2050. Discounting the incremental growth of the economy at 3%, which is the discount rate used as the base case in this paper, the total is just under $100 billion and it is reached by 2030. This is slightly larger than the total consumer pocketbook savings.

> This combination of effects—price increases for vehicles and lower demand and world oil prices—would impact all sectors of the economy that use light-duty vehicles and fuels as intermediate inputs (e.g., delivery vehicles) to produce final goods. Households would also be impacted indirectly as consumers of final goods, and directly as consumers of fuels and light-duty vehicles.
>
> It is important to note, however, that these potential impacts do not represent additional benefits or costs from the regulation. Instead, they represent the effects on the U.S. economy as its direct benefits and costs are transmitted through changes in prices in the affected markets, including those for vehicles and their components, fuel, and the various resources used to supply them.[52]

The way the memo discusses these impacts, they are an indirect effect of the rule, a genuine externality. This approach has become quite common with detailed analyses of energy

efficiency across a range of activities (autos, appliances, buildings, industries),[53] sectors (e.g. energy, manufacturing, service, particularly as it impacts use of labor)[54] and with a variety of analytic approaches (qualitative, econometric).[55] These efforts to model the economic impact of energy efficiency have proliferated with different models[56] being applied to different geographic units, including states[57] and nations.[58] The results differ across studies because the models are different, the impact varies according to the size of the geographic unit studied and because the assumptions about the level and cost of energy savings differ. These differences are not an indication that the approach is wrong. On the contrary, all the analyses conclude that there will be increases in economic activity and employment. Given that there are different regions and different policies being evaluated, we should expect different results.

The intense interest in jobs since the financial meltdown represents the beginning of the period we refer to as "the present" for the adoptions of standards, regulatory analyses tend to estimate the job impact on the industry. While this narrow view of economic impacts misses the much broader macroeconomic view discussed above, it is notable that the impact on the industry that is the target of the standard tends to be positive.[59] This results in part from the indirect effect – shifting jobs to new technology production within the sector – and in part from the induced effect, since reducing the total (ownership plus operating) cost use goes down, tends to increase demand in the mid and long terms. The energy sector is less than half as labor intensive as the rest of the economy, so the ratio of job creation for efficiency, compared to other production option in electricity is also two to one.[60] This effect is compounded where energy is imported (as in the transportation sector). As consumers substitute away from energy, the goods and services they purchase stimulate economic and disproportionately large job growth.

The rule of thumb – an approximate doubling of the economic impact – that emerges in the literature reflects the observation on jobs.[61] Similarly, in a study of 52 examples of increases in industrial productivity, where benefit was monetized, the productivity savings were 1.25 times as large as the energy savings.[62] Macroeconomic models measuring the outcome in change in GDP yield a "respending" effect that clusters around 90%.[63]

In this analysis, we take a very cautious approach to estimating the induced macroeconomic benefits of efficiency. We apply the multiplier only to the net pocketbook savings. That is, we subtract the technology cost from the savings before we use the multiplier. This ensures that we do not double count the indirect effect, although that might have an induced multiplier effect of its own.

We also do not include a separate impact of the consumption externality, the effect that U.S. consumption has on lowering the market price of energy. In petroleum, this number is substantial. Agencies have estimated it, but not included it in their cost benefit analysis. Where they have presented the calculations, it is equal to about one-fifth of what we call the macroeconomic multiplier.[64] In the appliance sector, this effect has been model by considering the impact that reduced electricity demand has on the price of natural gas.[65]

We do not apply the multiplier to the value of environmental, public health and other externalities. Although these have been monetized in the traditional cost benefit analysis, that monetization DOTs not generally include macroeconomic multipliers. Since it could be argued that these costs are reflected in the model coefficients that are a representation of empirically

observed real world relationships, out of an abundance of caution we do not apply the multiplier to these benefits, which is the traditional approach.

Table IV-2 shows the multiplier, with the GDP impact expressed as a multiplier of the value of net pocketbook savings. That is, we subtract costs from the estimated value of energy savings. This ensures we do not double count benefits.

Since none of these studies take the rebound effect into account, which the regulatory impact analyses subtract from total benefits, we show a multiplier adjusted for the rebound effect. While we have chosen not to add the rebound effect back into the pocketbook savings, it is necessary to add it into macroeconomic effect, since that is essentially what the rebound effect (to the extent there is one) represents, i.e. a respending of savings. To err on the side of caution, we assume the lowest value in the table and set the multiplier equal to the net pocketbook savings.

TABLE IV-2: ESTIMATES OF MACROECONOMIC MULTIPLIERS AS A MULTIPLE OF NET POCKETBOOK SAVINGS

Modeler	Model	Date	Policy Assessed	Region	GDP/$ of Net Savings	
					Base Case	Rebound Adjustment
Roland-Holst	DEAR		Computer Standard	California	1.8	2.0
ENE	REMI		Utility Efficiency	Northeast	2.2	2.4
Cadmus	REMI		Utility Efficiency	Wisconsin	2.5	2.8
Arcadia	REMI		Utility Efficiency	Canada	2.7	3.0

Sources:
David Roland-Holst, 2016, *Revised Standardized Regulatory Impact Assessment: Computers, Computer Monitors, and Signage Displays*, prepared for the California Energy Commission, June. ENE, *Energy Efficiency: Engine of Economic Growth: A Macroeconomic Modeling Assessment*, October 2008. Cadmus, 2015, *Focus on Energy, Economic Impacts 2011–2014*, December. Arcadia Center, 2014, *Energy Efficiency: Engine of Economic Growth in Canada: A Macroeconomic Modeling & Tax Revenue Impact Assessment*, October 30.

V. A COMPREHENSIVE VIEW OF THE BENEFITS OF EFFICIENCY STANDARDS

In the analysis that follows, we include a "pure externalities" view of the cost benefit rules. This consists of two components (macroeconomic effects and environmental, public health and other externalities) that are very unlikely to be internalized in the private transaction of the manufacture sale of an energy using consumer durable. As noted above, one can argue that consumer pocketbook savings are an externality of environmental regulation. In this analysis, we treat it as a direct benefit in of the rule.

Although we identify these separate components of the benefits, we believe that the correct way to view the standards is to start with the consumer pocketbooks savings and traditional externalities and recognize the additional macroeconomic stimulus created by adding new technology and lowering the total cost of owning and operating energy consuming durable goods. We also offer a scenario in which costs are projected to be 70% of the based case assumptions as a separate scenario.

In this section, in laying out our comprehensive approach, we reject several arguments that would narrow the view of the benefits of efficiency standards because the externalities are real.

A. CONSUMER PREFERENCES AND MARKET IMPERFECTIONS

Opponents of regulation take a different view, arguing that, since there are choices in the marketplace, there can be no consumer utility gain from imposing standards. Consumers express their preferences and get what they want. We believe this is wrong on several counts.

First, the outcome in the market is not simply the result of consumer preferences, it is the result of all the forces that affect the options presented to consumers and that weigh on and constrain their choices. Manufacturers determine a narrow range of choices to present consumers and seek to influence consumers, through advertising and incentives, to purchase the vehicles that manufacturers want to sell. Consumer are imperfect in their calculations and projections about fuel usage and prices. Market imperfects matter and cannot be dismissed.

Second, consumers do express a great deal of interest in and concern about energy usage.

Third, more importantly, as noted, once a well-crafted standard is adopted and implemented, it lowers the cost of driving. To the dismay of anti-standard, free market ideologues, and the surprise of consumers who end up with a more fuel-efficient cars than they thought they could get, it puts more money in the consumer's pocket. The inevitable result is to increase disposable income and, under any reasonable assumption, trigger the macroeconomic multiplier effect, which includes the consumption externality that lower prices because of reduced consumption. The environmental and public health benefits of reduced pollution are also realized.

B. TRANSFER PAYMENTS AND ECONOMIC GROWTH

It is possible to argue that the consumer pocketbook savings are just a transfer payment from energy producers to consumers and manufacturers of energy saving technology. As a transfer payment, they might not be considered a net gain for the economy or society.

We disagree with this on two grounds. First, transfers do matter. Manufacturers of energy-using consumer durables are quick to argue distributive effects when it comes to low income households, claiming incorrectly that it prices them out of the market. We think the distribution between consumers and energy suppliers does matter.

Second, if the transfers are not counted, but still recognized, then the macroeconomic effect becomes extremely important. Some uses of disposable income have much larger multipliers than others. Transferring wealth from energy producers to energy consumers has a substantial positive impact on economic growth that should be taken into account.

This categorization and recognition of the broad benefits is not unique to energy efficiency standards. For example, a recent National Academy of Sciences Transportation Research Board report prepared for the Transit Cooperative Research Program, entitled, *Practices for Evaluating the Economic Impacts and Benefits of Transit,* noted that "Because of shifting demands and constrained budgets, transit agencies have an increasing need to consistently and defensibly document the economic impacts and benefits of the services they provide."[66] The report identifies direct and indirect benefits that are akin to those discussed in this section.

> Two primary forms of economic analysis are discussed in this report:
>
> *Impacts on the economy* – most often referred to as "economic impacts" or "economic development impacts," which encompass effects on jobs and income: and
>
> *The economic valuation of broader societal benefits* – sometimes referred to as "social welfare," benefits which encompass the valuation of "non-user benefits" (affecting quality of life, environments, and productivity) in addition to user benefits….
>
> Economic impact = the study of the net change in economic activity (jobs, income, investment or value added) resulting from a project, event, or policy.
>
> Economic valuation of societal benefits = the social welfare value of prices ($) and non-prices (non-$) benefits associated with a project, policy or event. The non-priced benefits are assigned a valued based on revealed or stated preference methods. [67]

This quote includes all the impacts we have identified and the approach to valuing them. We agree they are the building blocks of a comprehensive and rigorous benefit-cost analysis.

C. WILLINGNESS-TO-PAY

Willingness-to-pay studies that address the core issue in benefit-cost analysis – valuing benefits – have been prominent in the benefit-cost literature and extensively criticized for underestimating the value of public policies that correct market imperfections.[68] The willingness-to-pay observed in survey analysis and derived as implicit through econometric

analysis reflect opinions and decisions offered or made by individuals in the context of all the imperfections that afflict the market. They reflect the market structure the policy is intended to correct more than the "true" value of correction, as shown in Table V-1. The problems with willingness-to-pay analysis are not limited to survey (contingent valuation) based studies. They also apply to econometric studies that base their estimates on econometrically identified implicit willingness-to-pay.

TABLE V-1: QUESTIONS ABOUT THE CONCEPT OF WILLINGNESS-TO-PAY

Conceptual Problems
Individual
Lack of (sufficient & appropriate) information
Willingness v. Capacity to pay
Inherent discrimination (value)
Risk aversion
Marginal v. average
Respondent Characteristics
SES
Experience v. Hypothetical
Market Structure
Information asymmetries
Availability in market
Aggregation of preferences
Lack of competition
Externalities
Positive effects
Importance of public (social) value

Methodological Problems
Internal and External validity
Representativeness
Variability
Generalization
Surveys
Questions
Order & presentation of
Open v. Closed
Provision of information
Response sets
Choice Set
Emphasis on costs, not benefits

Sources: Benjamin Leard, et al., 2017, *How Much Do consumers Value Fuel Economy and Performance? Evidence from Technology Adoption*, Brookings Institution, June; David Green, et. al., 2017, *Consumer Willingness to Pay for Vehicle Characteristics: What Do We Know?*, March; Mark Sagoff, What does willingness to pay measure/" University of Maryland; Frank Ackerman,, 2008 *Critique of Cost-Benefit Analysis, and Alternative Approaches to Decision-Making*, Report toe Friends of the Earth Engaln,, Wales and Northern Ireland; , Joaquin F. Mould Quevedo, et al., "The Willingness-to-Pay Concept in Question," Rev. Sauide Publica: 43(2), for health care.

A recent study from Resources for the Future provides a lens to identify some of the key concerns.[69] It advances the art significantly, but leaves many of the underlying issues unaddressed. RFF finds a substantial "efficiency gap" based on a hedonic analysis that puts the willingness to pay at just $0.54 on the $1.00. It goes on to argue that the welfare gain of increased fuel economy created by increasing fuel economy standards is offset by lost value of performance.

The argument is that, even though the pocketbooks of consumers have more money as a result of the standards, they would have preferred to have the increased performance (horsepower/weight). The study concludes that the gain from fuel economy is offset by the loss in performance. In a sense this is an encouraging result, since all of the public benefits are "free." The authors recognize that this analysis does not take into account the social value of

reduced fuel consumption in terms of improved national security, pollution reduction, and climate change. The welfare value of these benefits could be significant.

The analysis also does not take into account the welfare value of the good and services consumers purchase with the increased disposable income that fuel economy standards create. Since they cannot spend their money on more performance and they have more money in their pockets, they spend it on other things. The multiplier still operates.

There is also a sense in which the analysis conceptually begs the question. The analysis ignores the fundamental problem – it assumes no market failure. The preferences reflect the market imperfections, the restricted choices the automakers choose to offer and the distorted choices consumers make, given the limitations on their time and ability to search and calculate. The specific market imperfections not considered include induced innovation, insufficient incentives for innovation, imperfect competition, the interaction between new and used vehicles, and transitional dynamics.[70] As is typical of these studies, the supply-side does not play a key role in determining the outcomes observed in the marketplace.[71]

Of equal, if not greater importance are empirical and measurement questions. The study appears to derive an implicit cost per MPG of about $300, engineering estimates are less than $100. Although it has tried to capture the impact of other "quality" factors, it has failed. Given the value of pocketbook savings in the study, adjusting the cost of fuel economy would double it, meaning that the performance preference is half the fuel economy value. Of course, consumer might be overestimating the cost of fuel economy, which would be a market imperfection that the standards could correct.

