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Analysis of Corporate Average Fuel Economy (CAFE) Standards for Light Trucks and Increased Alternative Fuel Use

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Introduction

Sen. Frank Murkowski, the Ranking Minority Member of the Senate Committee on Energy and Natural Resources requested an analysis of selected portions of Senate Bill 1766 (S. 1766, the Energy Policy Act of 2002), House Resolution 4 (the Securing America's Future Energy Act of 2001) and Senate Bill 517 (S. 517, the Energy Policy Act of 2002).[1,2,3] In response, the Energy Information Administration (EIA) has prepared a series of analyses showing the impacts of each of the selected provisions of the bills on energy supply, demand, and prices, macroeconomic variables where feasible, import dependence, and emissions. The analysis provided is based on the Annual Energy Outlook 2002[4] (AEO2002) midterm forecasts of energy supply, demand and prices through 2020.

Because of the rapid delivery requested by Sen. Murkowski, each requested component of the Senate and House bills was analyzed separately, that is, without analyzing the interactions among the various provisions. Because of the approach taken:

- The combined impact of the individual policies cannot be determined by simply adding the individual policy impacts together. For example, a provision establishing a renewable portfolio standard (RPS) for electricity production, and one that establishes a bio-diesel program for transportation fuels, each increases the use of biomass. The simultaneous enactment of the two provisions would be likely to increase biomass costs because of the competition for land and other needed resources. The estimated fossil energy displaced will therefore be lower than the sum of the two individual policy impacts because of the higher resource costs. Stated another way, the impacts of multiple simultaneous policies are non-linear.

- Some policies will interact to increase the overall response while others may interact to mitigate the impacts of each other. For example, when two separate policies increase demand and, consequently, production of an advanced technology, the reductions in manufacturing costs expected from increased production are likely to be accelerated, making the technology even more attractive in later years. The total adoption of the advanced technology in this case could be greater than the sum of the parts.

[1] Letter from Sen. Murkowski to Mary J. Hutzler, dated December 20, 2001. See Appendix A for a copy of the original letter.
[2] Letter from Sen. Murkowski to Mary J. Hutzler, dated February 6, 2002. See Appendix A for a copy of the original letter.
[3] Email from Bryan Hannegan to Mary J. Hutzler dated February 21, 2002. See Appendix A for a copy of the original email.
[4] Energy Information Administration, *Annual Energy Outlook 2002, With Projections to 2020*, DOE/EIA-0383(2002), (Washington, DC, December 2001).

In addition, the following should also be noted:

- At of the time of the initial request, Section 801 of S. 1766 had been designated as a placeholder for increased fuel economy provisions; therefore, it was originally requested that this study examine, the impacts of the CAFE standards proposed in Senate Bill 804 (S. 804, the Automobile Fuel Economy Act of 2001). It has since been requested that Section 801 of S. 517 also be analyzed.

- Increasing fuel economy standards results in consumer benefits realized through increased fuel savings. Although this is a positive aspect, significant reductions in vehicle horsepower and weight are generally associated with aggressive increases in CAFE standards. Given current consumer preference for these attributes, significantly increasing CAFE could have the unintended effect of reducing new vehicle sales or shifting new vehicle sales to larger size classes.

- Embodied in this analysis is the assumption that manufacturers will opt to produce more expensive, lighter weight vehicles to meet the proposed CAFE standards as opposed to paying the less expensive fine for non-compliance. For the most aggressive standards examined in this study, if no additional fuel economy improvements were achieved relative to the reference case, the CAFE fines for non-compliance would approximate $590 per vehicle for like trucks and $500 per vehicle for cars. Although the fine is only slightly lower than the estimated increase in cost for cars due to improved fuel economy, for light trucks, the fine for no fuel economy improvement would represent about 60 percent of the cost of improving fuel economy.

- This study does not consider increases in diesel or hybrid market penetration, beyond those estimated in the reference case, as an option to meet the proposed CAFE standards. This is due to uncertainties regarding emissions compliance for diesels and consumer acceptance for either of the technologies. Technologies requiring mild hybridization are addressed in this study. Mild hybridization typically refers to the incorporation of a 42-volt electrical system on a vehicle. The 42-volt electric system increases electrical power thus allowing the use of electrically powered systems such as electric power steering, electric brakes, and electromechanical value actuation.

EIA's projections are not statements of what will happen but what might happen, given known technologies, current technology and demographic trends, and current laws and regulations. Thus, the AEO2002 provides a policy-neutral Reference Case that can be used to analyze energy policy initiatives, as has been done for each of these studies. EIA does not propose, advocate or speculate on future legislative or regulatory changes. Laws and regulations are assumed to remain as currently enacted or in force in the Reference Case; however, the impacts of emerging regulatory changes, when clearly defined, are reflected.

Models are simplified representations of reality because reality is complex. Projections are highly dependent on the data, methodologies, model structure and assumptions used to develop them. Because many of the events that shape energy markets are random and cannot be anticipated (including severe weather, technological breakthroughs, and geo-political

disruptions), energy market projections are subject to uncertainty. Further, future developments in technologies, demographics, and resources cannot be foreseen with any degree of certainty. These uncertainties are addressed through analysis of alternative cases in the AEO2002.

National Energy Modeling System

The projections and quantitative analysis for this report were prepared using the Transportation Demand Module (TRAN) of the National Energy Modeling System (NEMS). NEMS is a computer-based, energy-economic model of the U.S. energy system for the mid-term forecast horizon, through 2020. NEMS projects production, imports, conversion, consumption, and prices of energy, subject to assumptions about macroeconomic and financial factors, world energy markets, resource availability and costs, behavioral and technological choice criteria, cost and performance characteristics of energy technologies, and demographics. Using econometric, heuristic, and linear programming techniques, NEMS consists of 13 submodules that represent the demand (residential, commercial, industrial, and transportation sectors), supply (coal, renewables, oil and natural gas supply, natural gas transmission and distribution, and international oil), and conversion (refinery and electricity sectors) of energy, together with a macroeconomic module that links energy prices to economic activity. An integrating module controls the flow of information among the submodules, from which it receives the supply, price, and quantity demanded for each fuel until convergence is achieved.[5]

Domestic energy markets are modeled by representing the economic decision-making involved in the production, conversion, and consumption of energy products. For most sectors, NEMS includes explicit representation of energy technologies and their characteristics. In each sector of NEMS, economic agents—for example, representative households in the residential demand sector and producers in the industrial sector— are assumed to evaluate the cost and performance of various energy-consuming technologies when making their investment and utilization decisions. The costs of making capital and operating changes to comply with laws and regulations governing power plant and other emissions are included in the decision making process.

Provisions Addressed in this Study

This study addresses the provisions of H.R. 4, S. 804, and S. 517 that pertain to light vehicle fuel economy in the transportation sector. An additional case that represents a 5 percent increase in fuel economy in 2005, followed by a 10 percent increase in 2010 is also examined. There are three main sections. The first provides a summary comparing the impacts of the CAFE cases to a revised AEO2002 Reference Case. A detailed analysis of each case is presented in the second section where the estimated effects of the fuel economy provisions are presented. A qualitative discussion is provided in the last section for the alternative fuels provisions included in S. 1766 and H.R. 4.

[5] For more information on the National Energy Modeling System see, *The National Energy Modeling System: An Overview 2000*, DOE/EIA-0581(2000), (Washington, DC, April 2000).

Summary of CAFE provisions

This analysis provides a comparison of the energy, carbon and economic impacts of five proposed CAFE standards to a specific baseline. The five CAFE cases include:

1) H.R. 4 Section 201, specifying that light truck[6] (8,500 pounds or less gross vehicle weight) CAFE standards are to increase to a level that would provide a cumulative 5 billion gallon reduction in gasoline use between 2004 and 2010;
2) A Sensitivity Case, specifying that new light vehicle (including cars) fuel economy increases 5 percent in 2005 and 10 percent in 2010, relative to the current standards;
3) S. 804, specifying that light truck (10,000 pounds or less gross vehicle weight) fuel economy standards increase to 22.5 miles per gallon (mpg) in model years 2003 through 2004, 25 mpg in model years 2005 through 2007, and 27.5 mpg for model years 2008 and beyond;
4) An S. 804 Sensitivity Case in which the introduction dates for advanced conventional technologies are moved forward 3 to 4 years and are analyzed for potential fuel economy gains relative the CAFE standards defined S. 804; and
5) S. 517, specifying that the combined average fuel economy of new light vehicles increase to 35 mpg by 2013. For cars, the standard increases from 27.5 mpg to 38.3 mpg and for light trucks (10,000 pounds or less gross vehicle weight), the standard increases from 20.7 mpg to 32 mpg.

These individual cases are referred to as H.R. 4 Case, Sensitivity Case, S. 804 Case, S. 804 Advanced Date Case, and S. 517 Case in the body of this report, respectively. The S. 804 and S. 517 proposals also include an important provision that expands the definition and coverage of CAFE standards from light trucks with a gross vehicle weight (GVW) of 8,500 lbs or less to 10,000 lbs or less. The definition brings in the heavy light truck fleet, which has much poorer fuel efficiency than light trucks under the previous standards and definition.

Two additional cases are discussed as well, the 2002 Technology Case[7] and the AEO2002 Revised Reference Case. These cases are compared with the CAFE cases. The 2002 Technology Case provides an outlook that assumes no new technology is adopted over the projection period. The AEO2002 Revised Reference Case was developed specifically for this report and updates the AEO2002 Reference Case with new data for advanced conventional vehicle technologies. The report provides a detailed discussion of the proposed CAFE cases compared against the AEO2002 Revised Reference Case. All graphical comparisons include projections from the 2002 Technology Case, so that the reader can measure the impacts relative to a vehicle with today's technology as well as the a vehicle with the improvements projected in the Revised Reference Case.

The detailed projections for the AEO2002 Revised Reference Case and CAFE cases are shown in Table 1. The following is a summary of the findings of this report:

[6] Light trucks include vehicles defined as pickup trucks, vans or minivans, and sport utility vehicles (SUVs).
[7] Energy Information Administration, *Annual Energy Outlook 2002, With Projections to 2020*, DOE/EIA-0383(2002), (Washington, DC, December 2001).

- For H.R. 4, it is estimated that in order to save 5 billion gallons of gasoline, the light truck CAFE standard would need to be increased to 21.5 mpg from the current standard of 20.7 mpg. The light truck fuel savings and subsequent increase in CAFE standards required in H.R. 4 are exceeded in the AEO2002 Revised Reference Case. Comparing the AEO2002 Revised Reference Case to the 2002 Technology Case, by 2010, light truck energy use is reduced 2.2 billion gallons annually and cumulative fuel savings exceed 8 billion gallons.