The study may have overestimated the value placed on performance. The authors note that automaker behavior is inconsistent with their theoretical approach, in that under their assumptions the automakers should not trade off fuel economy for performance, absent the standard[72]. There is clear evidence that they did. A quick look at trends in fuel economy and horsepower suggests that attitudes may have changed (see Figure V-1). Declining marginal value of going faster at 0-60 mph and a shift in attitudes highlights one of the great weaknesses of willingness to pay analysis – whose willingness and under what circumstances.

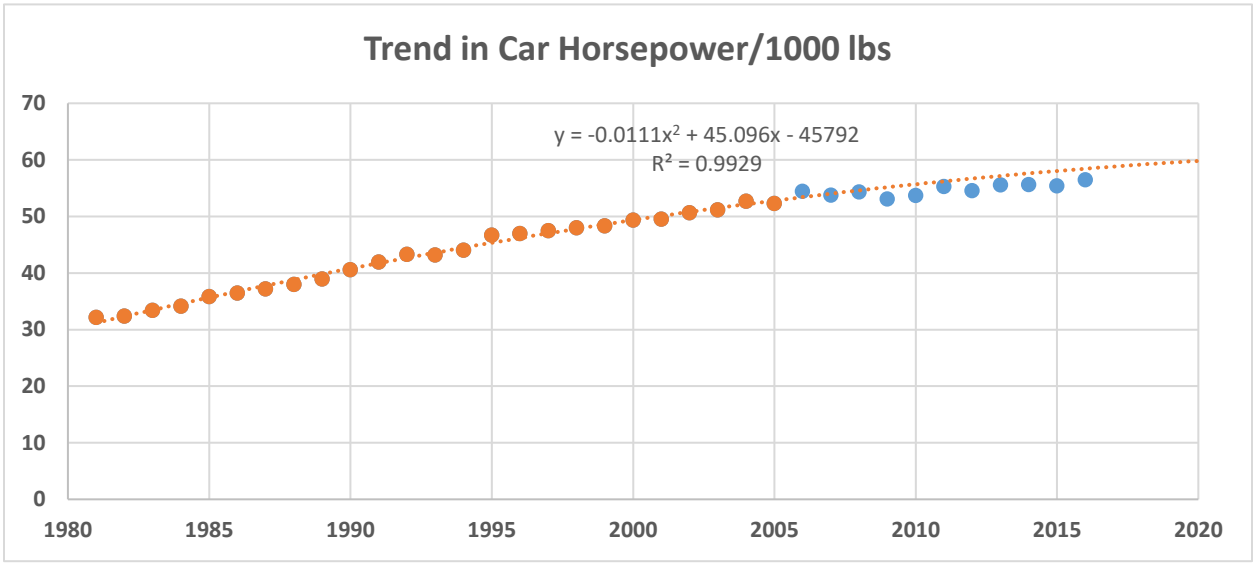
D. THE PUBLIC IS NOT AS ENAMORED OF GASOLINE POWERED MUSCLE CARS AND TRUCKS AS THE AUTOMAKERS CLAIM.

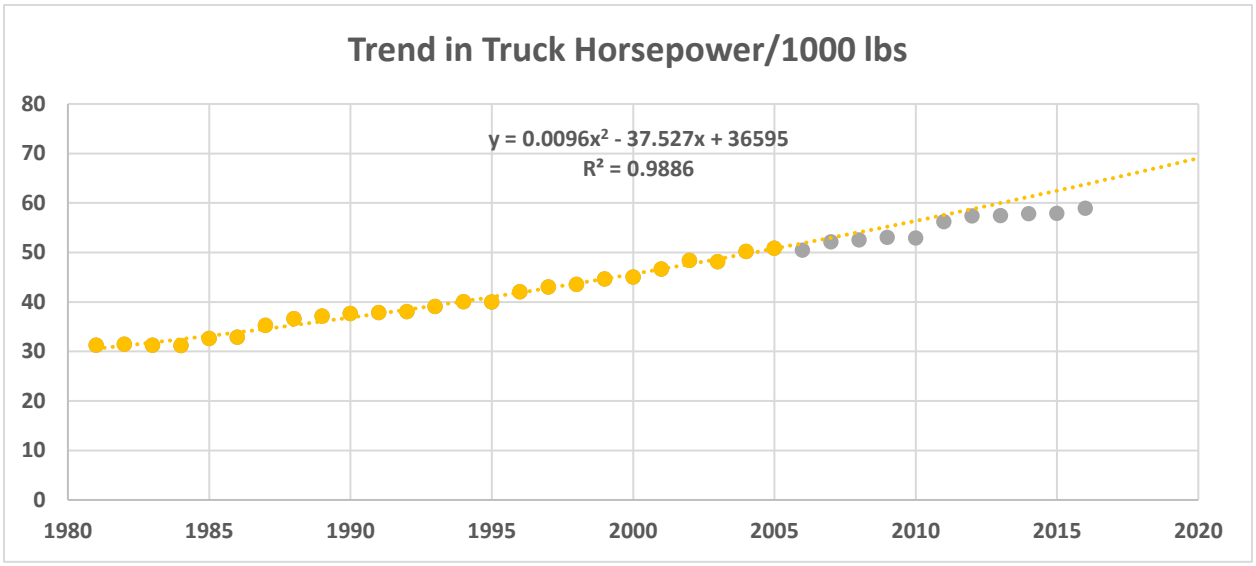
The automaker spend a great deal of time complaining about policies to promote electric vehicles (EVs), claiming they will drive up the cost of the National Program. We have shown that the EV program will have little impact on the cost of compliance for three reasons.

First, electric vehicles are projected to make up a very small part of the fleet in the targeted compliance period.

Second, the cost of electric vehicles is plummeting, with a number of cost-competitive, consumer-friendly vehicles planned for the market long before the compliance period.

FIGURE V-1: TRENDS IN PERFORMANCE INCREASES





Source: EPA, 2016, Trends Report, 2016, pp. 26-27, Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016, November,

Third, as frequently happens in efficiency programs, the cost of compliance declines as producers learn and volumes rise. This is the powerful intersection of "command but not control" regulation and the market forces on which it relies.

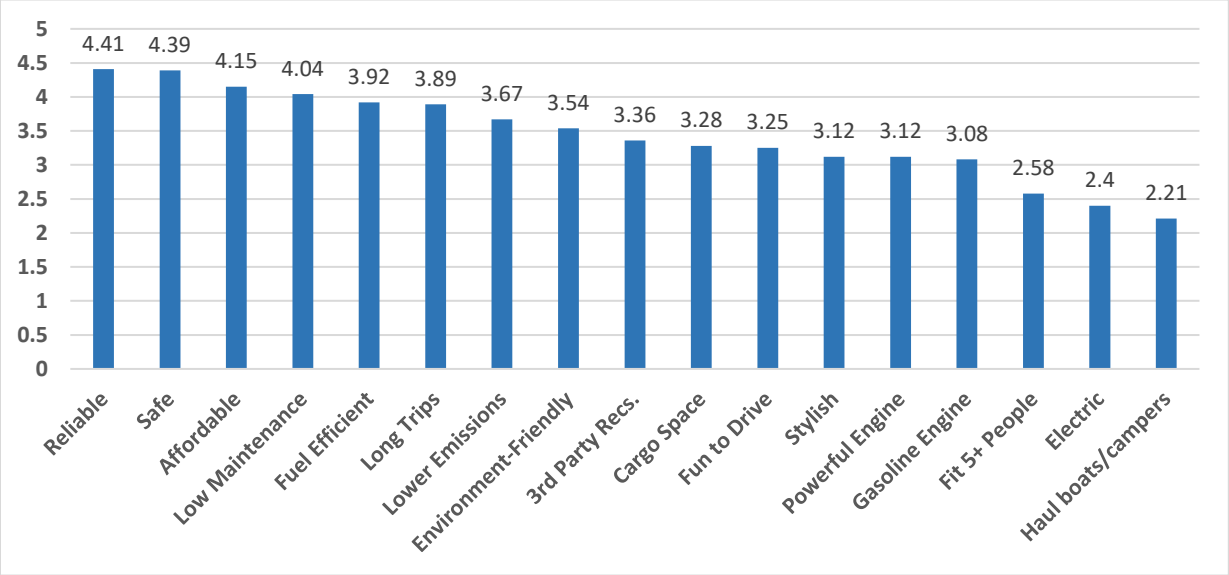
As we pointed out during the House hearing, this was the experience with hybrid vehicles. California's leadership in the LEV program created the global market for those vehicles. With respect to EV's, the global market is rapidly emerging. In this case, California's leadership will help to ensure that the U.S. automakers are not left behind.

Moreover, the automakers' survey evidence does not support their claim. If an EV and gasoline vehicle were matched on cost and travel length,[73] more would prefer the electric vehicles (48% to 43%) and a clear majority (57%) are willing to pay more for an electric vehicle.

As Figure V-2 shows, the analysis of desirable vehicle attributes shows that consumers want reliable, safe, affordable and low maintenance vehicles.[74] There is no reason to believe that fuel efficient gasoline engines or electric vehicles (EVs) cannot fill the bill and automakers are working hard to achieve that goal.

As Figure V-2 shows, after the big four attributes, respondents care as much about fuel efficiency as the ability to take long trips and the automakers are working on that too. Beyond these big six attributes, the valuation of others falls off, but even here the message for EVs is positive. Environmental impacts rank a lot higher (8th and 9th) than powerful engines (13th) or engine type (gasoline power =14th, electricity = 16th). Fitting more than 5 people (15th) or hauling boats and campers don't matter much (ranks dead last). If you watch the TV ads and go into the showrooms, you would have to conclude that the automakers are pushing the wrong vehicles.

FIGURE V-2: ALLIANCE OF AUTOMOBILE MANUFACTURERS, VEHICLE ATTRIBUTE SURVEY



Source and Notes: Mitch Bainwol, President and CEO, Alliance of Automobile Manufacturers, *Consumers & Fuel Economy,* CAR Management Briefing Seminars, Traverse City, Michigan, August 2016, p. 10. The winter related question, specific to the North East, has been discarded. It would rank 12th of 18, low in California, high in New England).

The analysis of our most recent public opinion poll discussed in Section II, reinforces the thrust of this discussion in two respects. First, fuel economy is an important consideration for the majority of respondents. Second, it is driven to some extent by concerns about externalities that are notoriously difficult to quantify for consumers. The engineering/pocketbook analysis should remain the primary basis on which regulatory impact analysis rests.

VI. QUANTITATIVE ANALYSIS

In this section, we discuss the costs and benefits of four decades of fuel economy standard (see Table VI-1). We discuss the basic methodological approach to the analysis first. We then discuss the results in chronological order and start with the traditional benefit- cost factors.

A. EVALUATION METRICS AND OVERVIEW

Benefit/Cost Ratios: Since the agencies report the costs and pocketbook benefits, it is straight forward to estimate the benefit cost ratios.

B/C = (Units Saved * $ per unit)/ ($ per appliance* number of vehicles) =$ benefits/ $ costs

Each of the variables in this equation are estimates that are subject to uncertainties. The agencies engage in extensive technical analysis and utilize numerous sensitivity cases to build confidence in their results. We use their preferred or base case for our analysis.

Cost of Saved Energy: We have long argued that the cost of saved energy (which is frequently calculated in the academic literature on efficiency)[75] is a second, intuitive evaluation metric. Since the agencies identify all the technology costs (initial capital and additional maintenance) and the physical quantity of energy saved, it is possible to calculate the cost per unit of saved energy. The proposition is simple, if a consumer must spend X-$ to save Y-kWh of electricity, the cost per kWh saved can be calculated as

Cost of Saved Energy = $ Cost of Technology/# of kWh saved = $/kWh.

Using discounted, real costs and physical quantities provides an estimate that can be compared to the current, or excepted cost of consuming energy. Given that the efficiency investment brought about by the standards is highly beneficial, the cost of saved energy tends to be far below the cost of consumed energy. This view helps to understand how "bullet proof" the standards are in the sense that they are not dependent on projecting the future price of energy. That is, the real cost of consumed energy would have to fall to very, improbably low levels to make the standards a bad deal from the consumer point of view.

Payback periods: More recently, agencies have begun to show simple payback periods. While we believe that these are important from the consumer point of view, there are few examples of these. Those that have been done indicate attractive paybacks. Given the benefit cost ratios across the studies, they are generally less than half of the life the durable good. In some cases, where investments are financed, cash flow is positive in the first year.

Each of the metrics involves assumptions, about costs and some involve assumptions about the value of benefits. In this analysis, we report the benefit/cost ratio and the comparison between cost of saved energy and the current cost of consumed energy. The sources and notes identify the source of the estimates and any features of the analysis that deviate from the basic assumptions discussed earlier.

TABLE VI-1: EVALUATION OF EFFICIENCY STANDARDS, PAST, PRESENT AND FUTURE

Type of Durable Good	Period (Source) (Discount rate, 3% exceptons noted)	Cost & Benefits Type	$2,016 Billions at 3% discou (except as Noted)	Evaluation of Standard Benefit/ Cost Ratio (b/c)	*b/c @ 70% of Cost*	Resource Value Cost of Saved Energy $/Gallon Gasoline	Cost of Consumed Energy $/Gallon Gasoline	Value of other externalities Primarily Envirionmental $2016, billions	b/c	Externalities Macro-econ + Enviro/Health b/c	*b/c @ 70% of Cost*	Total benefits b/c	*b/c @ 70% of Cost*
Past													
Light Duty Vehicles	980-2014 (Greene & Walsh) 6%	Technology Cost	$499										
		Pocketbook Savings	$2,121	**4.25**								**4.25**	
		Macroconomic Benefits	$1,622	3.25									
		Total Economic Benefit	$3,743	7.50								**7.50**	
Present													
Light Duty Vehicles	2008-2011 (NHTSA, TSD)	Technology Cost	$9			$1.11	$2.47						
		Pocketbook Savings	$27	**3.00**	*4.29*			$6	**0.67**			**3.67**	*5.24*
		Macroconomic Benefits	$18	2.00	*2.86*					2.67	*3.81*		
		Total Economic Benefit	$45	5.00	*7.14*							**5.67**	*8.10*
	2012-2016 (EPA/NHTSA, TSD)	Technology Cost	**62**										
		Pocketbook Savings	$182	**2.94**	*4.19*			$41	**0.66**				*0.00*
		Macroconomic Benefits	$120	1.94	*2.76*					2.60	*3.71*		
		Total Economic Benefit	$302	4.87	*6.96*							**5.53**	*7.90*
	2017-2021 (National Program, NHTSA)	Technology Cost	$47			$0.88	$2.47						
		Pocketbook Savings	$192	**4.09**	*5.84*			$48	**1.02**			**5.11**	*7.29*
		Macroconomic Benefits	$131	**2.78**	*3.97*					3.80	*5.43*		
		Total Economic Benefit	$323	**6.86**	*9.80*							**7.88**	*11.26*
Heavy Duty Trucks	Present, Phase I (EPA, NHTSA)	Technology Cost	$9			$1.07	$2.70						
		Pocketbook Savings	$56	**6.22**	*8.89*			$6	**0.67**			**6.89**	*9.84*
		Macroconomic Benefits	$47	5.22	*7.46*					5.89	*8.41*		
		Total Economic Benefit	$103	11.44	*16.35*							**12.11**	*17.30*
Near Future													
Light Duty Vehicles	2022-2025 (EPA Determination, CFA Suporting)	Technology Cost	$36			$0.75	$2.47						
		Pocketbook Savings	$92	**2.56**	*3.65*			$41	**1.14**			**3.69**	*5.28*
		Macroconomic Benefits	$56	**1.56**	*2.22*					2.69	*3.85*		
		Total Economic Benefit	$148	**4.11**	*5.87*							**5.25**	*7.50*
Heavy Duty,	Phase II (EPA, NHTSA CFA Supporting)	Technology Cost	$29										
		Pocketbook Savings	$163	**5.62**	*8.03*	$0.33	$2.70	$66	**2.28**			**7.90**	*11.28*
		Macroconomic Benefits	$134	**4.62**	*6.60*					6.90	*9.85*		
		Total Economic Benefit	$297	**10.24**	*14.63*							**12.52**	*17.88*
Far Future													
Ligth duty Vehicles	2025-2030 (ICCT Adapted)	Technology Cost	$39										
		Pocketbook Savings	$117	**3.00**				$52	**1.33**	2.92	*4.18*	**3.00**	*4.29*
		Macroconomic Benefits	$78	1.59									
		Total Economic Benefit	$195	4.59								**4.59**	*6.56*
Heavy Duty,	Alt. 5 Increment (EPA, NHTSA)	Technology Cost	$24										
		Pocketbook Savings	$66	**2.28**	*3.26*	$0.33	$2.70	$27	**1.12**			**3.40**	*4.86*
		Macroconomic Benefits	$42	**1.45**	*2.07*					2.57	*3.67*		
		Total Economic Benefit	$108	**3.73**	*5.33*							**4.85**	*6.92*

Sources and Notes

Past: Light Duty Vehicles: This estimate is based on David Greene and Jilleah G. Welch, The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States, Howard Baker Center for Public Policy, January 2017. A slight period of overlap between past and present is subtracted based on the NHTSA estimate of 208-2012.

Present: Light Duty Vehicles: These are from the Technical Support Documents. Here we use the Federal Register Notice with the EPA economic analysis, since EPA separated out pocketbook (fuel) and other benefits. The inflator to bring the estimates to 2016 is 1.1.

2008-2011:https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/2006_friapublic.pdf
2012-2016: https://nepis.epa.gov/Exe/ZyPDF.cgi/P1006V2V.PDF?Dockey=P1006V2V.PDF
2017-2025: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100F1E5.PDF?Dockey=P100F1E5.PDF

Heavy Duty Trucks: The first standard for heavy duty trucks adopted as a result of the Energy Independence and Security Act. Taken from the Technical Support Document: Phase I: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EG9C.PDF?Dockey=P100EG9C.PDF, In the Technical Assessment Report (TAR) and the Final Determination, EPA projects substantial cost reductions from the original Technical Support Document for the National Program. The current incremental cost estimate is almost 20% lower than the original incremental cost for 2022-2025. Taking a cautious approach for this analysis, we assume that the cost decline represents a 10% decline in the 2025 costs (assuming no cost overestimation in the 2017-2021).

Near Future: Light Duty Vehicles: These are from the Technical Support Documents in the mid-term review. TAR: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100OXEO.PDF?Dockey=P100OXEO.PDF Final Determination:

Heavy Duty Trucks: These are from the Technical Support Documents: Phase II: https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf
Far Future: Light Duty Vehicles: This is based on a comparison of the ICCT projections for the five years between 2025-2030 to the analysis of the 2022-2025 period in the mid-term review. We use a 4.5% improvement scenario (the average of the ICCT 4% and 5% scenarios) because EPA discusses a 4.5% scenario for going forward in the mid-term review. The ICCT cost numbers are 10% higher and the savings rate 10% lower, compared to the EPA analysis, which seems reasonable given the movement up the supply curve for efficiency technology and the short period of time covered. ICCT: Nuc Lutsey, et al., *Efficiency Technology and Cost Assessment of U.S. 2025-2030 Light Duty Vehicles,* March 2017.

Heavy Duty Trucks: This is based on the Regulatory Impact Assessment of the Phase II Heavy Duty Truck Rule. We use the difference between the most stringent alternative considered and the final rule.

In Table V-1 we have highlighted the key results. The traditional factors included – consumer pocketbook and traditional externalities are in bold. The "pure externalities" view that adds the macroeconomic and traditional externalities are underlined. The total benefits view, which combines the pure externalities and consumer pocketbook benefits are bold and underlined. The view that assumes costs are only 70% of the regulatory estimate is in italics. We do not apply this view to the past standards, since those costs are estimated directly from experience.

The results of the analysis in Table VI-1 send a loud and clear message, which explains the strong public and bipartisan support for efficiency standards.

- Over forty years, past, present, and future, the consumer pocketbook savings of fuel economy standards have far exceeded the cost of technology.
- The cost of saved energy is generally between one-third and one-half of the current cost of consuming energy.
- Macroeconomic benefits generally run between two and four times the cost.
- The environmental, public health, and other externalities equal between two-third to100% of the costs.
- Thus, the "pure externalities" are between three- and five- times the cost.
- Total benefits are generally six times or more the cost.

B. BENEFIT-COST ANALYSIS BY PERIOD

Past Standards

The backward-looking evaluations of the broad impact of past standards are quite different than the technical support analyses that evaluate current and future standards, but they reach similar conclusions and support the methodology used for projections. The studies examine the units shipped, prices paid and the efficiency of specific products. They tend to use a higher discount rate than the one we use, but it is extremely difficult to adjust their findings, so we have only inflated the dollar amounts to state all costs and benefits in terms of 2016 dollars. The actual benefits would be higher with lower discount rates.

We do not have a means to readily assess the other externalities over this long period. However, even without an estimate of the environmental benefits, which are certainly substantial, as the analysis of vehicle standards in later years shows, the standard is clearly beneficial. This is true, even in the externalities only view because the very large pocketbook benefit drives a very large macroeconomic benefit is so large.

The backward looking analysis of the auto standards shows strong economic benefits. The dollar values are extremely large, with consumer pocketbook savings of $2.1 trillion and macroeconomic benefits of $1.3 trillion. The benefit-cost ratio for consumer pocketbook savings is 4.25-to-1. Consequently, the macroeconomic benefit is also larger, with a ratio of 2.6-to-1. The analysis of pocketbook savings for gasoline put the impact at the household level at savings of $20,000. Over 35 years, the savings work out to about $600 per household per year.

Present Standards

For present standards that do not appear to be under threat at present we see consumer pocketbook savings of close to $500 billion and macroeconomic benefits of over $300 billion, with light duty vehicles accounting for seven-eighths of those gains. Environmental benefits are about $120 billion. Costs are just under $120 billion. Thus, the overall benefit of about $900 billion are over eight times the cost. If costs follow their historic pattern of decline through the implementation phase, the benefit-cost ratio would be over 10-to-1.

Future Standards

We divide the future into two periods. The standards in the near future appear to be the targets of attack by the Trump Administration. Longer term standards that could advance fuel economy are also at risk in the new regulatory environment.

Future standards that are at risk are projected to deliver over $400 billion in pocketbook savings and $260 billion in macroeconomic benefits, for a total of close to $700 billion. Environmental, public health benefits and other benefits would add almost $200 billion for a total close to $900 billion. The projected cost is just over $125 billion, for a benefit cost ratio over seven-to-one. If costs follow their historic pattern, the benefit-cost ratio would be above 10-to-1.

C. CONCLUSION

Every present and near future fuel economy standard passes the benefit cost test either on the consumer pocketbook test or the externalities test standing alone. The statistics demonstrate that these standards are equally attractive from the consumer and the societal point of view.

Economic theory provides a clear explanation for this large benefit-cost ratio in the combination of significant, persistent market imperfections that are addressed by well-crafted, "command-but-not-control," performance standards. We believe the strong public and bipartisan support for these programs reflects their positive economics, which should also inform policymakers and regulatory agencies in their regulatory "reform" endeavors. Reductions of regulatory burdens that do not increase net benefits should be rejected.

ENDNOTES

[1] 82 Fed. Reg. 24582 (May 30, 2017).While the RFI is narrowly styled in terms of infrastructure projects, the notice makes it clear that comments will broadly impact the DOT thinking on regulatory reform. (p. 26735), In EO 13771 and EO 13777, President Trump directed agencies to further scrutinize their regulations. The review described in this notice will supplement the Department's periodic regulatory review and its activities under EO 13771 and EO 13777. Unlike those activities, this request for input is narrowly focused on identifying and addressing impediments to the completion of transportation infrastructure projects. The comments that DOT receives in response to this notice will inform those other, broader activities." We believe it is important for the agency to have the broad terrain of regulatory reform in view.

[2] Id., Acknowledging the Superior Force of the Law and Executive Orders in force.

[3] Office of Management and Budget, Memorandum For: Regulatory Policy Officers at Executive Departments and Agencies and Managing and Executive Directors of Certain Agencies and Commissions, May 5, 2017, states "Agencies should continue to comply with all applicable laws and requirements. In addition, EO 12866 remains the primary governing EO regarding regulatory planning and review. Accordingly, among other requirements, except where prohibited by law, agencies must continue to assess and consider both the benefits and costs of regulatory actions, including deregulatory actions, when making regulatory decisions, and issue regulations only upon a reasoned determination that benefits justify costs."

[4] The Administrative Procedure Act (APA), Pub.L. 79–404, 60 Stat. 237, establishes the nature of judicial oversight over rulemaking agencies (https://en.wikipedia.org/wiki/Administrative_Procedure_Act_(United_States). The APA requires that in order to set aside agency action not subject to formal trial-like procedures, the court must conclude that the regulation is "arbitrary and capricious, an abuse of discretion, or otherwise not in accordance with the law." However, Congress may further limit the scope of judicial review of agency actions by including such language in the organic statute. To set aside formal rulemaking or formal adjudication whose procedures are trial-like, a different standard of review allows courts to question agency actions more strongly. For these more formal actions, agency decisions must be supported by "substantial evidence" after the court reads the "whole record", which can be thousands of pages long. Unlike arbitrary and capricious review, substantial evidence review gives the courts leeway to consider whether an agency's factual and policy determinations were warranted in light of all the information before the agency at the time of decision. Accordingly, arbitrary and capricious review is understood to be more deferential to agencies than substantial evidence review. Arbitrary and capricious review allows agency decisions to stand as long as an agency can give a reasonable explanation for its decision based on the information it had at the time. In contrast, the courts tend to look much harder at decisions resulting from trial-like procedures because those agency procedures resemble actual trial-court procedures, but Article III of the Constitution reserves the judicial powers for actual courts. Accordingly, courts are strict under the substantial evidence standard when agencies acts like courts because being strict gives courts final say, preventing agencies from using too much judicial power in violation of separation of powers.