- For the Sensitivity Case, the proposed CAFE standards for cars and light trucks are met with little impact on vehicle prices or performance. The new CAFE standards require slight increases over the AEO2002 Revised Reference Case projected fuel economy of cars and light trucks. As a result, light truck incremental costs are $60 (in 2000 dollars) in 2010, but fall to zero by 2020. For cars, incremental costs are $40 in 2010 and $110 in 2020, compared to the AEO2002 Revised Reference Case. Light vehicle annual fuel use is reduced 1.6 billion gallons (1 percent) in 2010 and 5.5 billion gallons (3 percent) in 2020 compared to the AEO2002 Revised Reference Case. Carbon equivalent emissions are reduced 3.9 million metric tons (MMTCe) (1 percent) in 2010 and 13.0 MMTCe (3 percent) in 2020.

- For the S. 804 Case, the proposed CAFE standard is not met. Although light trucks less than 8,500 pounds GVW achieve the standard by 2014, those light trucks greater than 8,500 pounds GVW, achieve a fuel economy of only18.2 mpg, reducing overall light truck CAFE to 26.6 mpg. As a result, light truck manufacturers would pay almost $10 billion in CAFE fines over the projection period. Light truck costs increase $601 in 2010 and $1,294 in 2020 above the AEO2002 Revised Reference Case. Assuming consumers hold vehicles for four years on average and using an 8 percent discount rate, the net present value of the realized fuel savings is approximately $500, resulting in a net increase in cost to consumers. Slight sales increases are projected for midsize and large cars due to lower fuel prices, thus lowering average new car fuel economy relative to the Revised Reference Case. In 2010, fuel use is 6.4 billion gallons (4.2 percent) lower and 14.7 billion gallons (8.1 percent) lower in 2020, compared to the AEO2002 Revised Reference Case. The reduction in light vehicle fuel demand is projected to reduce net petroleum imports by 5 percent (830 thousand barrels per day) by 2020. The projected decrease in imported petroleum fuels results in a 1.7 percent decrease ($0.42 in 2000 dollars) in world oil prices by 2020. Carbon equivalent emissions from the transportation sector are reduced by 15 million metric tons in 2010 and 34.8 million metric tons in 2020. By 2020, this equates to an annual carbon reduction of 8.0 percent for light vehicles.

  The macroeconomic impacts of imposing stricter CAFE standards are relatively small. Declining real consumption and investment expenditures dominate the early part of the forecast period and introduce cyclical behavior in the economy. In 2010, real GDP is forecast to be 0.1 percent lower relative to the reference case and non-agricultural employment declines by 214 thousand jobs, 0.15 percent of total non-agricultural employment in the economy. Beyond 2015, the economy is expected to recover and move back toward the reference growth path. The sum of the discounted change in real GDP (billions of dollars discounted at 7 percent) is $134 billion between 2003 and 2020. This

represents a loss of 0.11 percent of real GDP relative to the reference discounted sum of real GDP over this period.

- In the S. 804 Advanced Date Case light trucks less than 8,500 pounds meet the standard in all years except 2008 and 2009, but again the overall CAFE standard is not achieved due to the fuel economy of heavy light trucks. Although heavy light truck fuel economy increases from 14.2 mpg to 18.2 mpg over the projection period, including them in the CAFE estimation results in light trucks not meeting the standard. Because fuel economy improvements occur more rapidly in this case, CAFE fines are reduced $2.6 billion to $7.4 billion over the projection period, compared to the S. 804 Case. Light truck costs are $1,013 higher in 2010 and $1,116 higher in 2020, compared to the reference case. As in the S. 804 Case, the net present value of the realized fuel savings is approximately $500, resulting in a net increase in cost to consumers. By 2020, annual fuel savings exceed 15 billion gallons. The reduction in highway fuel demand is projected to reduce net petroleum imports by 5.2 percent (860 thousand barrels per day) by 2020 compared to the AEO2002 Revised Reference Case. The projected decrease in imported petroleum fuels results in a 1.9 percent decrease ($0.48 per barrel) in world oil prices by 2020. By 2020, carbon equivalent emissions are reduced 35.6 million metric tons, a decrease of 8.2 percent in light vehicle emissions and are similar to the S. 804 Case.

- For the S. 517 Case, the proposed minimum CAFE standards for 2013 are not met. For cars, the standards are met through 2009, after which fuel economy continues to increase to a peak of 35.9 mpg in 2018. Light trucks (trucks less than 10,000 pounds GVW) meet the proposed standards through 2007; fuel economy continues to climb to a peak of 26.5 mpg in 2018. In 2013, the combined fuel economy achieved by cars and light trucks is 30.2 mpg, 4.8 mpg less than the required minimum. By 2020, the combined average increases to 31.0 mpg. Vehicle manufacturers would pay a projected $40 billion in CAFE fines over the projection period. In addition, the projections show that compared to the AEO2002 Revised Reference Case the incremental cost of a new car would be $535 higher and light trucks would be $961 higher in 2020. Assuming consumers hold vehicles for four years and using an 8 percent discount rate, the net present value of the realized car fuel savings is approximately $390, resulting in a net increase in cost to consumers. For light trucks, the net present value of fuel savings is approximately $500, also resulting in a net increase in the cost to consumers. In 2010, light vehicle fuel use decreases 6.7 billion gallons (4.2 percent) and 22.4 billion gallons (11.8 percent) in 2020, compared to the reference case. The reduction in light vehicle fuel demand is projected to reduce net petroleum product imports by 7.7 percent (1.3 million barrels per day) by 2020. Carbon equivalent emissions from the transportation sector are reduced by 15.7 million metric tons in 2010 and 53.1 million metric tons in 2020. By 2020, this equates to an annual carbon reduction of 12.3 percent for light vehicles.

  The impact on the economy is small through 2010. By 2010, real GDP is projected to be 0.14 percent lower than the reference, almost the same impact as under the S. 804 Case. However, with the steady increase in the incremental cost of new light duty vehicles from 2010 through 2020, the economy continues to worsen and by 2015 real GDP is 0.30 percent lower than the reference. The economy begins to rebound past 2015, but by 2020 real GDP is still 0.15 percent lower. The sum of the discounted change in real GDP (billions of dollars discounted at 7 percent) is $170 billion between 2003 and 2020. This represents a loss of

0.14 percent of real GDP relative to the reference discounted sum over this period. By 2015, the peak loss in non-agricultural employment is 453 thousand jobs, 0.30 percent of the total non-agricultural employment in the economy. By 2020, with the economy beginning to recover, non-agricultural employment is still down by 293 thousand jobs (0.19 percent).

National Research Council CAFE Comparison

The National Research Council (NRC) recently published a report on the effectiveness of CAFE standards and estimates of potential car and light truck fuel economy improvements and the incremental vehicle costs associated with those improvements.[8] The study did not allow for weight reduction as a means of increasing fuel economy and assumed vehicle weight would remain at today's levels. Their analysis indicated that by 2015, average new car fuel economy could be increased to about 33.5 mpg at an incremental cost of $690. For the EIA S. 517 Case, the analysis indicated that cars could achieve 35.9 mpg at an incremental cost of $535. The higher fuel economy and lower incremental cost projections in the EIA S. 517 Case compared to the NRC study reflect the improvements gained when weight reduction is included as an option to increase fuel economy. In the EIA S. 517 Case, average car weight in 2020 is projected to be 364 pounds lighter than the average car in model year 2000, a decrease of 11.8 percent.

The NRC study estimates that average new light truck (less than 8,500 pounds gross vehicle weight) fuel economy could be increased to about 27.5 mpg at an incremental cost of $1,260 with no reduction in vehicle weight. The EIA S. 517 Case analysis shows that light truck (less than 8,500 pounds gross vehicle weight) fuel economy could increase to 27.6 mpg at an incremental cost of $961. This estimate includes a weight reduction of 321 pounds (7.5 percent) from a model year 2000 light truck, showing the improvements in cost reduction and fuel economy realized from vehicle weight reduction. It's important to note that although our analysis agrees with the NRC study for cars and light trucks less than 8,500 pounds gross vehicle weight (GVW), increasing the CAFE weight limit to less than 10,000 pounds GVW limits the fuel economy improvement potential for light trucks.

Summary of Alternative Fuel Provisions

For the alternative fuel provisions in S. 1766, the following Sections have been reviewed: 811, 812, 814, 815, 816, and 819.[9] There are two main purposes of these provisions of S. 1766: increase the use of alternative fuels in Federal fleets and fund a large demonstration program aimed at using alternative, fuel cell, and ultra-low sulfur diesel school buses. The funding that would be authorized in these provisions totals $260 million.

[8] National Research Council, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFÉ) Standards*, (Washington, DC, 2002).

[9] Sections 817 and 818 which provide biodiesel fuel use credits and specifies required renewable fuel content of motor vehicle fuels are discussed in a separate response, *Summary of Renewable Fuels Standard/MTBE Cases Requested by the Senate Energy Committee*.

Table 1. Summary of Key Results of Four CAFE Cases Compared to the AEO2002 Revised Reference Case (2010, 2020)

		AEO2002 Revised Reference[1]	Sensitivity	S. 804	S. 804 Advanced Date	S. 517
	2000	**2010**				
Light Vehicle Consumption (billion gallons)	124.9	154.0	152.4	147.6	146.6	147.4
Net Petroleum Imports (million barrels per day)	10.49	14.30	14.19	13.91	13.83	13.90
World Oil Price (2000 $)	27.72	23.36	23.36	23.14	23.09	23.13
GDP (billion 1996 dollars)	9,224	12,309	12,308	12,292	12,282	12,292
Light Vehicle Carbon Equivalent Emissions (million metric tons)	297.9	366.0	362.1	350.9	348.4	350.3
Average New Car Fuel Economy (miles per gallon)	28.90	29.58	30.82	29.53	29.52	33.44
Average New Light Truck Fuel Economy (miles per gallon)	21.08	22.52	23.25	25.56	26.41	25.05
Average New Car Horsepower	165	202	194	202	202	174
Average New Light Truck Horsepower[2]	193	237	235	203	203	215
Average New Car Weight (pounds)	3087	3257	3160	3258	3258	2826
Average New Light Truck Weight (pounds) [2]	4257	4554	4513	4053	3966	4105
		2020				
Light Vehicle Consumption (billion gallons)		181.8	176.3	167.1	166.8	159.4
Net Petroleum Imports (million barrels per day)		16.69	16.38	15.86	15.83	15.40
World Oil Price (2000 $)		24.68	24.68	24.26	24.20	24.01
GDP (billion 1996 dollars)		16,530	16,525	16,519	16,527	16,505
Light Vehicle Carbon Equivalent Emissions (million metric tons)		432.1	419.2	397.3	396.6	379.1
Average New Car Fuel Economy (miles per gallon)		29.63	31.79	29.53	29.53	35.84
Average New Light Truck Fuel Economy (miles per gallon)[2]		23.18	23.57	26.48	26.47	26.49
Average New Car Horsepower		220	198	220	220	168
Average New Light Truck Horsepower[3]		252	249	206	206	206
Average New Car Weight (pounds)		3359	3100	3360	3360	2723
Average New Light Truck Weight (pounds) [3]		4784	4721	3984	3960	3936

Source: National Energy Modeling System runs: s804base.d020702b, s8045and10.d020702a, s804base.d020702b, s804advd.d021102a, and s517cafe.d022502a.