[5] The Energy Policy Conservation Act was signed by a Republican president and had large majorities in both houses of congress. In fact, eight of the nine major pieces of legislation that effect the energy efficiency of consumer durables were signed by Republican presidents. Both the House and the Senate have voted overwhelmingly in favor of these laws (14 times in all) with over 85 percent voting in favor.

[6] CFA has argued this throughout its regulatory interventions, starting with fuel economy standards () and ending, most recently and explicitly in comments on EPA's final determination in the National Program for light duty vehicles ()

[7] CFA emphasized this throughout our regulatory interventions, see note 1. The issue was formally recognized in the National Program rule.

[8] Results of over a dozen national random sample public opinion polls are among the 140 pieces of research to be found at the CFA website (http://consumerfed.org/issues/energy/)

[9] The Executive Orders cited in the RFI combined with the use of the Congressional Review Act, a dozen times within a year, compared to once, in the previous twenty, constitute an unprecedented attack.

[10] In addition to the comments, testimony and reports listed on the CFA web site, CFA has presented a comprehensive analytic framework and literature review to the California Energy Academy (Mark Cooper, 2014, *Energy Efficiency Performance Standards: Driving Consumer and Energy Savings in California.* Presentation at the California Energy Commission's Energy Academy, February 20, 2014; 2013; *Energy Efficiency Performance Standards: The Cornerstone of Consumer-Friendly Energy Policy*, Consumer Federation of America, October 2013).

[11] The comprehensive literature review has been updated to include over 400 peer-reviewed papers published in the past 10-years that provide the conceptual and empirical foundation for understanding the market imperfection that policy can address to deliver substantial net benefits to consumers and society (see Appendices II and III in Mark Cooper, *The Political Economy of Electricity: Progressive Capitalism and the Struggle to Build a Sustainable Sector* (Santa Barbara, Praeger, 2017).

[12] We have identified these characteristics in the study of standards in a broad range of goods not limited to energy consuming durables (including light duty vehicles, heavy duty trucks, to gas furnaces) but also other goods computers and services (see Mark Cooper, "Command But Not Control: Progressive Capitalism and Regulatory Institutions for the Third Industrial Revolution: The Paris Agreement on Climate Change," *Session on Regulation and Industry Structure The Digital Broadband Migration*: *The Evolving Industry Structure of the Digital Broadband Landscape*, 2016).

[13] Mark Cooper, 2014, *Energy Efficiency Performance Standards: Driving Consumer and Energy Savings in California.* Presentation at the California Energy Commission's Energy Academy, February 20, 2014; 2013; *Energy Efficiency Performance Standards: The Cornerstone of Consumer-Friendly Energy Policy*, Consumer Federation of America, October 2013. See Mark Cooper, 2017, *The Political Economy of Electricity: Progressive Capitalism and the Struggle to Build a Sustainable Power Sector*, (Praeger), Chapter 7 and Appendix II for a more recent comprehensive review.

[14] We have identified these characteristics in the study of standards in a broad range of goods including light duty vehicles, heavy duty trucks, gas furnaces and computers. The key characteristics of "command but not control" regulation extend to policies that create institutional arrangement as discussed in Cooper, 2017.

[15] Republican presidents signed the legislation that created the fuel economy program in 1976 and then reformed it in 2007. The laws passed both houses of Congress with large majorities. In fact, eight of the nine major pieces of legislation that effect the energy efficiency of consumer durables were signed by Republican presidents. Both the House and the Senate have voted overwhelmingly in favor of these laws (14 times in all) with over 85 percent voting in favor.

[16] Mary and Robert Raymond Professor of Economics at Stanford University, and the George P. Shultz Senior Fellow in Economics at Stanford University's Hoover Institution.

[17] He was a member of the President's Council of Economic Advisors during the George H. W. Bush Administration and Senior Economist at the Council of Economic Advisors during the Ford and Carter Administrations.

[18] John, B. Taylor, *Economics* (Houghton Mifflin, 11998, pp. 410, 896.

[19] W. Kip Viscusi, John M. Vernon and Joseph E. Harrington, Jr., *Economics of Regulation and Antitrust* (MIT, 2001).

[20] Id., pp. 28-29.

[21] Office of Management and Budget, Memorandum For: Regulatory Policy Officers at Executive Departments and Agencies and Managing and Executive Directors of Certain Agencies and Commissions, May 5, 2017,

[22] Viscusi, Vernon, and Harrington, 2000, pp. 2-3.

[23] Viscusi, et al., 2001, pp. 35-37.

[24] Luke Stewart, 2010, The impact of Regulation on Innovation in the United States: A Cross-Industry Literature Review, Institute of Medicien Committee on Patient Safety and Health IT, June.

[25] Institute for European Environmental Policy, Review of Costs and Benefits of Energy Savings: Task 1 Report 'Energy Savings 2030, May 2013 IEER, pp. 4…6.

[26] Cooper, 2014, "Energy Efficiency Performance Standards, slide 22.

[27] At the time of the filing in New Mexico, CFA issued a report entitled, A Consumer Analysis of the Adoption of the California Clean Cars Program in Other States, November 2007.

[28] Cooper, 2017, *The Political Economy of Electricity*, Chapter 5.

[29] The survey was conducted for CFA by ORC International, which interviewed a representative sample of 1,008 American adults by landline or phone on July 13-16. The margin of error for the survey is plus or minus three percentage points.

[30] All of the surveys were conducted for the Consumer Federation by ORC, based on a national random sample of 1,000 households with a margin of error of + 3

[31] American Action Forum, *Regulatory Rodeo*.

[32] National Academy of Sciences analyses have played a large part in the estimation of vehicle technology costs.

[33] Roland Hwang and Matt Peak, 2006, Innovation and Regulation in the Automobile Sector: Lessons Learned and Implications for California's CO2 Standard, Natural Resources Defense Council, April.

[34] Winston Harrington, 2006, Grading Estimates of the Benefits and Costs of Federal Regulation: A Review of Reviews, Resources for the Future, 2006; p. 3.

[35] Steven Nadel and Andrew Delaski, *Appliance Stnadards: Comparing Predicted and Observed Prices*, American Council for an Energy Efficient Economy and Appliance Standards Awareness Project, July 2013.

[36]Whitefoot, Kate, Meredith Fowler and Steven Skerlos, 2012, Product Design Response to Industrial Policy: Evaluating Fuel Economy Standards Using an Engineering Model of Endogenous Product Design, Energy Institute at Haas, May, pp. 1…5. We perform counterfactual simulation of firms' pricing and medium-run design responses to the reformed CAFE regulation. Results indicate that compliant firms rely primarily on changes to vehicle design to meet the CAFE standards, with a smaller contribution coming from pricing strategies designed to shift demand toward more fuel-efficient vehicles... Importantly, estimated costs to producers of complying with the regulation are three times larger when we fail to account for tradeoffs between fuel economy and other vehicle attributes.

[37] Worrell, Ernst, et al., 2003, "Productivity Benefits of Industrial Energy Efficiency measures," Energy, 28(11): This examination shows that including productivity benefits explicitly in the modeling parameters would double the cost-effective potential for energy efficiency improvement, compared to an analysis excluding those benefits. (p 1)

[38] Larry Dale, et al., "Retrospective Evaluation of Appliance Price Trends," *Energy Policy* 37, 2009. p. 1. For demand-side technologies the experience curve approach also seems applicable to measure autonomous energy efficiency improvements. Interestingly, we do find strong indications that in this case, policy can bend down (at least temporarily) the experience curve and increase the speed with which energy efficiency improvements are implemented. 1. For the past several decades, the retail price of appliances has been steadily falling while efficiency has been increasing. 2. Past retail price predictions made by the DOT analysis of efficiency standards, assuming constant price over time, have tended to overestimate retail prices. 3. The average incremental price to increase appliance efficiency has declined over time. DOT technical support documents have typically overestimated the incremental price and retail prices. 4. Changes in retail markups and economies of scale in production of more efficient appliances may have contributed to declines in prices of efficiency appliances

[39] Onno Kuok, 2006, "Environmental Innovation Dynamics in the Automotive Industry," 2006, "The European car industry is highly dynamic and innovative. Its R&D expenditures are well above average in Europe's manufacturing sector. Among the most important drivers of innovation are consumer demand (for comfort, safety and fuel economy), international competition, and environmental objectives and regulations… One element of success of technology forcing is to build on one or more existing technologies that have not yet been proven (commercially) in the area of application. For improvements in the fuel economy of cars, many technological options are potentially available… With respect to innovation, the EU and Japanese policy instruments perform better than the US CAFE program. This is not surprising, given the large gap between the stringency of fuel-efficiency standards in Europe and Japan on the one hand and the US on the other…. One of the reasons for the persistence of this difference is that the US is not a significant exporter of cars to the European and Japanese markets." R D Van Buskirk, et al., 2014, "A retrospective investigation of energy efficiency standards: policies may have accelerated long term declines in appliance costs," Environmental Research Letter, November 14.

[40] David Greene and Jilleah G. Welch, The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in the United States, Oak Ridge National Laboratory and the Energy Foundation, September 2016, pp. 60- 62; David Greene and Jilleah G. Welch, *The Impact of Increased Fuel Economy for Light-Duty Vehicles on the Distribution of Income in* the *United States*: *A retrospective and Prospective Analysis* Oak Ridge National Laboratory and the Energy Foundation, March 2017, section 5.2.

[41] CFA laid out this argument in comments supporting the heavy duty truck standard.

[42] Residential electricity revenues represent about 46% of total revenues, see the EIA data base at https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_02; Residential natural gas revenues represent about 65% of natural gas revenues, excluding for electric utilities, whose costs would be recovered in electricity bills. Allocating petroleum cost recovery is more complicated, but CFA concluded that residential consumer account for about 55% of transportation fuel costs. See, Mark Cooper, Paying the Freight, Consumer Federation of America, 2012.

[43] Jennifer, Brown, , Tanjim Hossain and John Morgan, 2007, Shrouded Attributes and Information Suppression: Evidence from the Field, November; Xavier Gabaix and David Laibson, 2005, Shrouded Attributes, Consumer Myopia, and Information Suppression I Competitive Markets, NBER Working Paper 11755, November; Tanjim Hosain and John Morgan, 2006, Shrouded Attributes and Information Suppression: Evidence from Field Experiments, Competition Policy Center, UC Berkeley, September.

[44] Taylor, p. 898.

[45] James D. Hamilton, "Causes and Consequences of the Oil Shock of 2007–08," *Brookings Papers on Economic Activity* Spring; Warr, Benjamin S, Robert U. Ayres, and Eric Williams, 2009, *Increase Supplies, Increase Efficiency: Evidence of Causality Between the Quantity and Quality of Energy Consumption and Economic Growth*. 2009/22/EPS.ISIC, Faculty & Research Working Paper. INSEAD.

[46] In addition to the recent U.S. analysis by U.S. EPA/NHTSA, 2011, see Jamie Howland, et al., 2009, *Energy Efficiency: Engine of Economic Growth.* Rockport, ME: Environment Northeast; and New York State Energy Research & Development Authority, 2011, *Macro-Economic Impact Analysis of New York's Energy Efficiency Programs: Using REMI Software*. Albany NY: NYSERDA, August 4; Holmes Ingrid and Rohan Mohanty, 2012, *The Macroeconomic Benefits of Energy Efficiency: The Case for Pubic Action*, E3G, April; Cambridge Centre for Climate Change Mitigation Research, 2006, *The Macro-Economic Rebound Effect and the UK Economy*. Cambridge, U.K.: Cambridge Econometrics and Policy Studies Institute, May; and Lisa, Ryan, and Nina Campbell, 2012, *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements*. Insight Series. Paris, France: International Energy Agency, for a general global review.

[47] James Lazar and Ken Colburn, *Recognizing the Full Value of Energy Efficiency* (Regulatory Analysis Project, September 2013),

[48] Ryan, and Campbell, 2012, *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements*. Insight Series. Paris, France: International Energy Agency, pp. 1…2 …3.

[49] Lutz, Christian, Ulrike Lehr and Martin Pehnt, 2012, *Economic impacts of energy efficiency and Renewable energy in Germany, 20th* International Input-Output Conference, June 26-29, pp. 1… 6-7…8.

[50] U.S. EPA, 2010, pp. 3-4.

[51] Memorandum To: Docket EPA-HQ-OAR-2009-0472, Subject: Economy-Wide Impacts of Greenhouse Gas Tailpipe Standards, March 4, 2010.

[52] Id., p. 1.

[53] The IEER review of studies lists seven studies covering the residential building and the industrial sectors covering a handful of European nations in 2010-2013. The effects studies were primarily employment, cost of saved energy and competitiveness. Worrel, et al., identified 70 industrial case studies, with 52 that monetized the benefits.

[54] Max Wei, Shana Patadia, and Daniel Kammen, 2010, "Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US?" *Energy Policy* 38.

[55] Ryan and Campbell, identify a dozen partial equilibrium models that have been applied to regions within nations, individual nations, groups of nations and the global economy. The effects analyze include GDP, employment by sector, public budgets, trade, distribution, and investment.

[56] For example, EPA, 2010, IGEM; Rachel Gold, et al., 2011, *Appliance and Equipment Efficiency Standards: A Money Maker and Job Creator,* American Council for an Energy Efficient Economy, January 2011, p. 9, based on the IMPLAN Model, 2009. Howland and Murrow and NYSERDA 2011, REMI),

[57] For example, New York (NYSERDA, 2011), New England (Howland and Murrow), California (David Roland-Holst, 2016)

[58] For example, U.S. (Gold,, 2011, EPA, 2010, Warr, Ayres and Williams, 2009) and UK (Cambridge Center, 2006), note recent studies on Asian economies, Korea, Canada and Spain,

[59] In the mid- and long-terms employment and output increase.

[60] Wei, Patadia, and Kammen, 2010, Gold, et al., 2011.

[61] ACEEE, "In our experience modeling efficiency investments, we find that re-spending the energy savings typically creates an equivalent number of jobs as implementing the investment." (p. 2)

[62] Worrell, et al., p. 5.

[63] Ryan and Campbell, p. 5., Howland, et al., 2009.

[64] EPA, 2012-2016,

[65] Wiser, Bolinger and St. Clair, 2005.

[66] 2017, forward. This example is particularly appropriate since infrastructure spending and projects, on which transit would be an important area, appear to be widely supported because of the benefits they deliver to individuals and the economy

[67] Id., pp. 3… 10.

[68] Thomas G. Poder and Jie He, 2017, Willingness to pay for a cleaner car: The case of car pollution in Quebec and France, Energy 130; Susan Rose-Ackerman, 2011, Putting Cost-Benefit Analysis in Its Place: Rethinking Regulatory Review, Yale Law School Legal Scholarship Repository.; Lisa Heinzerling, Frank Ackerman, 2002, Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection, 150 U. Pa. L. Rev. 1553.

[69] Benjamin Leard, et al., 2017, How Much Do consumers Value Fuel Economy and Performance? Evidence from Technology Adoption, Brookings Institution, June;

[70]Leard, et al., 2017, p. 27, put it as follows, "Moreover, this conclusion does not account for potential induced innovation caused by tighter standards, market failures associated with insufficient market incentives for innovation, market failures associated with imperfect competition (such as the possible underprovision of fuel economy), and interactions between new and used vehicle smarkets. Finally, the conclusion does not account fro transitional dynamics. 2

[71]For example, a similar sentiment is expressed by one critique of willingness-to-pay studies in healthcare (Joaquin F. Mould Quevedo, et al., "The Willingness-to-Pay Concept in Question," Rev. Sauide Publica: 43(2), as follows: "[M]ost of these investigations still do not differentiate the economic factors that might be distorting the market, centering the investigation on a hypothetical aggregate demand when whoever defines the price and amount offered of a particular medication or medial intervention in the health sector generally comes from the supply-side.

[72] Leard, et al., p. p. 29.

[73] Mitch Bainwol, President and CEO, Alliance of Automobile Manufacturers, *Consumers & Fuel Economy,* CAR Management Briefing Seminars, Traverse City, Michigan, August 2016, p. 10. The winter related question, specific to the North East, has been discarded. It would rank 12th of 18, low in California, high in New England).

[74] Id., p. 10.

[75] Cooper, 2017, Chapter 5.

Appendix B

An Analysis of Consumer Savings and Automaker Progress On the Road to 2025 CAFE Standards

Jack Gillis

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Consumer Federation of America

July 24, 2017

INTRODUCTION

This report evaluates the direct consumer savings, and automaker progress, associated with the 2025 CAFE standards. It is in response to current efforts by certain members of Congress and the current Administration to roll back those standards. The rationale for the rollback is that it costs too much to comply with the standards and, as a result, vehicle prices will increase, thus dissuading consumers from buying new cars. The fact is, rolling back the standards would not only cause great harm to consumer pocketbooks, but, because of consumer demand for fuel efficiency, would also harm sales.

Public opinion surveys, including one recently conducted by the Consumer Federation of America, demonstrate unquestionably that consumers want more fuel efficient vehicles and that they strongly support standards requiring them. Consumers understand that gasoline costs are a major household expenditure and improvements in vehicle fuel economy puts money directly back into their pocketbooks. Furthermore, while gas prices are currently low, they understand the cyclical nature and volatility of those prices.

Our analysis shows that Congress and the Administration would be making a serious mistake in rolling back the standards. Not only would the impact be immediately felt by already financially strapped Americans, but it would put the U.S. car companies at a distinct disadvantage, both nationally and globally, in competing with the Asian manufacturers, who are quite capable of complying with the standards. As this report will demonstrate, not only do fuel economy standards pay off in lower ownership and operating costs, but the carmakers are fully capable of meeting the standards at a reasonable cost, and improving fuel economy improves sales.

We examined the current progress in meeting fuel economy standards by analyzing the performance of 2017 and 2016 vehicles from a variety of perspectives. On

July 24, 2017, CFA released its most recent survey of consumer attitudes towards fuel economy in link.

NEARLY HALF OF "ALL-NEW" 2017 VEHICLES COST LESS TO BUY AND FUEL THAN THEIR 2011 COUNTERPARTS

25% of the 2017 All-New Vehicles Cost Less Than Their 2011 Counterparts AND Got Better Fuel Economy

Manufacturers have the greatest opportunity to improve vehicle fuel economy when they introduce a truly new vehicle.[1] For this analysis, we compared the cost and fuel economy of 19 of the 27 "all-new" 2017 models which had a 2011 version, the year before the current standard was put in place.[2] These 19 models included 79 different EPA designated engine/drive train/transmission/MPG configurations (or what are called "trims"). When we compared the cost difference between the "all-new" 2017 models and their 2011 version, after factoring in inflation, 21 or 27% actually went down in price, yet every one of these vehicles saw a 1 to 10 MPG increase. Vehicles that improved their fuel economy while going down in price ranged from the Subaru Impreza and GMC Acadia to the Mercedes E Series, clearly demonstrating that improvements in fuel economy do not have to generate higher prices.

FUEL SAVINGS EXCEEDED FUEL ECONOMY TECHNOLOGY COSTS FOR 94% OF ALL-NEW 2017 MODELS

Annual vehicle price increases (less inflation) cover many different improvements such as new safety technology, convenience items, design changes, as well as upgraded fuel economy technology. By separating out the cost of fuel economy improvements from these other costs, we were able to get a more accurate look at the impact of the

[1] Each year only about 10 percent of the fleet is made up of truly "all-new" vehicles. Typically, when a new model is introduced, that vehicle essentially stays the same for 5-6 years. This is called a "model series" and while there may be some style and feature changes during a model's series, the mechanics of the vehicle generally stay the same

[2] There were 27 all new vehicles introduced in 2017, 19 of them had a previous version available in 2011. These 19 vehicles were the ones we included in this analysis.

standards on consumer pocketbooks. Overall, for 74 of the 79 vehicles (94%), the added cost of new fuel efficient technology was far exceeded by the resulting fuel cost savings over the first 5 years of ownership.

EVEN IF THE PRICE OF THE VEHICLE GOES UP, FUEL ECONOMY SAVINGS CAN OFFSET THE INCREASE

For 12 of the 58 vehicles whose cost went up, the savings in fuel costs exceeded the entire price increase for that vehicle, even though only part of that increase can be attributed to fuel efficiency.

Each mile per gallon of improvement is estimated to cost about $100 in improved fuel economy technology.[3] For 41 of the 58 vehicles whose cost went up, the savings in fuel costs outweighed the cost of the fuel economy technology. Finally, for the few vehicles whose fuel economy stayed the same or actually decreased, all experienced an increase in price.

Figure 1: 2011 vs. 2017 "All-New" Price Comparison (Accounting for Inflation)

	"All-New" Trims[123]	Percent of "All-New Trims"
Total "All-New" Vehicles with 2011 Counterpart	79	100%
2011 Vehicles Which Were LESS Expensive in 2017 Dollars and Had Higher MPG	21	27%
2011 Vehicles Which Were MORE Expensive in 2017, Who's Fuel[4] Savings Offset the Entire Price Increase	12	15%
2011 Vehicles Which Were MORE Expensive in 2017, Whose Fuel[4] Savings Offset the $100/MPG Cost of Fuel Economy Technology[5]	41	52%
2011 Vehicles Which Were MORE Expensive in 2017, Who's Fuel Economy Stayed the Same or Decreased	5	6%

[1]Inflation was calculated using BLS average inflation numbers from 2011-2016.

[2]Average "All-New" Vehicle Price from the New Car Cost Guide.

[3] CFA bases its estimate of the cost of fuel economy on a review of the literature including historical, market-based and engineering studies, as described in Appendix B.

[3]Fuel Economy of "All-New" Vehicles based on EPA combined estimates.
[4] Gas costs from AAA $2.27 (7/19/17) and driving an average of 14,000 miles per year.
[5] CFA bases its estimate of the cost of fuel economy on a review of the literature including historical, market-based and engineering studies, as described in Appendix B.

OVERALL, FUEL ECONOMY IMPROVEMENTS FAR EXCEED THEIR COST, AND PARTIALLY OFFSET THE COST OF OTHER IMPROVEMENTS

The average "all-new" vehicle increased in price from $37,808[4] in 2011 to $39,723 in 2017, (4.8%). Their increase in fuel economy went from an average of 21.0 to 24.2 MPG, (13.2%). Considering that every mile per gallon of improvement costs about $100, the average cost of these improvements was $320. However, this fuel economy increase saved owners of these "all-new" vehicles an average of $946 in gas costs over 5 years. The difference between the cost of these improvements and their benefit provided consumers with an average savings of $626 over 5 years in gasoline costs. These savings go directly into consumer pocketbooks and back into the economy or offset about 40% of the non-fuel efficiency technology component of the average price increase of "all-new" cars from 2011-2017.

[4] 2017 Dollars

Figure 2: 2011 & 2017 Average "All-New" Vehicle Price and Fuel Economy (Accounting for Inflation)			
Year	**Ave. "All-New" Vehicle Price[1][2]**	**Ave. Fuel Economy of "All-New" Vehicles[3]**	**Gas Cost for 5 Years[4]**
2011 Price in 2017 Dollars	$37,808	21.0	$7,567
2017 Price	$39,723	24.2	$6,621
Change in Price	$1,915	3.2	-$946
% Change	4.8%	13.2%	-14.3%
COST: $100 per MPG Increase for Fuel Economy Technology[5]	-$320		
BENEFIT: Gas Savings Due to Fuel Efficient Technology	$946		
SAVINGS: Average Savings for "All-New" Car Buyers	$626		

[1]Inflation was calculated using BLS average inflation numbers from 2011-2016 averaging 1.4% per year.

[2]Average "All-New" Vehicle Price is from the New Car Cost Guide for the 79 vehicles.

[3]Average Fuel Economy of 79 "All-New" Vehicles is based on EPA combined mileage estimates.

[4]Gas costs from AAA $2.27 (7/19/17) and driving an average of 14,000 miles per year.

[5] CFA bases its estimate of the cost of fuel economy on a review of the literature including historical, market-based and engineering studies, as described in Appendix B.

CAFE COMPLIANCE AMONG "ALL-NEW" VEHICLES SHOW MANUFACTURERS ARE ON THEIR WAY TO 2025 COMPLIANCE

The introduction of "all-new" vehicles is the best barometer of a manufacturer's ability to comply with CAFE standards. Changing the fuel economy of existing vehicles is difficult, as the vehicle is already designed and is being manufactured to its original specifications. With "all-new" vehicles, manufacturers can incorporate their latest fuel-saving technologies.

In comparing the CAFE compliance of "all-new" models introduced in 2015, 2016 and 2017, there was a significantly higher percentage of CAFE-compliant vehicles in 2017. In fact, 70 percent of the "all-new" 2017 vehicles had a CAFE-compliant trim, compared to 41 percent of the "all-new" 2015 vehicles (Figure 3). Particularly noteworthy was the fact that 78% of the "all-new" light duty trucks had a CAFE

compliant trim for 2017. Interestingly, percentage-wise, trucks beat cars for CAFE compliance in 2017.