[1] The AEO2002 Revised Reference Case also represents the H.R. 4 Case.

[2] Average new light truck fuel economy for the AEO2002 Revised Reference and Sensitivity Cases represent light trucks less than 8,500 pounds gross vehicle weight. Light truck fuel economy shown for the S. 804, S. 804 Advanced Date, and S. 517 Cases represent light trucks less than 10,000 pounds gross vehicle weight.

[3] The values shown in the table represent vehicles less than 8,500 pounds gross vehicle weight. NEMS does not address the horsepower or weight aspects of Class 2b vehicles (8,500 to 10,000 pound vehicles).

The Federal fleet provisions basically codify the requirements of Executive Order 13149. However, the proposed legislation would require flexible fuel vehicles to eventually use only alternative fuels. The proposed legislation would also allow neighborhood electric vehicles to qualify as alternative fuel vehicles. Since the covered vehicles in the Federal fleet accounted for less than 0.2 percent of highway fuel use in 2000, it is likely that little if any measurable reduction in transportation petroleum consumption would result from these Federal fleet provisions. Another provision of S. 1766 would exempt alternative fuel vehicles from High Occupancy Vehicle (HOV) requirements. The impact of this provision cannot be estimated, as there is no data specific to petroleum consumption in HOV lanes, but the impact of this provision would be more likely to increase transportation petroleum consumption (due to increased congestion in HOV lanes).

For H. R. 4, the following Sections have been reviewed: 151, 205, 206, 2101-2105, 2131-2133.[10] The funding that would be authorized in these provisions totals $515 million. There are three main purposes of these H.R. 4 provisions: increase the use of alternative fuels in Federal fleets, fund a large demonstration program aimed at using alternative, fuel cell, and ultra-low sulfur diesel school buses, and fund a program to provide grants to local governments to purchase alternative fuel vehicles and low-sulfur diesel vehicles.[11] Many of these provisions of H.R. 4 are similar to the S. 1766 provisions. For example, the school bus provisions are virtually identical to S. 1766 except that H.R. 4 would authorize an additional $40 million. However, the Federal fleet provision is more extreme than the corresponding S. 1766 provisions in that the Federal fleet would have to be entirely converted to alternative fuel vehicles by 2009. In terms of dollar authorization, the largest difference between the two bills is H.R. 4's Alternative Fuels Vehicle Acceleration Act of 2001. The latter provisions would provide grants to local governments to purchase alternative fuel vehicles, with a total budget authorization of $200 million.

While some provisions of these bills may have the effect of advancing technology development, there is likely to be little impact on total transportation fuel consumption.

AEO2002 Revised Reference Case

The AEO2002 Revised Reference Case represents a modified version of the AEO2002 Reference Case. The modifications made for this case are limited to advanced conventional technologies used in the evaluation of fuel economy improvement. The National Energy Modeling System (NEMS) evaluates a menu of fifty-two advanced conventional engine technologies for improvement of conventional vehicle performance and/or fuel economy over the projection period.[12] Performance is defined as a vehicle's horsepower to weight ratio. Due to increasing consumer demand for heavier vehicles, much of the advanced technology adopted

[10] Section 153 which would provide biodiesel credits is discussed in a separate response, *Summary of Renewable Fuels Standard/MTBE Cases Requested by the Senate Energy Committee*.

[11] Possible effects of the transition to ultra low-sulfur diesel are discussed in Energy Information Administration, *The Transition to Ultra-Low-Sulfur Diesel Fuel: Effects on Prices and Supply*, SR/OIAF/2001-01, (Washington, DC, May 2001).

[12] Vehicle technology inputs to the analysis include the cost, introduction date, and the impact a specific technology has on horsepower, vehicle weight, and fuel economy.

in the past has been utilized to increase horsepower so that performance is enhanced while maintaining vehicle fuel economy.

The findings reported in *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*[13] by the National Research Council and concerns regarding the ability of certain advanced conventional engine technologies to provide increased fuel efficiency while meeting Tier 2[14] emissions standards, led to a re-examination of the AEO2002 slate of technologies and their associated performance and cost attributes. This research resulted in the adjustment of seven of the advanced conventional technologies used for new vehicle fuel economy evaluation (Table 2).

Table 2. AEO2002 Revised Reference Case Advanced Technology Attributes Compared to the AEO2002 Reference Case.

	AEO2002 Reference Case		AEO2002 Revised Reference Case	
Technology Type	Efficiency Improvement	Incremental Cost (2000 $)	Efficiency Improvement	Incremental Cost (2000 $)
Advanced drag reduction	6.9%	112	1.5%	70
Engine friction reduction	5.0%	90	3.0%	90
Variable valve timing	8.0%	230	3.0%	140
Accessory improvement	1.0%	30	2.0%	90
Advanced tires	2.0%	32	1.5%	32
Continuously variable Transmission	10.0%	250	6.0%	250
Gasoline direct injection	17.0%	650	5.0%	650
Added Technologies				
Electromechanical valve actuation	N/A	N/A	7.5%	420
Intake valve throttling	N/A	N/A	4.5%	315
Variable compression ratio	N/A	N/A	4.0%	320

N/A = Not Applicable
Source: Energy Information Administration, *Assumptions to the Annual Energy Outlook 2002 (AEO2002)*, Table 28, p. 51, DOE/EIA-0554(2002), Washington, DC, December 2001.

The technologies showing the largest decrease in efficiency improvement include: advanced drag reduction reduced from 6.9 percent to 1.5 percent, variable valve timing reduced from 8 percent to 3 percent, continuously variable transmission reduced from 10 percent to 6 percent, and gasoline direct injection was reduced from 17 percent to 5 percent. In addition, adjustments were made to the expected cost of advanced vehicle technologies. The incremental costs for advanced drag reduction and advanced variable valve timing were reduced reflecting the significantly lower efficiency improvement expected for these technologies. The costs

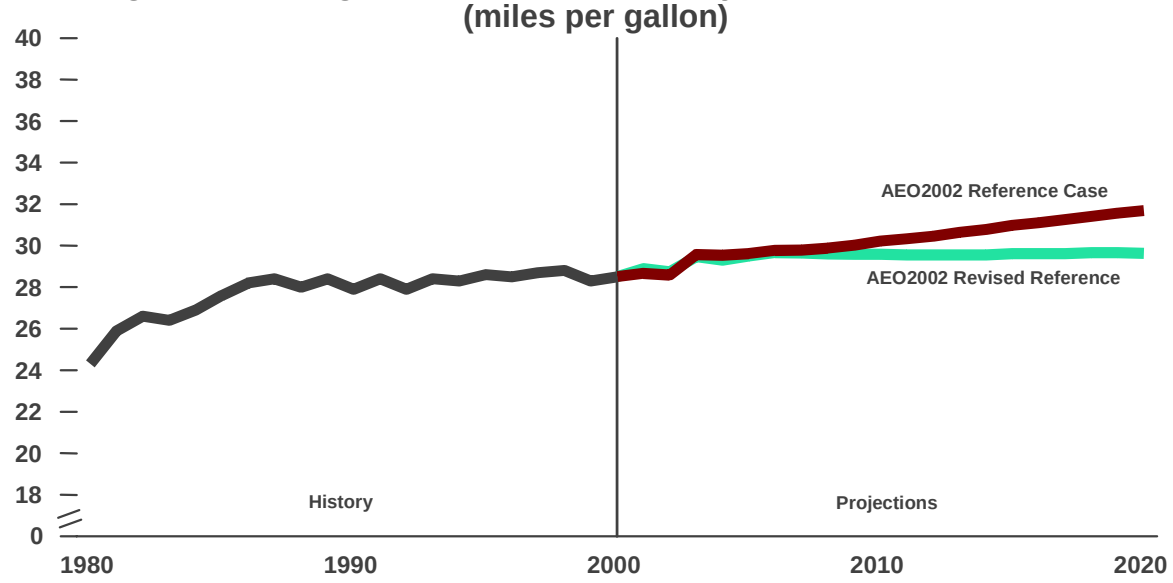
[13] National Research Council, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFÉ) Standards*, (Washington, DC, 2002).
[14] In February of 2000, the Environmental Protection Agency finalized more stringent emissions standards for cars and light trucks to take effect in year 2004.

associated with advanced engine friction reduction, advanced tires, continuously variable transmission and gasoline direct injection remained unchanged. The only technology to increase in price was engine accessory improvements. Success in research and development activities has resulted in the introduction of several new advanced conventional technologies. Three of these new technologies were added to NEMS for this analysis: electromechanical valve actuation, intake valve throttling, and variable compression ratio. Each of these technologies is expected to be introduced into the light vehicle market within the next five years.

Compared to the AEO2002 Reference Case, the modifications made to the advanced technology assumptions reduced new car fuel economy 6.5 percent and new light truck fuel economy 2.6 percent in 2020. Figures 1 and 2 show the projected car and light truck fuel economy for the AEO2002 Reference Case compared to the AEO2002 Revised Reference Case. In addition to reductions in vehicle efficiency, minor declines in vehicle weight and horsepower occur over the projection period relative to the AEO2002 Reference Case due to reduced market penetration of advanced conventional technologies (Table 3).

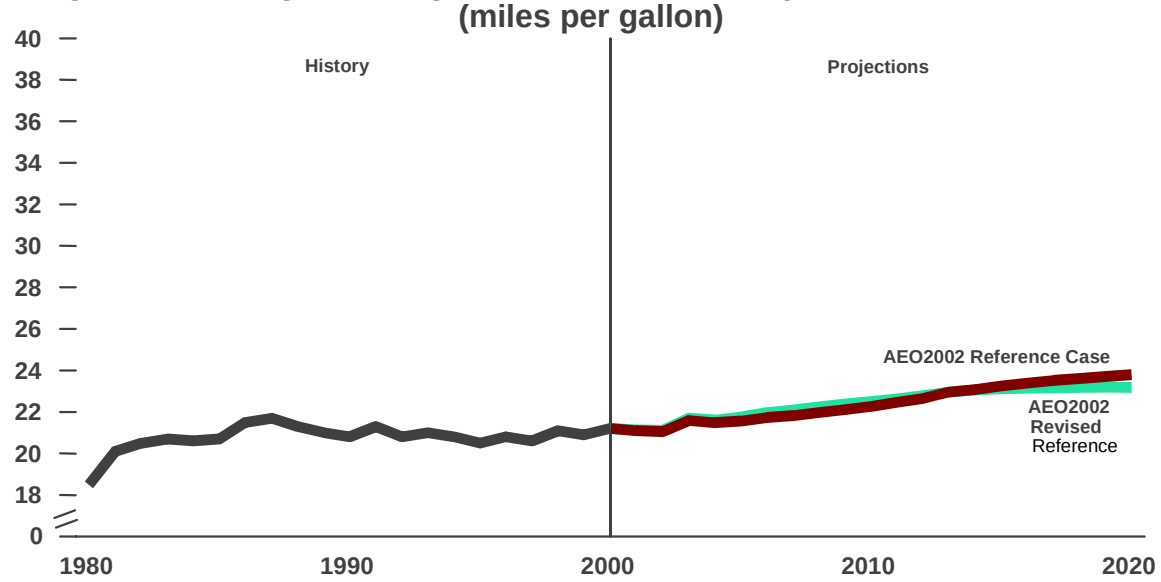
The impact of the AEO2002 Revised Reference Case fuel economy changes results in a 1.9 percent increase in light vehicle fuel consumption in 2020, an increase of 1.8 billion gallons.

Figure 1. Average New Car Fuel Economy in Two Cases, 1980-2020 (miles per gallon)



Source: National Highway Traffic Safety Administration, "Summary of Fuel Economy Performance," Washington, DC, March 2001. National Energy Modeling System runs: aeo2002.d102001b, s804base.d020702b.

Figure 2. Average New Light Truck Fuel Economy in Two Cases, 1980-2020 (miles per gallon)



Source: National Highway Traffic Safety Administration, "Summary of Fuel Economy Performance," Washington, DC, March 2001. National Energy Modeling System runs: aeo2002.d102001b, s804base.d020702b.

Table 3. Comparison of AEO2002 Reference Case Vehicle Horsepower and Weight to the AEO2002 Revised Reference Case.

	AEO2002 Reference Case		AEO2002 Revised Reference Case	
2000	Horsepower	Weight (pounds)	Horsepower	Weight (pounds)
Car	165	3105	165	3105
Light truck	193	4257	193	4257
2005				
Car	191	3230	188	3191
Light truck	218	4410	217	4380
2010				
Car	206	3306	202	3257
Light truck	240	4618	236	4554
2015				
Car	217	3353	213	3309
Light truck	249	4733	246	4684
2020				
Car	223	3390	220	3359
Light truck	253	4812	252	4784

Source: National Energy Modeling System runs: aeo2002.d102001b, s804base.d020702b.

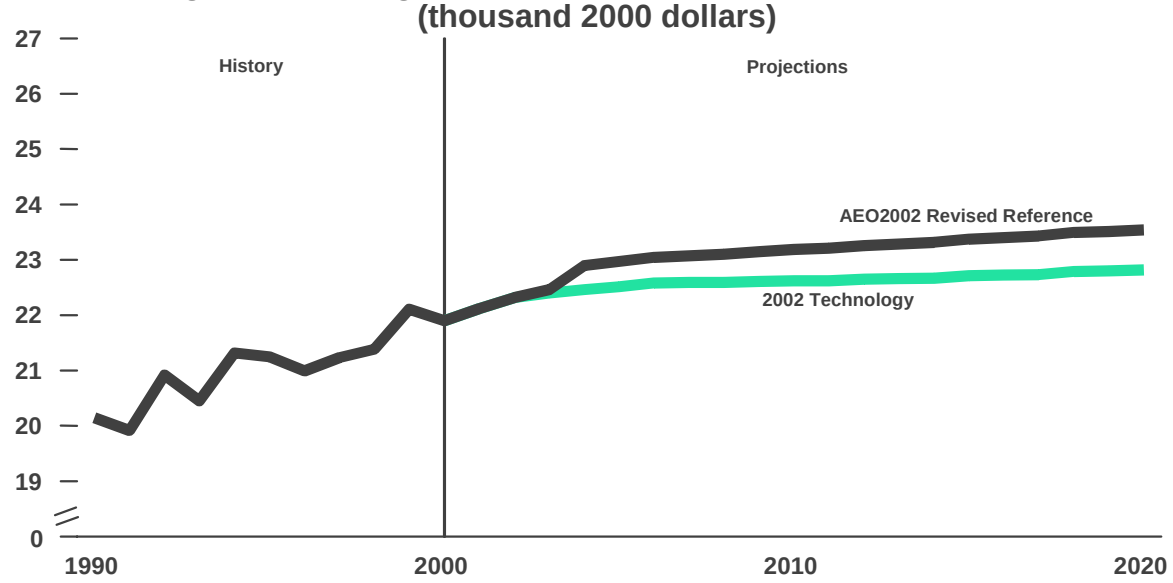
2002 Technology Case

The 2002 Technology Case assumes that after year 2002 no new technology will be adopted to increase vehicle efficiency over the forecast period. This case was developed to show the amount of efficiency gained in the AEO2002 Revised Reference Case compared to a case with no new technology.

Holding vehicle technology constant over the forecast results in lower projected vehicle prices (Figures 3 and 4). In 2020, car prices projected for the AEO2002 Revised Reference Case are 3.1 percent higher ($770) than those projected in the 2002 Technology case. Light truck vehicle prices are projected to be 2.6 percent higher ($720) in the AEO2002 Revised Reference Case in 2020. The increased vehicle prices reflected in the AEO2002 Revised Reference Case account for the market adoption of technology to improve safety, emissions control, and fuel economy over the projection period.

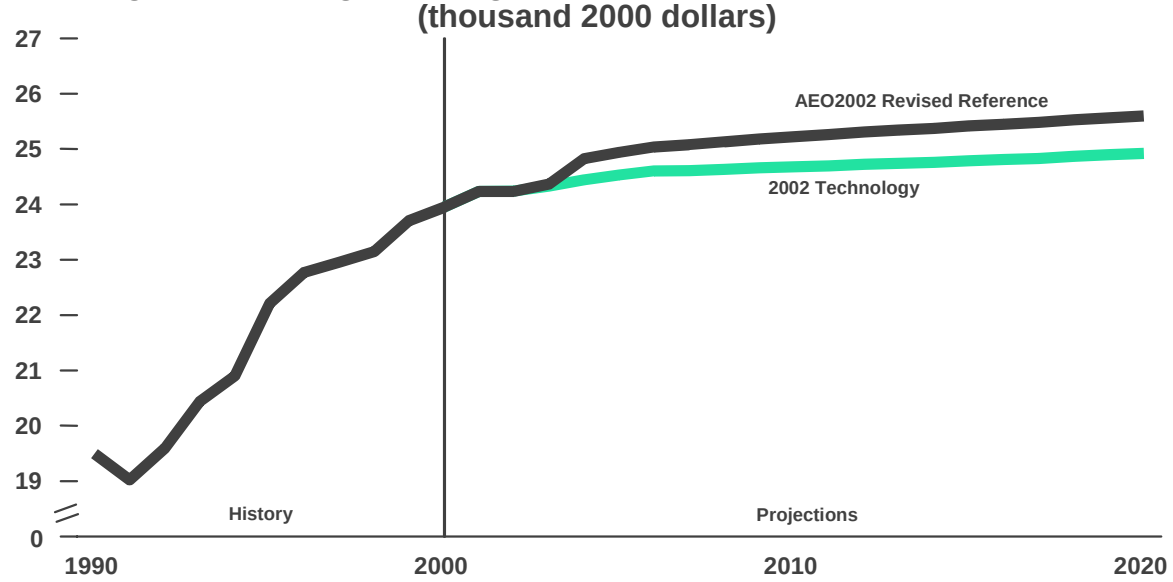
Fuel economy is projected to increase slightly in the AEO2002 Revised Reference Case. Car fuel economy increases from 28.7 in 2002 to 29.7 mpg in 2020. In the 2002 Technology Case, car fuel economy increases to 29.0 mpg in 2020 (Figure 5). In the AEO2002 Revised Reference Case, light truck fuel economy is projected to increase from 21.1 mpg in 2002 to 23.1 in 2014, where it levels off for the remainder of the projection period. For the 2002 Technology Case, light truck fuel economy increases to just 21.4 mpg in 2020 (Figure 6). Although the 2002 Technology Case represents a frozen technology scenario, slight increases in the projected fuel economy of cars and light trucks are realized through sales of electric, hybrid, and fuel cell vehicles sold to meet the Low-Emission Vehicle Program (LEVP) requirements mandated in California. It is assumed that Massachusetts, New York, Maine, and Vermont will also adopt the California LEVP mandates.

Figure 3. Average New Car Prices in Two Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s804base.d020702b and ltrkiten.d102501a.