Figure 3: Percentage of CAFE Compliant Vehicles Among "All-New" Models 2015-2017			
	2015	**2016**	**2017**
Total "All-New" Vehicles	34	32	27
Total CAFE Compliant	14 (41%)	19 (60%)	19 (70%)
Percentage of CAFE Compliant Vehicles Among "All-New" Model Cars 2015-2017			
	2015	**2016**	**2017**
Total "All-New" Cars	19	19	18
Total CAFE Compliant	8 (42%)	15 (80%)	12 (67%)
Percentage of CAFE Compliant Vehicles Among "All-New" Model Trucks 2015-2017			
	2015	**2016**	**2017**
Total "All-New" Trucks	15	13	9
Total CAFE Compliant	6 (40%)	5 (40%)	7 (78%)

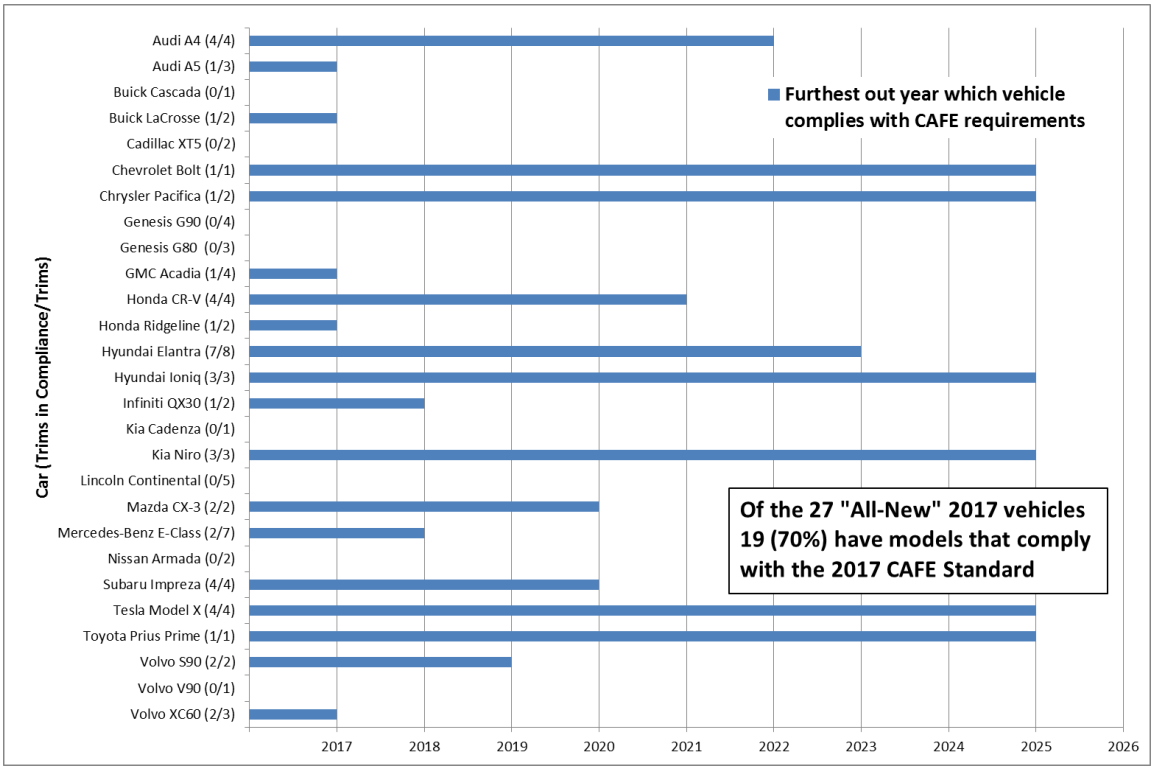
MANY MODELS EXCEED CURRENT YEAR CAFE REQUIREMENTS – SOME COMPLYING TO 2025

In reviewing the "all-new" vehicles, we also determined how many years into the future each model would comply with the *gradual increase* in CAFE requirements. Current vehicles that meet CAFE requirements for future years indicate that manufacturers are actually "ahead of the game" in terms of compliance.

70% (19) of the 27 "all-new" vehicles for 2017 had models which met, at the minimum, the 2017 CAFE standard. In fact, from 2015-2017, the majority of these compliant cars actually exceeded the minimums required for that year. Figure 4a shows that 6 of the 2017 vehicles are already CAFE compliant with the 2025 standard—a record number.

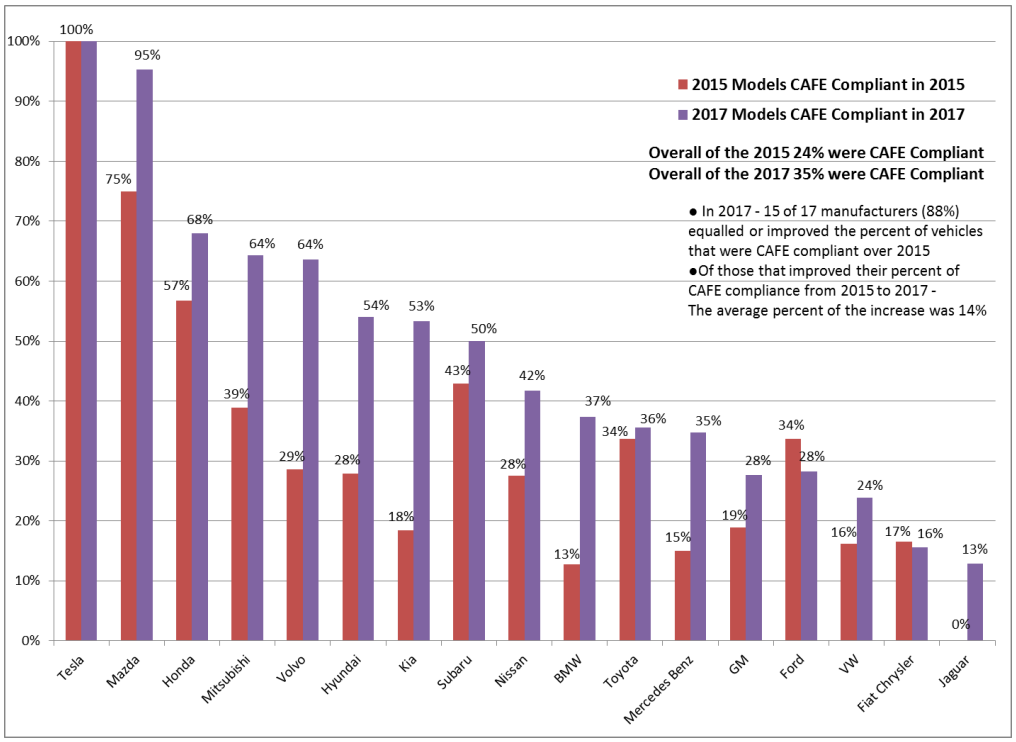
Figure 4a: Among the "All-New" Vehicles – How Many Will Continue Their CAFE Compliance Until:											
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
2015	14	10 (71%)	8 (57%)	6 (43%)	5 (36%)	3 (21%)	3 (21%)	2 (14%)	0	0	0
2016	-	19	18 (95%)	18 (95%)	15 (79%)	14 (74%)	11 (58%)	7 (37%)	6 (32%)	4 (21%)	2 (11%)
2017	-	-	19	14 (74%)	11 (58%)	10 (53%)	8 (42%)	8 (42%)	7 (37%)	6 (32%)	6 (32%)

Figure 4b. 2017 "All-New" Vehicles and Their CAFE Compliance



What is particularly remarkable is the improvements in CAFE compliance by each of the manufacturers. 14 of the 17 major manufacturers improved the percent of their vehicles that were CAFE compliant from 2015 to 2017. (Tesla at 100% compliance matched its 2015 compliance.) While Ford and Fiat Chrysler lost ground, many of the other manufacturers actually doubled the percent of CAFE compliant vehicles. (Figure 4c)

Figure 4c. Percent of 2015 and 2017 Vehicle Trims that were CAFE Compliant by Manufacturer

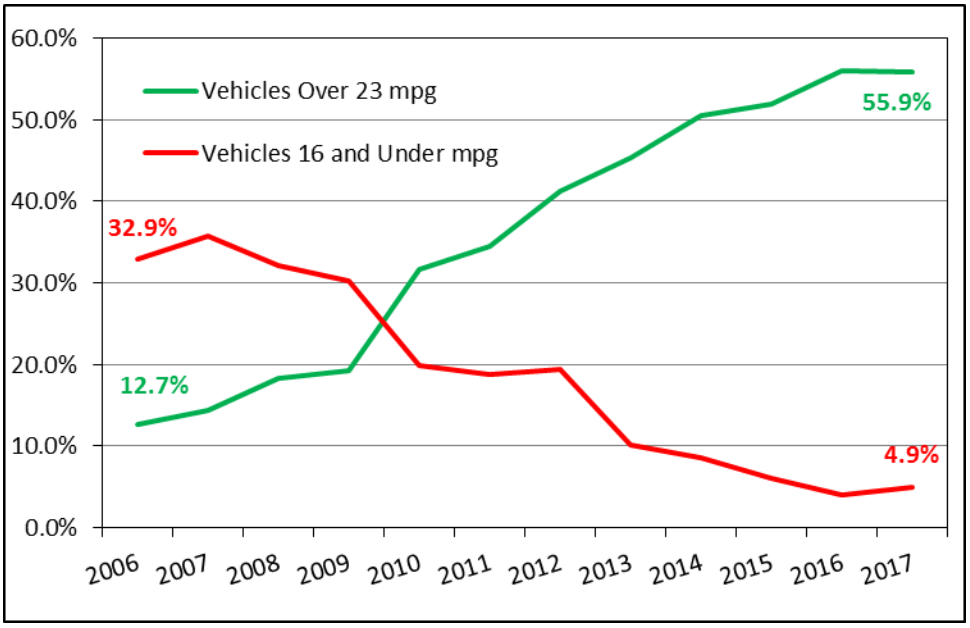


GAS GUZZLERS DECLINE SIGNIFICANTLY IN 2017 - VEHICLES GETTING OVER 30 MPG STAYS STEADY

Fuel economy progress is going well. In looking at all of the 2017 models, "gas guzzlers" getting below 14 MPG are a miniscule 0.4% in 2017, down from 8.5% in 2011. At the other end, there was a small increase in vehicles getting over 38 MPG, going from 4% last year to 4.3% in 2017. (Figure 5a)

Figure 5a: On the Road to 40 mpg by 2025: Carmakers Demonstrate Significant Progress													
EPA Grade	**MPG**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
10	38+	0.4%	0.2%	0.2%	0.2%	0.6%	1.0%	1.1%	2.9%	3.1%	3.0%	4.0%	4.3%
9	31-37	0.7%	0.4%	0.8%	1.1%	2.1%	3.2%	4.7%	6.4%	8.5%	8.7%	9.3%	8.8%
Over 30MPG		**1.1%**	**0.6%**	**1.0%**	**1.3%**	**2.7%**	**4.2%**	**5.8%**	**9.3%**	**11.6%**	**11.7%**	**13.4%**	**13.0%**
8	27-30	2.4%	3.0%	3.5%	4.4%	7.3%	7.8%	9.2%	12.0%	14.8%	16.5%	17.3%	15.8%
7	23-26	10.3%	10.2%	12.8%	12.4%	18.9%	18.3%	20.4%	25.0%	24.1%	23.8%	25.4%	27.1%
Acceptable		**12.7%**	**14.4%**	**18.3%**	**19.3%**	**31.6%**	**34.5%**	**41.2%**	**45.3%**	**50.5%**	**52.0%**	**56.1%**	**55.9%**
6	22	10.4%	10.4%	7.2%	11.7%	8.4%	8.0%	7.0%	7.7%	6.1%	8.0%	7.5%	7.7%
5	19-21	28.2%	26.5%	28.5%	27.6%	29.2%	30.4%	26.9%	26.5%	24.3%	22.2%	21.8%	21.1%
4	17-18	14.7%	13.7%	14.9%	12.5%	13.8%	12.5%	11.3%	9.4%	10.6%	11.7%	10.7%	10.5%
3	15-16	24.4%	24.6%	16.6%	15.6%	11.4%	10.3%	9.8%	6.7%	6.1%	4.7%	3.7%	4.5%
2	13-14	5.0%	5.9%	9.9%	8.2%	6.7%	6.8%	7.8%	3.0%	2.4%	1.4%	0.3%	0.4%
1	0-12	3.5%	5.2%	5.7%	6.4%	1.7%	1.7%	1.8%	0.4%	0.0%	0.0%	0.0%	0.0%
Poor		**86.2%**	**86.3%**	**82.8%**	**82.0%**	**71.2%**	**69.7%**	**64.6%**	**53.7%**	**49.5%**	**48.0%**	**43.9%**	**44.1%**
# of Trims[1]		**1076**	**1184**	**1198**	**1182**	**1101**	**1053**	**901**	**1057**	**1091**	**1194**	**1094**	**1097**
[1]We did not include large passenger vans or exotic vehicles.													

Figure 5b. Percent of Gas Guzzlers and Misers



SUVs, Crossovers and Pickups with Higher MPG Increases Sell Better

A key concern among U.S. automakers is the impact of fuel economy standards on sales. Rolling back the standards, they say, is necessary to maintain sales. Our analysis specifically demonstrates just the opposite.

SUVs, pickups and crossovers, whose MPGs (miles per gallon) increased by over 10% between 2011 to 2016, had a 59% increase in sales. On the other hand, those same vehicles with less than a 10% increase in MPGs from 2011 to 2016 experienced only a 41% increase in sales, almost 20% less. (Figure 6) This analysis completely debunks automaker claims that consumers don't value good gas mileage. Clearly, the more improvement in MPG, the better the sales. NOTE: 2011 was the year prior to when the current CAFE requirements went into effect.

Figure 6: SUVs, Crossovers, Light Trucks - 2011-2016

Percent Increase in MPG 2011 - 2016	Number of Vehicles	2011 Average Sales Per Model	2016 Average Sales Per Model	Average Change in Sales (Units)	2011 - 2016 Average % Change in Sales
10% or More	29	95,143	150,828	55,685	59%
Under 10%	37	63,423	89,696	26,273	41%
Mileage figures from EPA and Sales from Auto News					

The Toyota RAV4, which increased by 10 MPG from 2011 to 2016 and saw a sales increase of almost 220,000 or a 166% increase in annual vehicle sales. Meanwhile, the GMC Terrain which had a 1 MPG decrease saw only a 6% increase in sales from 2011 to 2016. And even though consumers are increasingly choosing crossover models over sedans, the typical crossover now gets 10% better gas mileage than in 2011, thanks to fuel economy standards which are currently under threat of a rollback.