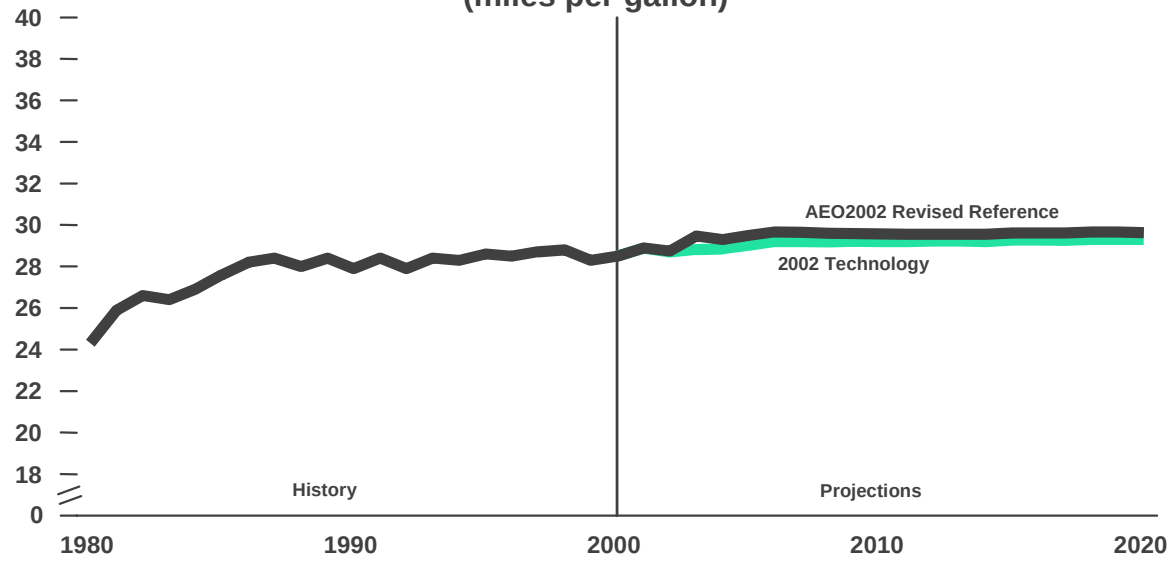
Figure 4. Average New Light Truck Prices in Two Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s804base.d020702b and ltrkiten.d102501a.

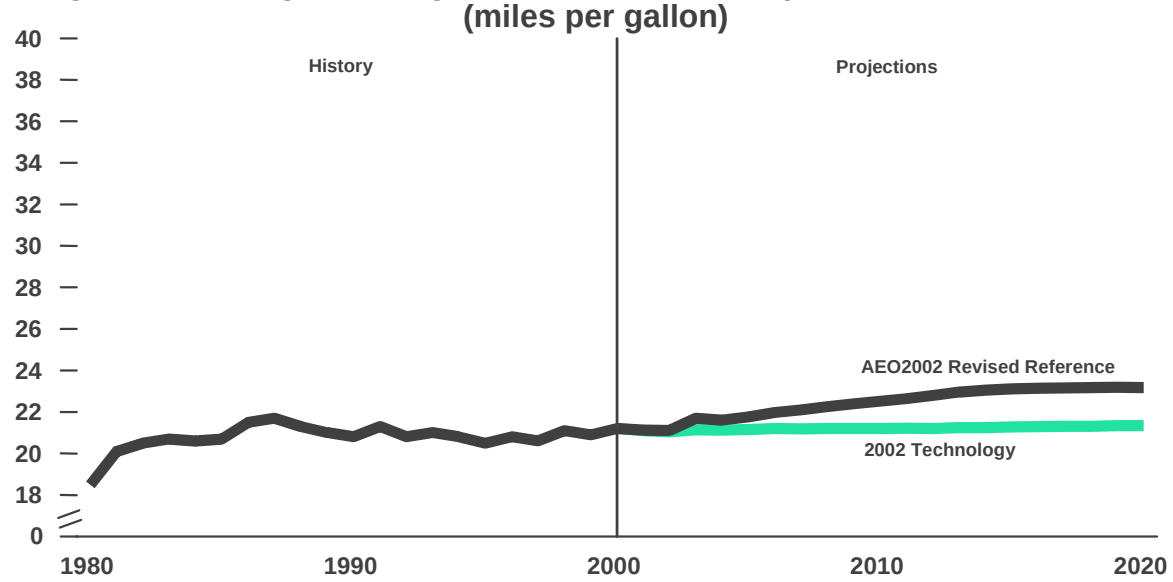
In the 2002 Technology Case, the difference in new vehicle efficiency over the forecast results in a 4 percent increase in light vehicle energy use in 2020, an increase of 7.6 billion gallons, compared to the AEO2002 Revised Reference Case.

Figure 5. Average New Car Fuel Economy in Two Cases, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s804base.d020702b and ltrkiten.d102501a.

Figure 6. Average New Light Truck Fuel Economy in Two Cases, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s804base.d020702b and ltrkiten.d102501a.

H.R. 4 Section 201 – Reduce Gasoline Consumption by 5 Billion Gallons

Section 201 of H.R. 4 requires the establishment of new light truck Corporate Average Fuel Economy (CAFE) standards that would reduce cumulative light truck (less than 8,500 pounds gross vehicle weight) gasoline use by five billion gallons from 2004 through 2010. Two separate approaches are provided for evaluating this provision. The first approach does not employ NEMS, but uses a spreadsheet model that replicates the NEMS light vehicle stock model. This approach limits the analysis to energy savings realized by examining standards alone and does not account for any variability that would occur in meeting the new CAFE standard. The second approach measures the energy savings from fuel economy improvements realized in the AEO2002 Revised Reference Case compared to the 2002 Technology Case. Under this approach, light trucks in the 2002 Technology Case exceed the current CAFE standard, as evidenced historically, thus providing a more accurate measure of potential fuel savings from increased fuel economy.

For the estimation of potential energy savings in the first approach, it was assumed that manufacturers produce vehicles in the 2004 to 2010 time frame to meet but not exceed the current CAFE standard of 20.7 miles per gallon (mpg). New light truck fuel economy was increased until the desired fuel savings were achieved. It is estimated that the light truck CAFE standard would have to increase to 21.5 mpg in 2004 to achieve the desired gasoline reductions. This increases the current standard of 20.7 mpg by 0.8 mpg or 3.9 percent. If the CAFE standards discussed above were met exactly, the required cumulative fuel use reduction of 5 billion gallons over the proposed time frame would be achieved.

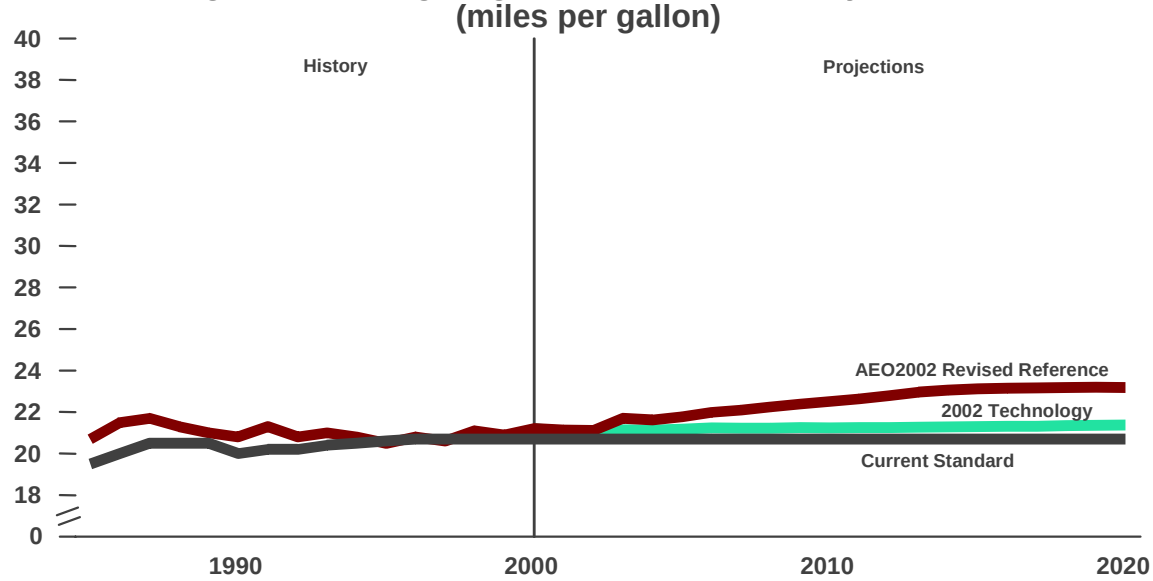
Historically, the CAFE actually achieved in any given year varies from the required minimum. This is due to improvements in engine efficiency and changing consumer purchase patterns.

Although manufacturers control the fuel economy achieved in the mix of vehicles offered to consumers, ultimately, consumer purchase decisions based on desired performance, size, and/or vehicle type will determine the CAFE achieved by a manufacturer. Light truck manufacturers have failed to meet current CAFE standards only twice in the last 15 years, in 1995 and 1997. Over the same period, light truck manufacturers have met or exceeded a 21 mpg CAFE in 8 years, and twice (1986 and 1987) the light truck CAFE met or exceeded 21.5 mpg. In model year 2001, on average light trucks achieved a CAFE of 21.2 mpg

Estimating the potential fuel savings through the examination of standards alone is complicated by the fact that variation in CAFE will occur and that manufacturers have a tendency to, on average, exceed the standard. So, evaluating fuel economy standards as a mechanism to achieve a desired reduction in fuel use should incorporate a reference case that reflects historical trends. Therefore, the second approach calculates the fuel savings realized as a result of the fuel economy improvements projected in the AEO2002 Revised Reference Case compared to the 2002 Technology Case.

Projections in the AEO2002 Revised Reference Case show that new light truck fuel economy exceeds the 21.5 mpg CAFE standard estimated in the first approach, increasing from 21.6 mpg in 2004 to 22.5 mpg in 2010. In the 2002 Technology Case, light truck fuel economy remains relatively constant at about 21.2 mpg over the forecast period (Figure 7).

Figure 7. Average Light Truck Fuel Economy, 1985-2020 (miles per gallon)



Source: National Highway Traffic Safety Administration, *Summary of Fuel Economy Performance*, Washington, DC, March 2001, Table I-1 and Table II-6. Source: National Energy Modeling System runs: s804base.d020702b, ltrkiten.d102501a.

As a result of the incremental fuel economy improvements projected for the AEO2002 Revised Reference Case over the 2002 Technology Case, cumulative light truck fuel use is reduced 8.2 billion gallons from 2004 to 2010 (Table 4), amounting to a 0.8 percent cumulative reduction in light vehicle energy use. This shows that in the AEO2002 Revised Reference Case, the H.R. 4 fuel use reduction and implied CAFE improvements are met and exceeded. By 2010, annual light vehicle energy use is reduced 1.8 percent and carbon emissions are reduced 1.9 percent compared to the 2002 Technology Case. Because the energy savings presented in this analysis are in comparison to the 2002 Technology Case and reflect no change in the AEO2002 Revised Reference Case, there was no attempt to quantify the macroeconomic impacts associated with this provision.

Table 4. AEO2002 Revised Reference Case Light Vehicle Fuel Savings Relative to the 2002 Technology Case and Total Light Vehicle Energy Use (billion gallons)

Year	Light Vehicle Fuel Savings		Total AEO2002 Revised Reference Case Light Vehicle Energy Use	
	Annual	Cumulative	Annual	Cumulative
2004	0.4	0.4	137.1	137.1
2005	0.6	1.0	140.4	277.5
2006	0.8	1.8	143.2	420.7
2007	1.1	2.9	146.3	567.0
2008	1.4	4.3	149.8	716.8
2009	1.8	8.0	153.4	870.2
2010	2.2	8.2	156.9	1027.1

Source: National Energy Modeling System runs: s804base.d020702b, ltrkiten.d102501a.

Sensitivity Case

In addition to examining the current fuel economy proposals, it was requested that an additional analysis of CAFE standards be examined for this study. For this Case, the CAFE standard for both cars and light trucks increases 5 percent in 2005 and 10 percent in 2010, compared to the current standard. This increases the current CAFE standard for cars from 27.5 mpg to 28.9 mpg in 2005 and 30.3 mpg in 2010. The light truck CAFE standard increases from 20.7 mpg to 21.7 mpg in 2005 and 22.8 mpg in 2010.

The CAFE standards proposed in this Case could be achieved with little impact on incremental vehicle prices relative to the AEO2002 Revised Reference Case. As shown in Figure 8 and Figure 9, vehicle prices increase marginally over the projection period. For the Sensitivity Case, the incremental cost paid for a new car in 2020, is $110 above the AEO2002 Revised Reference Case. For light trucks, the incremental cost increases $60 in 2010, but diminishes to zero by 2020.

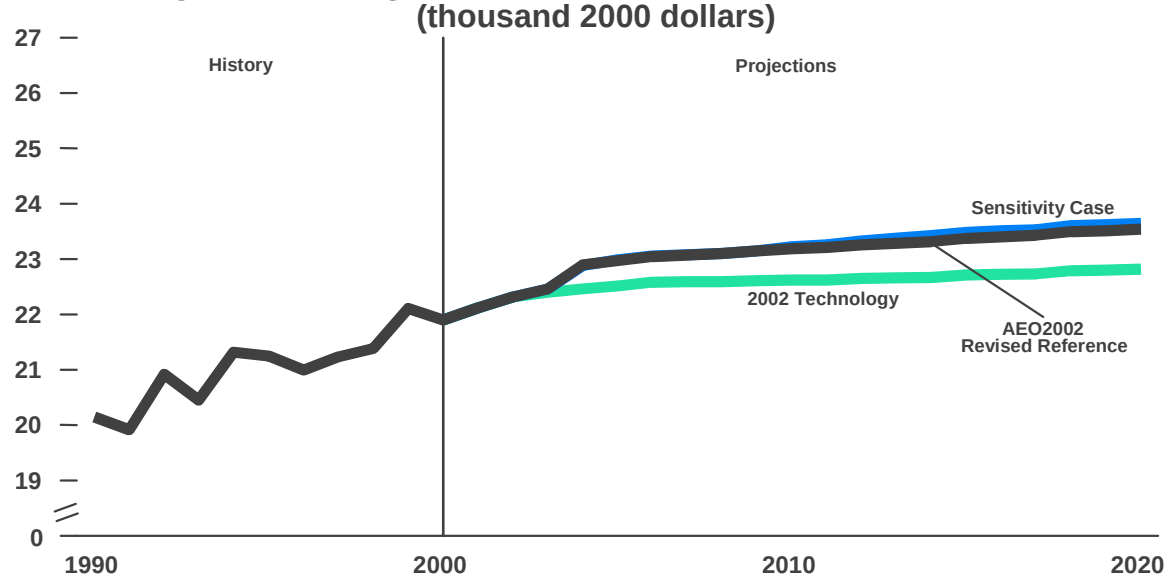
The incremental costs for the Sensitivity Case are minimal because little additional technology must be adopted to meet the proposed standards. This is primarily due to the AEO2002 Revised Reference Case fuel economy projections closely approximating the standards proposed in the

Sensitivity Case. Because only minimal fuel economy improvement is needed to achieve the standard, the incremental fuel economy benefit of additional advanced technology does not pay for the incremental cost. Therefore, the analysis shows it is more cost effective to optimize the AEO2002 Revised Reference technologies for efficiency as opposed to performance. As a result, projections of horsepower and weight, for both cars and light trucks, are lower in the Sensitivity Case.

In the Sensitivity Case, car horsepower increases from 165 in 2000 to 198 in 2020, while weight remains constant at 3,100 pounds. Compared to the AEO2002 Revised Reference Case, this amounts to a 10 percent decrease in horsepower and a 7.5 percent decrease in weight, in 2020. But it is important to note that projected vehicle performance attributes of cars in the Sensitivity Case would exceed those of today's vehicles.

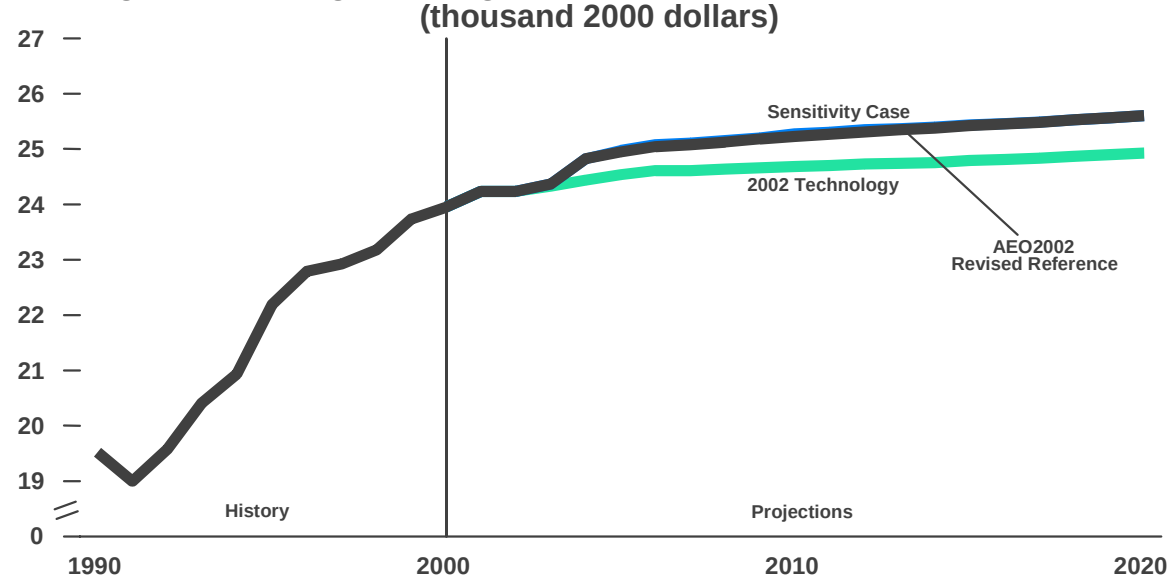
Light trucks experience minor performance effects in the Sensitivity Case because initially they have lower levels of advanced technology adoption compared to cars. As a result, there is greater opportunity for improvement from lower cost advanced technologies. Light truck horsepower increases from 193 in 2000 to 249 in 2020 and weight increases from 4,257 pounds to 4,721 pounds over the same time period. Compared to the AEO2002 Revised Reference Case, this represents a 1.6 percent reduction in horsepower and a 1.3 percent reduction in weight in 2020.

Figure 8. Average New Car Prices in Three Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s8045and10.d020702a, s804base.d020702b, ltrkiten.d102501a.

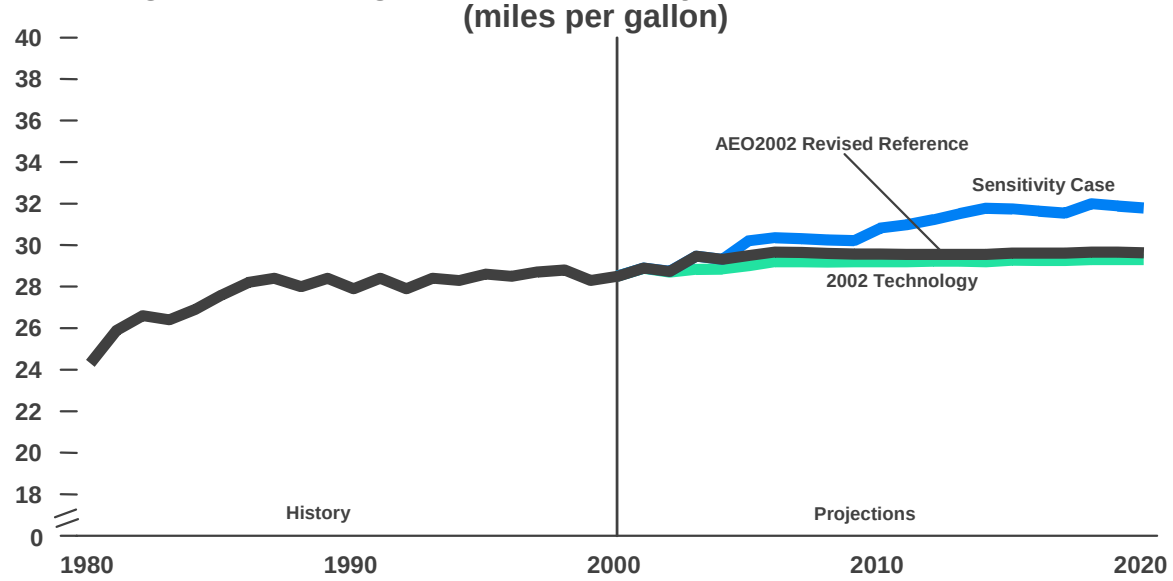
Figure 9. Average New Light Truck Prices in Three Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s8045and10.d020702a, s804base.d020702b, ltrkiten.d102501a.

As indicated above, the imposed standards are achieved for both cars and light trucks. Because cars have higher levels of advanced technology utilization in 2000, there is limited potential for continued improvement, as evidenced in Figure 10. As a result, increases in car fuel economy are more expensive and require greater optimization of existing technology and weight reduction. As shown in Figure 11, light trucks in the AEO2002 Revised Reference Case continue to improve fuel economy over the projection period as additional low cost technology penetrates that market. The analysis shows that to ensure compliance, manufacturers will produce vehicles that marginally exceed the standard.