Conclusion: Rolling Back Fuel Economy Standards Will Hurt Both the U.S. Car Companies and the American Consumer—There's No Need For A Roll Back

Not only do consumers want more fuel efficiency, but this data and analysis make it abundantly clear that manufacturers are fully capable of meeting the current standard and that fuel economy helps sales. This should be no surprise, because the standard was specifically designed to help manufacturers meet the challenges they face with improving fuel efficiency. The current standards are not "one-size fits all" and were specifically crafted to respect the differing vehicle mixes among manufacturers as well as consumer choice. Acknowledging the fuel economy challenges inherent in larger vehicles, the standard incorporates two separate calculations, one for cars and one for light trucks, SUVs, and most crossovers. Furthermore, within those calculations, a sliding scale further reduces the requirements on larger vehicles. Finally, automakers meet requirements on an average basis across their entire fleet, which means that not all of the manufacturer's models have to meet a given year's target. This enables automakers to produce a mix of vehicles in response to consumer demand. The result: the standards have helped create a much more efficient U.S. auto fleet while preserving both manufacturer and consumer choice on size, weight and performance.

It is also evident that increased fuel economy plays an important role in vehicle sales. That was made clear in the mid 2000's when auto dealer lots were filled with gas guzzlers they simply couldn't sell, resulting in government bailouts for the industry. Rolling back the standards today would not only hurt U.S. automakers as the Asian companies roar ahead with vehicles in compliance, but would be a big blow to American pocketbooks, especially as gas prices rise in the future.

In spite of their current compliance with the standards and the positive impact on sales, the auto manufacturers want to roll-back the requirements. They've lobbied the President to reopen the final determination on fuel economy standards for 2025, inviting a rollback from the Environmental Protection Agency. In addition, Congress is now working on bills (S.1273 and an anticipated House Bill) that will lower mileage requirements for these larger vehicles. While the automakers may try to "lay the blame" on their customers for "needing" to roll back the standards, consumers are voting for the higher mileage vehicles with their dollars. This shortsighted thinking by certain members

of Congress, the Administration and the auto companies ignores consumer demand for more fuel efficiency. As gas prices creep back up, car companies will be in the same spot they were back in 2009 when they had to be bailed out by the government, with lots filled with larger, fuel inefficient vehicles they can't sell.

APPENDIX A: VEHICLE AND PRICE CHANGES AMONG "ALL-NEW" MODELS 2011 TO 2017

The following information was used to analyze the performance of "all-new" vehicles in the 2017 fleet with their 2011 counterparts. 2011 was the year before the current standard was implemented. The 2011 vehicle pricing was adjusted for inflation in order to fairly compare price changes with the 2017 models. There were 27 "all new" models in 2017. For 19 of those models, there was a corresponding vehicle available in 2011. Those are the vehicles we were able to compare. Among the 19 models, there were 79 different trim configurations each having a separate cost and MPG rating. Using current gas prices and assuming 14,000 miles driven in a typical year, the savings from increased fuel economy was determined for all 79 different trim configurations.

Vehicle Price Change From 2011 to 2017 Compared to Gas Savings Due to Increased Fuel Efficiency										
Division	Model	Trim	2011 Price in 2017 Dollars[12]	2017 Price	Change in Price	Change in MPG[3]	Cost of FE Tech ($100/ MPG)[4]	Change in 5 Yr. Gas Costs[5]	Price Difference Plus Gas Savings	FE Tech Cost Plus Gas Savings
GMC	Acadia FWD	2011 - SL [3.6, V6, A(A6)] 2017 - SL [2.5, I4, A(A6)]	$34,005	$29,070	-$4,935	4	$400	-$1,474	-$6,409	-$1,074
GMC	Acadia FWD	2011 - SLE [3.6, V6, A(A6)] 2017 - SLE-1 [2.5, I4, A(A6)]	$36,809	$32,450	-$4,359	4	$400	-$1,474	-$5,832	-$1,074
GMC	Acadia AWD	2011 - SLE [3.6, V6, A(A6)] 2017 - SLE-1 [3.6, V6, A(A6)]	$38,945	$34,450	-$4,495	1	$100	-$424	-$4,918	-$324
Honda	Ridgeline 4WD	2011 - RTS [3.5, V6, A(A5)] 2017 - RTS [3.5, V6, A(A6)]	$33,754	$31,515	-$2,239	5	$500	-$2,152	-$4,392	-$1,652
GMC	Acadia FWD	2011 - SLT [3.6, V6, A(A6)] 2017 - SLT-1 [2.5, I4, A(A6)]	$40,782	$38,350	-$2,432	4	$400	-$1,474	-$3,905	-$1,074
Honda	Ridgeline 4WD	2011 - RT [3.5, V6, A(A5)] 2017 - RT [3.5, V6, A(A6)]	$30,865	$29,475	-$1,390	5	$500	-$2,152	-$3,543	-$1,652
Honda	Ridgeline 4WD	2011 - RTL [3.5, V6, A(A5)] 2017 - RTL [3.5, V6, A(A6)]	$36,825	$35,580	-$1,245	4	$400	-$1,804	-$3,049	-$1,404
Subaru	Impreza Wagon	2011 - 2.5i Premium [2.5, I4, A(S4)] 2017 - Premium [2.0, I4, A(AV-S7)]	$20,287	$19,895	-$392	10	$1,000	-$2,287	-$2,679	-$1,287
Subaru	Impreza AWD	2011 - 2.5i [2.5, I4, A(S4)] 2017 - Base [2.0, I4, A(AV-S7)]	$19,753	$19,395	-$358	10	$1,000	-$2,287	-$2,645	-$1,287
Mercedes	E-Series	2011 - E 350 4MATIC [3.5, V6, A(A5)] 2017 - 300 4MATIC [2.0, I4, A(A9)]	$55,429	$54,650	-$779	5	$500	-$1,765	-$2,545	-$1,265
Cadillac	SRX/XT5 AWD	2011 - Luxury [3.0, V6, A(S6)] 2017 - Luxury [3.6, V6, A(S8)]	$49,229	$47,390	-$1,839	2	$200	-$807	-$2,646	-$607
Hyundai	Elantra	2011 – Touring SE [2.0, I4, A(A4)] 2017 - Eco [1.4, I4, A(AM7)]	$21,675	$20,650	-$1,025	9	$900	-$1,592	-$2,617	-$692
Chrysler	T&C/Pacifica	2011 - Touring [3.6, V6, A(A6)] 2017 - Touring [3.6, V6, A(A9)]	$32,211	$30,495	-$1,716	2	$200	-$732	-$2,448	-$532
GMC	Acadia AWD	2011 - SLT [3.6, V6, A(A6)] 2017 - SLT-1 [3.6, V6, A(A6)]	$42,918	$41,450	-$1,468	1	$100	-$424	-$1,891	-$324
GMC	Acadia AWD	2011 - Denali [3.6, V6, A(A6)] 2017 - Denali [3.6, V6, A(A6)]	$48,295	$46,920	-$1,375	1	$100	-$424	-$1,799	-$324
Hyundai	Elantra	2011 - Touring SE [2.0, I4, M(M5)] 2017 - Value Edition [2.0, I4, A(S6)]	$20,821	$20,250	-$571	6	$600	-$1,161	-$1,732	-$561
GMC	Acadia FWD	2011 - Denali [3.6, V6, A(A6)] 2017 - Denali [3.6, V6, A(A6)]	$46,159	$44,920	-$1,239	1	$100	-$424	-$1,663	-$324
Mercedes	E-Series	2011 - E 350 Coupe [3.5, V6, A(A5)] 2017 - 300 [2.0, I4, A(A9)]	$52,172	$52,150	-$22	5	$500	-$1,610	-$1,632	-$1,110
Mercedes	E-Series	2011 - E 550 [5.5, V8, A(A7)] 2017 - 550 (coupe) [4.7, V8, A(A7)]	$60,983	$60,650	-$333	3	$300	-$1,278	-$1,611	-$978
Mercedes	E-Series	2011 - E 550 (CONVERTIBLE) [5.5, V8, A(A7)] 2017 - 550 (convertible) [4.7, V8, A(A7)]	$69,206	$69,100	-$106	3	$300	-$1,421	-$1,527	-$1,121
Hyundai	Elantra	2011 - GLS [1.8, I4, A(A6)] 2017 - SE [2.0, I4, A(S6)]	$18,241	$18,150	-$91	1	$100	-$152	-$244	-$52
Subaru	Impreza Wagon	2011 - 2.5i Premium [2.5, I4, A(S4)] 2017 - Premium [2.0, I4, A(AV-S7)]	$21,355	$21,695	$340	10	$1,000	-$2,287	-$1,947	-$1,287
Subaru	Impreza AWD	2011 - 2.5i [2.5, I4, A(S4)] 2017 - Base [2.0, I4, A(AV-S7)]	$20,821	$21,195	$374	10	$1,000	-$2,287	-$1,913	-$1,287
Mazda	CX-9 2WD	2011 - Sport [3.7, V6, A(S6)] 2017 - Sport [2.5, I4, A(S6)]	$31,116	$31,520	$404	5	$500	-$1,765	-$1,362	-$1,265

Division	Model	Trim	2011 Price in 2017 Dollars[12]	2017 Price	Change in Price	Change in MPG[3]	Cost of FE Tech ($100/ MPG)[4]	Change in 5 Yr. Gas Costs[5]	Price Difference Plus Gas Savings	FE Tech Cost Plus Gas Savings
Volvo	XC60 FWD	2011 - 3.2 R [3.2, V6, A(S6)] 2017 - T5 Inscription [2.0, I4, A(S8)]	$40,637	$40,950	$313	5	$500	-$1,474	-$1,162	-$974
Volvo	XC60 AWD	2011 - 3.2 R [3.2, V6, A(S6)] 2017 - T5 Inscription [2.0, I4, A(S8)]	$42,773	$42,950	$177	3	$300	-$1,050	-$873	-$750
Mazda	CX-9 4WD	2011 - Sport [3.7, V6, A(S6)] 2017 - Sport [2.5, I4, A(S6)]	$32,601	$33,320	$719	4	$400	-$1,474	-$754	-$1,074
Honda	CR-V 4WD	2011 - EX-L [2.4, I4, A(A5)] 2017 - EX-L [1.5, I4, A(AV)]	$29,792	$30,495	$703	6	$600	-$1,448	-$745	-$848
Honda	CR-V 2WD	2011 - EX [2.4, I4, A(A5)] 2017 - EX [1.5, I4, A(AV)]	$28,457	$29,195	$738	6	$600	-$1,342	-$604	-$742
Chrysler	T&C/Pacifica	2011 - Touring L [3.6, V6, A(A6)] 2017 - Touring L [3.6, V6, A(A9)]	$34,347	$34,495	$148	2	$200	-$732	-$584	-$532
Honda	CR-V 4WD	2011 - EX [2.4, I4, A(A5)] 2017 - EX-L [1.5, I4, A(AV)]	$26,962	$27,995	$1,033	6	$600	-$1,448	-$415	-$848
Honda	CR-V 2WD	2011 - EX-L [2.4, I4, A(A5)] 2017 - EX [1.5, I4, A(AV)]	$25,627	$26,695	$1,068	6	$600	-$1,342	-$273	-$742
Honda	CR-V 2WD	2011 - LX [2.4, I4, A(A5)] 2017 - LX [2.4, I4, A(AV)]	$23,170	$24,045	$875	4	$400	-$958	-$84	-$558
Mazda	CX-9 2WD	2011 - Touring [3.7, V6, A(S6)] 2017 - Touring [2.5, I4, A(S6)]	$33,167	$35,970	$2,803	5	$500	-$1,765	$1,038	-$1,265
Mazda	CX-9 2WD	2011 - Grand Touring [3.7, V6, A(S6)] 2017 - Grand Touring [2.5, I4, A(S6)]	$35,399	$40,470	$5,071	5	$500	-$1,765	$3,306	-$1,265
Buick	Lacrosse	2011 - CXS [3.6, V6, A(A6)] 2017 - Premium [3.6, V6, A(S8)]	$36,061	$41,065	$5,004	5	$500	-$1,610	$3,394	-$1,110
Buick	Lacrosse	2011 - CXL [3.6, V6, A(A6)] 2017 - Essence [3.6, V6, A(S8)]	$31,565	$38,665	$7,100	5	$500	-$1,610	$5,490	-$1,110
Mazda	CX-9 4WD	2011 - Touring [3.7, V6, A(S6)] 2017 - Touring [2.5, I4, A(S6)]	$34,651	$37,770	$3,119	4	$400	-$1,474	$1,645	-$1,074
Mazda	CX-9 4WD	2011 - Grand Touring [2.5, I4, A(S6)] 2017 - Grand Touring [3.7, V6, A(S6)]	$36,883	$42,270	$5,387	4	$400	-$1,474	$3,913	-$1,074
Volvo	XC60 FWD	2011 - 3.2 [3.2, V6, A(S6)] 2017 - T5 Dynamic [2.0, I4, A(S8)]	$34,603	$40,950	$6,347	5	$500	-$1,474	$4,872	-$974
Volvo	XC60 AWD	2011 - T6 [3.0, V6, A(S6)] 2017 - T6 Inscription [2.0, I4, A(S8)]	$41,011	$46,350	$5,339	3	$300	-$1,156	$4,183	-$856
Volvo	XC60 AWD	2011 - T6 R [3.0, V6, A(S6)] 2017 - T6 R-Design [2.0, I4, A(S8)]	$44,375	$51,000	$6,625	3	$300	-$1,156	$5,469	-$856
Volvo	S80/S90 FWD	2011 - 3.2 [3.2, V6, A(S6)] 2017 - T5 Momentum [2.0, I4, A(S8)]	$39,463	$46,950	$7,487	5	$500	-$1,355	$6,132	-$855
Volvo	S80/S90 AWD	2011 - T6 [3.0, V6, A(S6)] 2017 - T6 Momentum [2.0, I4, A(S8)]	$43,468	$52,950	$9,482	4	$400	-$1,227	$8,256	-$827
Volvo	XC60 AWD	2011 - 3.2 [3.2, V6, A(S6)] 2017 - T5 Dynamic [2.0, I4, A(S8)]	$36,739	$42,950	$6,211	3	$300	-$1,050	$5,161	-$750
Hyundai	Equus/G90	2011 - Signature [4.6, V8, A(A6)] 2017 - Premium [3.3, V6, A(S8)]	$61,944	$68,100	$6,156	2	$200	-$894	$5,262	-$694
Nissan	Armada AWD	2011 - SV [5.6, V8, A(A5)] 2017 - SV [5.6, V8, A(S7)]	$46,469	$47,800	$1,331	1	$100	-$767	$565	-$667
Nissan	Armada AWD	2011 - SL [5.6, V8, A(A5)] 2017 - SL [5.6, V8, A(S7)]	$48,744	$52,550	$3,806	1	$100	-$767	$3,040	-$667