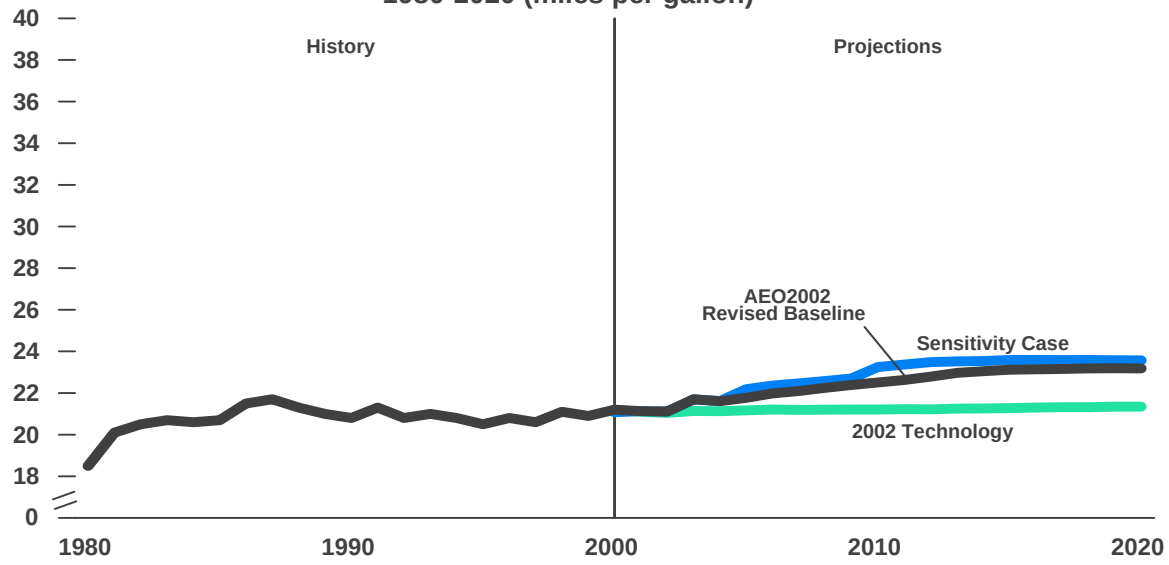
Figure 10. Average Car Fuel Economy in Three Cases, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s8045and10.d020702a, s804base.d020702b, ltrkiten.d102501a.

The energy and carbon impacts associated with this standard are minimal. In 2020, fuel use is reduced by 5.5 billion gallons, a reduction of 3 percent from the AEO2002 Revised Reference Case (Table 5). Carbon equivalent emissions from light vehicles are reduced 13 million metric tons (3 percent) in 2020 compared to the AEO2002 Revised Reference Case. Compared to the 2002 Technology Case, in 2020 fuel use is reduced 13.1 billion gallons, a 6.9 percent reduction (Figure 12). As is the case for fuel use reduction in the 2002 Technology Case comparatively, carbon emissions are reduced 6.9 percent. Because energy reductions are so small and the incremental vehicle costs associated with achieving the standards are minimal, the CAFE proposals in this case would not have a significant macroeconomic impact.

Figure 11. Average New Light Truck Fuel Economy in Three Cases, 1980-2020 (miles per gallon)

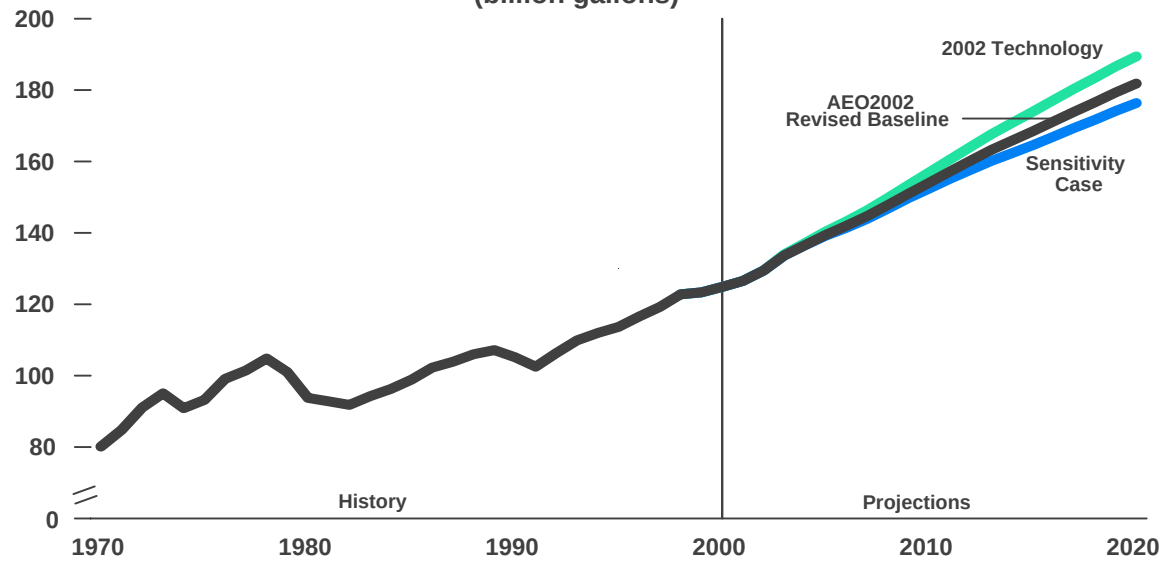


Source: National Energy Modeling System runs: s8045and10.d020702a, s804base.d020702b, ltrkiten.d102501a

S. 804 Case

At the time of the original request, Section 801 of S. 1766 had been designated as a placeholder for increased fuel economy provisions; therefore, it was originally requested that this study examine the impacts of the CAFE standards proposed in Senate Bill 804 (S. 804). S. 804 proposes that light truck CAFE standards increase to 22.5 mpg for model years 2003 and 2004, 25 mpg for model years 2005 through 2007, and for model years 2008 and later, 27.5 mpg. This bill also changes the gross vehicle weight rating of vehicles included in the estimation of a manufacturer's corporate average fuel economy by increasing the maximum gross vehicle weight to not more than 10,000 pounds. The previous maximum gross vehicle weight was not more than 8,500 pounds. In effect, this provision requires that heavy-duty light trucks be included in the estimation of a manufacturer's CAFE. Vehicles defined as having a gross vehicle weight rating of 8,500 to 10,000 pounds are identified as Class 2b vehicles and are included in the CAFE analysis provided below.

Figure 12. Light-Duty Vehicle Fuel Use in Three Cases, 1970-2020
(billion gallons)



Source: National Energy Modeling System runs: s8045and10.d020702a, s804base.d020702b, ltrkiten.d102501a

The inclusion of Class 2b vehicles in the estimation of CAFE increases the difficulty manufacturers will face meeting the proposed standards. Averaging the lower fuel economy of Class 2b vehicles with the current regulated fleet will reduce a manufacturer's CAFE. In addition, the towing and hauling requirements demanded of these vehicles will add additional burden in meeting the proposed CAFE standard. It is possible that the implementation of such stringent fuel economy standards for Class 2b vehicles would only serve to push the sales of these types of vehicles to the next largest size class where they would not be subject to fuel economy regulation.

The intent of the S. 804 provision is to eliminate the disparity between car and light truck CAFE standards. Currently, the CAFE standard for cars is 27.5 mpg while the light truck CAFE standard is considerably lower at 20.7 mpg. The lower standard for light trucks was based on the fact that these vehicles were primarily used as work vehicles in agricultural and trade industries and that they comprised only 20 percent of the light vehicle market when the standard was developed. As the light truck market has evolved from primarily work vehicles (pickup trucks and cargo vans) to passenger vehicles (sport utility vehicles and minivans), sales have increased rapidly. In the last twenty years, the sales of new passenger light trucks have increased from 5 percent of new light truck sales in 1980 to 44 percent in year 2000. Currently, light trucks account for approximately 50 percent of all new light vehicle sales.

Table 5. Summary of Sensitivity Case Impacts (2005, 2010, 2015, 2020)

	2005	2010	2015	2020
Light Vehicle Energy Use (billion gallons)				
AEO2002 Revised Reference Case	139.4	154.0	168.5	181.8
Sensitivity Case	139.2	152.4	164.6	176.3
Percent Change	-0.2	-1.0	-2.2	-2.9
Light Vehicle CO_2 Emissions (MMTCe)				
AEO2002 Revised Reference Case	331.2	366.0	400.3	432.1
Sensitivity Case	330.7	362.1	391.0	419.2
Percent Change	-0.2	-1.1	-2.3	-3.0
Net Petroleum Imports (million barrels per day)				
AEO2002 Revised Reference Case	12.58	14.30	15.32	16.69
Sensitivity Case	12.56	14.19	15.15	16.38
Percent Change	-0.2	-0.8	-1.1	-1.9
Average New Car Fuel Economy (mpg)				
AEO2002 Revised Reference Case	29.50	29.58	29.62	29.63
Sensitivity Case	30.21	30.82	31.74	31.79
Percent Change	2.4	4.2	7.2	7.3
Average New Car Price (thousands of 2000 $)				
AEO2002 Revised Reference Case	22.97	23.19	23.37	23.54
Sensitivity Case	22.98	23.22	23.48	23.64
Percent Change	0.1	0.2	0.5	0.4
Average New Car Horsepower				
AEO2002 Revised Reference Case	188	202	213	220
Sensitivity Case	187	194	193	198
Percent Change	-0.1	-3.9	-9.5	-10.0
Average New Car Weight (pounds)				
AEO2002 Revised Reference Case	3191	3257	3309	3359
Sensitivity Case	3152	3160	3093	3100
Percent Change	-1.2	-3.0	-6.5	-7.7
Average New Light Truck Fuel Economy (mpg)				
AEO2002 Revised Reference Case	21.77	22.52	23.12	23.18
Sensitivity Case	22.19	23.25	23.59	23.57
Percent Change	1.9	3.2	2.0	1.7
Average New Light Truck Price (thousands of 2000 $)				
AEO2002 Revised Reference Case	24.94	25.23	25.42	25.60
Sensitivity Case	24.98	25.28	25.44	25.60
Percent Change	0.1	0.2	0.1	0.0
Average New Light Truck Horsepower				
AEO2002 Revised Reference Case	217	237	246	252
Sensitivity Case	218	235	243	249
Percent Change	0.5	-0.8	-1.2	-1.2
Average New Light Truck Weight (pounds)				
AEO2002 Revised Reference Case	4380	4554	4684	4784
Sensitivity Case	4373	4513	4644	4721
Percent Change	-0.2	-0.9	-0.9	-1.3

Source: National Energy Modeling System runs: s804base.d020702b and s8045and10.d020702a.