Division	Model	Trim	2011 Price in 2017 Dollars[12]	2017 Price	Change in Price	Change in MPG[3]	Cost of FE Tech ($100/ MPG)[4]	Change in 5 Yr. Gas Costs[5]	Price Difference Plus Gas Savings	FE Tech Cost Plus Gas Savings
Nissan	Armada AWD	2011 - Platinum [5.6, V8, A(A5)] 2017 - Platinum [5.6, V8, A(S7)]	$56,487	$60,490	$4,003	1	$100	-$767	$3,237	-$667
Honda	CR-V 4WD	2011 - LX [2.4, I4, A(A5)] 2017 - LX [2.4, I4, A(AV)]	$23,170	$25,345	$2,175	4	$400	-$1,037	$1,138	-$637
Cadillac	SRX/XT5 AWD	2011 - Premium [3.0, V6, A(S6)] 2017 - Premium Luxury [3.6, V6, A(S8)]	$51,841	$54,390	$2,549	2	$200	-$807	$1,742	-$607
Nissan	Armada 2WD	2011 - SL [5.6, V8, A(A5)] 2017 - SL [5.6, V8, A(S7)]	$45,753	$49,650	$3,897	1	$100	-$671	$3,226	-$571
Nissan	Armada 2WD	2011 - Platinum [5.6, V8, A(A5)] 2017 - Platinum [5.6, V8, A(S7)]	$53,496	$57,590	$4,094	1	$100	-$671	$3,423	-$571
Nissan	Armada 2WD	2011 - SV [5.6, V8, A(A5)] 2017 - SV [5.6, V8, A(S7)]	$40,488	$44,900	$4,412	1	$100	-$671	$3,741	-$571
Cadillac	SRX/XT5 FWD	2011 - Performance [3.0, V6, A(S6)] 2017 - Premium Luxury [3.6, V6, A(S8)]	$45,337	$51,895	$6,558	2	$200	-$732	$5,827	-$532
Cadillac	SRX/XT5 FWD	2011 - Base [3.0, V6, A(S6)] 2017 - Base [3.6, V6, A(S8)]	$36,130	$38,995	$2,865	2	$200	-$732	$2,133	-$532
Cadillac	SRX/XT5 FWD	2011 - Luxury [3.0, V6, A(S6)] 2017 - Luxury [3.6, V6, A(S8)]	$40,862	$44,895	$4,033	2	$200	-$732	$3,302	-$532
Chrysler	T&C/Pacifica	2011 - Limited [3.6, V6, A(A6)] 2017 - Limited [3.6, V6, A(A9)]	$41,289	$42,495	$1,206	2	$200	-$732	$474	-$532
Audi	A4 Quattro	2011 - Prestige [2.0, I4, A(S8)] 2017 - Prestige [2.0, I4, A(AM-S7)]	$45,646	$48,000	$2,354	3	$300	-$745	$1,608	-$445
Audi	A4 Quattro	2011 - Premium [2.0, I4, A(S8)] 2017 - Premium [2.0, I4, A(AM-S7)]	$36,462	$39,400	$2,938	3	$300	-$745	$2,193	-$445
Audi	A4 Quattro	2011 - Premium Plus [2.0, I4, A(AM-S7)] 2017 - Premium Plus [2.0, I4, A(S8)]	$40,093	$43,200	$3,107	3	$300	-$745	$2,362	-$445
Audi	A4	2011 - Premium [2.0, I4, A(AV)] 2017 - Premium [2.0, I4, A(AM-S7)]	$34,123	$34,900	$777	3	$300	-$690	$87	-$390
Audi	A4	2011 - Premium Plus [2.0, I4, A(AV)] 2017 - Premium Plus [2.0, I4, A(AM-S7)]	$37,807	$41,100	$3,293	3	$300	-$690	$2,603	-$390
Hyundai	Equus/G90	2011 - Ultimate [4.6, V8, A(A6)] 2017 - Ultimate [5.0, V8, A(S8)]	$68,886	$69,700	$814	1	$100	-$471	$343	-$371
Buick	Lacrosse	2011 - CX [2.4, I4, A(S6)] 2017 - Preferred [3.6, V6, A(S8)]	$28,831	$36,065	$7,234	2	$200	-$560	$6,674	-$360
Lincoln	MKS/Continental FWD	2011 - FWD [3.7, V6, A(S6)] 2017 - Premiere [3.7, V6, A(S6)]	$44,076	$44,560	$484	1	$100	-$424	$60	-$324
Audi	A4 Quattro	2011 - Prestige [2.0, I4, M(M6)] 2017 - Prestige [2.0, I4, M(M6)]	$44,269	$48,000	$3,731	2	$200	-$477	$3,254	-$277
Audi	A4 Quattro	2011 - Premium [2.0, I4, M(M6)] 2017 - Premium[2.0, I4, M(M6)]	$35,084	$39,400	$4,316	2	$200	-$477	$3,839	-$277
Audi	A4 Quattro	2011 - Premium Plus [2.0, I4, M(M6)] 2017 - Premium Plus[2.0, I4, M(M6)]	$38,715	$43,200	$4,485	2	$200	-$477	$4,008	-$277
Hyundai	Genesis/G80	2011 - V6 [3.8, V6, A(A6)] 2017 - 3.8L V6 [3.8, V6, A(S8)]	$35,244	$41,400	$6,156	1	$100	-$348	$5,808	-$248
Audi	A5 Quattro	2011 - Premium [2.0, I4, A(S8)] 2017 - Sport [2.0, I4, A(S8)]	$40,360	$42,200	$1,840	1	$100	-$268	$1,572	-$168
Audi	A5 Quattro	2011 - Premium [2.0, I4, M(M6)] 2017 - Sport [2.0, I4, M(M6)]	$38,982	$41,200	$2,218	1	$100	-$248	$1,970	-$148

Division	Model	Trim	2011 Price in 2017 Dollars[1][2]	2017 Price	Change in Price	Change in MPG[3]	Cost of FE Tech ($100/ MPG)[4]	Change in 5 Yr. Gas Costs[5]	Price Difference Plus Gas Savings	FE Tech Cost Plus Gas Savings
Hyundai	Elantra	2011 - Touring GLS [2.0, I4, A(A4)] 2017 - GT [2.0, I4, A(S6)]	$18,364	$19,800	$1,436	1	$100	-$229	$1,206	-$129
Hyundai	Elantra	2011 - Touring GLS [2.0, I4, M(M5)] 2017 - GT [2.0, I4, M(M6)]	$17,083	$18,800	$1,717	1	$100	-$229	$1,488	-$129
Audi	A5 Cabriolet Quattro	2011 - Premium [2.0, I4, A(S8)] 2017 - Sport [2.0, I4, A(AM-S7)]	$47,195	$48,600	$1,405	0	$0	$0	$1,405	$0
Hyundai	Elantra	2011 - Limited [1.8, I4, A(A6)] 2017 - Limited [2.0, I4, A(S6)]	$21,339	$22,350	$1,011	0	$0	$0	$1,011	$0
Lincoln	MKS/Continental AWD	2011 - AWD [3.7, V6, A(S6)] 2017 - Premiere [3.7, V6, A(S6)]	$46,095	$46,560	$465	0	$0	$0	$465	$0
Hyundai	Elantra	2011 - GLS [1.8, I4, M(M6)] 2017 - SE [2.0, I4, M(M6)]	$15,838	$17,150	$1,312	-3	$0	$520	$1,832	$520
Hyundai	Genesis/G80	2011 - V8 [4.6, V8, A(A6)] 2017 - 5.0L V8 [5.0, V8, A(S8)]	$45,924	$54,550	$8,626	-2	$0	$894	$9,520	$894

[1]Inflation was calculated using BLS average inflation numbers from 2011-2016.

[2]Vehicle Price is from the New Car Cost Guide.

[3]Fuel Economy of Vehicles is from the EPA.

[4]CFA bases its estimate of the cost of fuel economy on a review of the literature including historical, market-based and engineering studies, as described in Appendix B.

[5]Gas costs based on driving the vehicle 14,000 miles per year for 5 years and using gas prices from AAA (7/10/17).

2011 Vehicles Which Were Less Expensive in 2017 Dollars and Had Higher MPG

2011 Vehicles Which Were More Expensive in 2017, but Who's Fuel Savings Offset the Entire Price Increase

2011 Vehicles Which Were More Expensive in 2017, but Who's Fuel[4] Savings Offset the $100 per MPG Cost of Fuel Efficient Technology

2011 Vehicles Which Were More Expensive in 2017 and Whose Fuel Economy Stayed the Same or Decreased

Appendix B: The Cost of Increasing Fuel Economy: Support for Identifying an Average of $100 as the Cost Per Mile of Fuel Economy Improvement

Estimating the cost of increasing fuel economy has been a matter of great debate for decades. Empirical analyses that look at actual costs show that regulators overestimate the cost by a factor of two and automakers overestimate it by much more.

David Greene, one of the leading experts on fuel economy, recently conducted a review of the literature in which he concluded that an estimate of 27% of the increase in vehicle cost, or about $150 for every mile per gallon improvement, was too high. He gave two reasons for this.

First, backward looking analysis of cost increases that included used vehicles (as his analysis did), were double counting the cost of increasing fuel economy because the sellers of vehicles were capturing a significant part of the capitalized value of better fuel economy equal to about 20% of the estimated cost of efficiency, in their sales price. This factor alone would lower the estimate to 21.6% of the increase in price or about $120 for each 1 mile improvement in the MPG.

Second, real world experience showed that there was a learning process in which costs fell as automakers gained more experience with increasing fuel economy. He suggested that 2% per year was a reasonable estimate. Over the redesign cycle of vehicles (e.g. five years) this learning rate would lower the cost by about 10%. Thus, one might argue that the appropriate numbers would be about 20% per year and $108 dollars per MPG, as shown in Table 1.

There is a third factor that is implicit in Greene's analysis. The distribution of the cost of vehicles is skewed. The much more expensive vehicles purchased by upper income households are likely to include a larger amount of costs incurred to upscale the vehicles, rather than for fuel economy.

In a subsequent analysis Greene estimated the cost of improving fuel economy directly with an econometric model that corroborated the above concerns, as shown in Table 1. The simple adjustment to a constant 20% of total cost moves the estimate much closer to

the empirical evidence offered by Greene suggesting costs that are about two thirds of the literature review—about 18% or $99/MPG.

EPA's analysis of the cost of the National Program currently yields an estimated cost for fuel savings that is similar, $97/MPG. This estimate reflects considerable technological progress over the early years of the National Program, which is consistent with the historical pattern. A recent study by the ICCT offers an estimate of going forward costs of improvement close to the rate of the national program (national program = 3.3%, ICCT = 4% per year). The ICCT study also includes continuing technological progress.

Moreover, our data on new models since the National Program reducing emissions/fuel economy, supports the key problem with using a simple percentage of the total cost of the vehicle to approximate the cost of improving fuel economy, as shown in the charts below. There is a strong, negative correlation (r = -.7) between the cost of a vehicle and the mileage and a moderate, negative correlation (r= -.4) between the cost of the vehicle and the change in mileage. A fixed percentage makes no sense.

In light of this analysis, we believe a cautious estimate of the cost of fuel economy improvements is $100/MPG improvement.

TABLE 1: HISTORICAL AND ENGINEERING ESTIMATES OF THE COST OF INCREASING MILEAGE

	Greene Literature Review	Simple Adjustment Approach	Greene Direct	EPA Final 2017-2025	ICCT Estimate for 2025-2030 4.5%/year
Annual Cost	$213	na	$141	$97	$110
% of Total Cost Increase	27%	20%	18%	na	na
$/MPG	$150	$108	$99	$97	$86

Sources: Greene 1,2, EPA Determination, ICT

VEHICLE COST AND MILEAGE