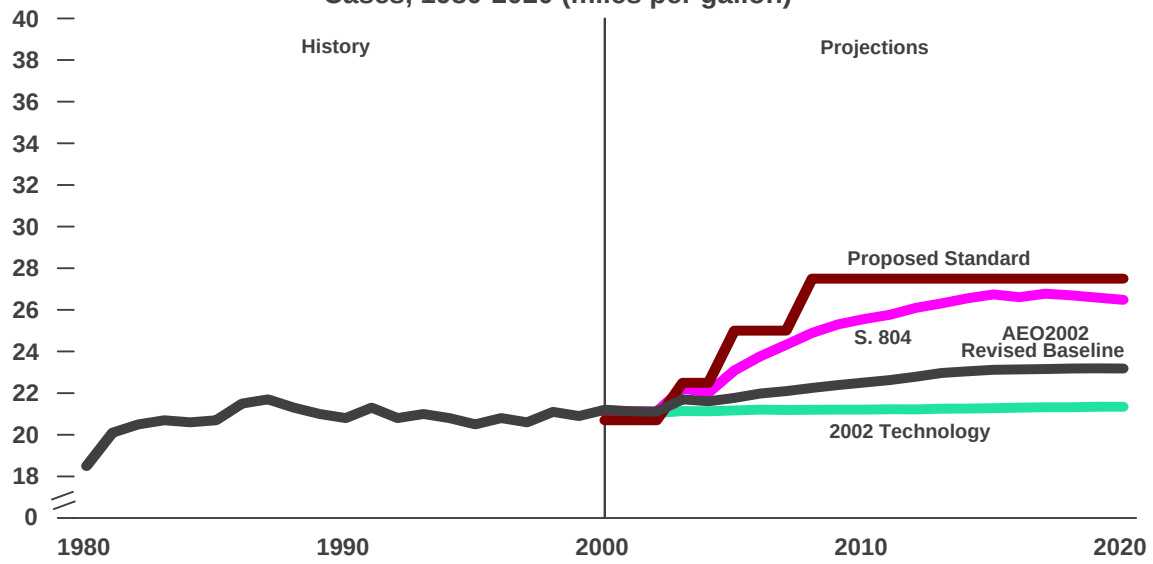
The CAFE standards analyzed for S. 804 represent a significant increase in new light truck (less than 10,000 pounds GVW) fuel economy. Meeting these standards will require a significant increase in the use of new engine technologies and advanced materials. The analysis of S. 804 examines a menu of 52 advanced conventional engine technologies and lightweight materials to estimate a manufacturer's ability to meet future CAFE standards. Technologies are introduced at varying dates through the forecast period and are representative of current industry expectations for market introduction. In the evaluation of technology to meet increased CAFE standards, this analysis considered impacts on engine efficiency, horsepower, and vehicle weight compared to incremental costs. In those years where the CAFE standards are not met, trade-offs between performance improvement and efficiency gain are made to ensure that advanced technology adoption is optimized for fuel economy improvement.

The projections made for the S. 804 Case show that, given current assumptions regarding future technology introduction dates and associated efficiency improvement, the proposed CAFE standard would not be met (Figure 13). Although light trucks less than 8,500 pounds GVW achieve the standard by 2014, those light trucks greater than 8,500 pounds GVW achieve a fuel economy of only 18.2 mpg, reducing overall light truck CAFE to 26.6 mpg. As a result, light truck manufacturers would pay almost $10 billion in CAFE fines over the projection period. In addition, projections show that compared to the AEO2002 Revised Reference Case the incremental cost of a new light truck would be $1,294 higher (4.4 percent) in 2020 (Figure 19). The economic impacts of this analysis are discussed in the section titled *Macroeconomic Impacts*.

Because both horsepower and weight decline relative to the AEO2002 Revised Reference Case, vehicle performance is relatively unchanged over the projection period. In 2020, light truck horsepower decreases 19.4 percent from, 252 to 203 in the AEO2002 Revised Reference and S. 804 Cases, respectively (Figure 14), while the average weight of a light truck is 800 pounds less in the S. 804 Case compared to the AEO2002 Revised Reference Case, a decrease of 16.7 percent (Figure 15). Compared to a 2000 light truck, weight decreases 273 pounds or 6.4 percent. The horsepower to weight ratio for the AEO2002 Revised Reference Case is projected to increase from 0.045 in 2000 to 0.053 in 2020. In the S. 804 Case, the horsepower to weight ratio grows to 0.051 by 2020. Although this represents a continual increase over the 2000 value, it is a 3.8 percent decrease from the 2020 AEO2002 Revised Reference Case forecast.

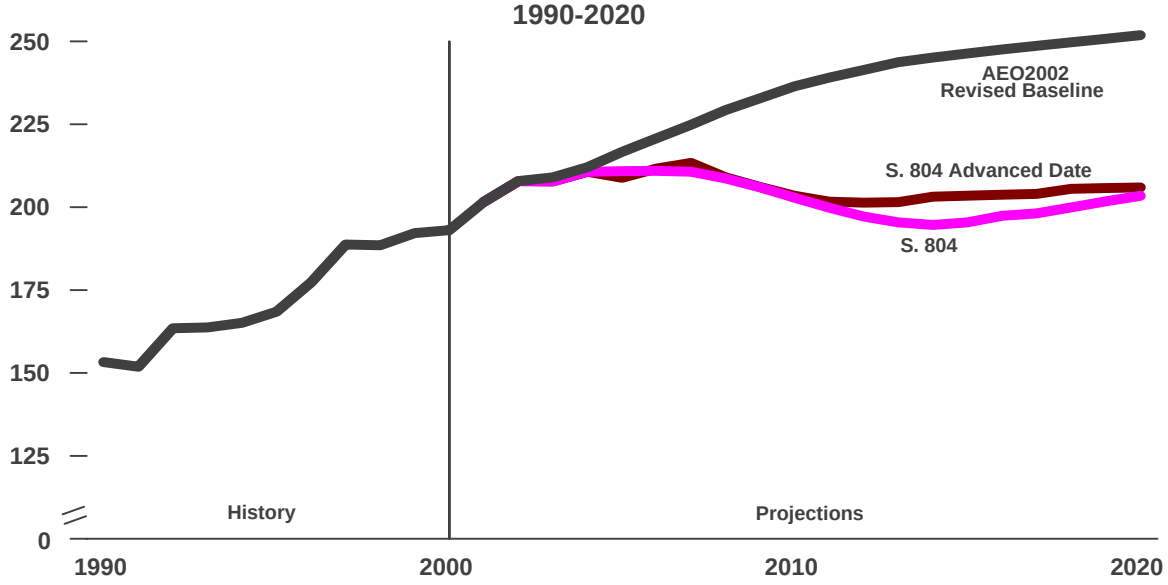
For the S. 804 Case, light vehicle fuel use is reduced over the projection period (Figure 16). By 2020, this provision results in annual fuel savings of 14.7 billion gallons compared to the AEO2002 Revised Reference Case (Table 6). The reduction in light vehicle fuel demand is projected to reduce net petroleum imports by 5 percent (830 thousand barrels per day) by 2020. The projected decrease in imported petroleum fuels results in a 1.7 percent decrease ($0.42 in 2000 dollars) in world oil prices by 2020. Carbon equivalent emissions from the transportation sector are reduced by 15 million metric tons in 2010 and 34.8 million metric tons in 2020. By 2020, this equates to an annual carbon reduction of 8.0 percent for light vehicles.

Figure 13. Average New Light Truck Fuel Economy Achieved in Three Cases, 1980-2020 (miles per gallon)



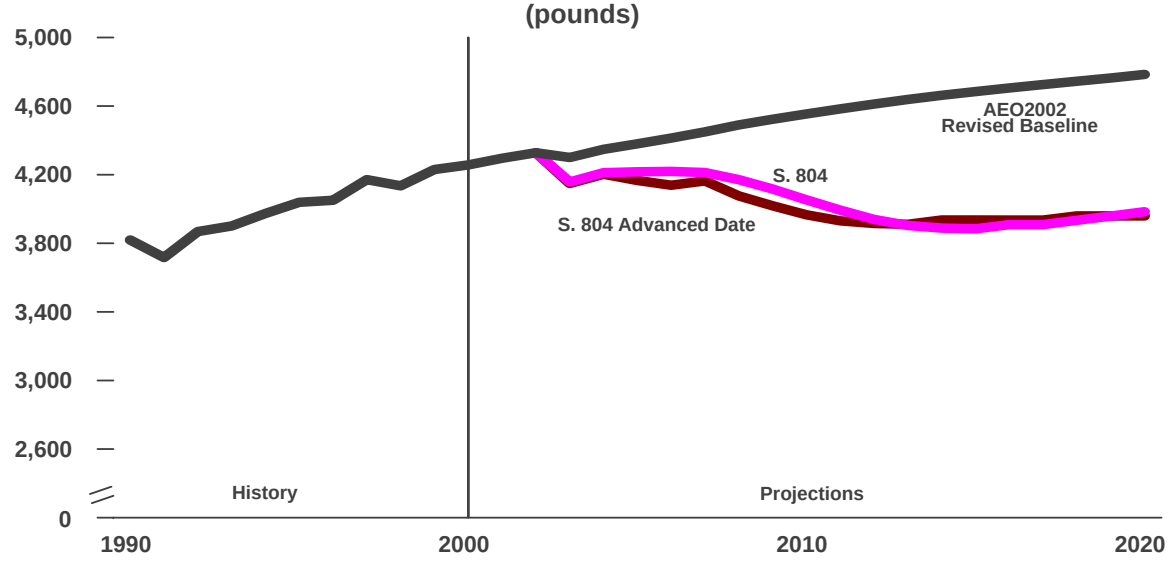
Source: National Energy Modeling System runs: s804cafe.d020802a, s804base.d020702b, ltrkiten.d102501a

Figure 14. Average New Light Truck Horsepower for Three Cases, 1990-2020



Source: National Energy Modeling System runs: s804base.d020702b, s804cafe.d020802a, and s804advd.d021102a.

Figure 15. Average New Light Truck Weight for Three Cases, 1990-2020 (pounds)



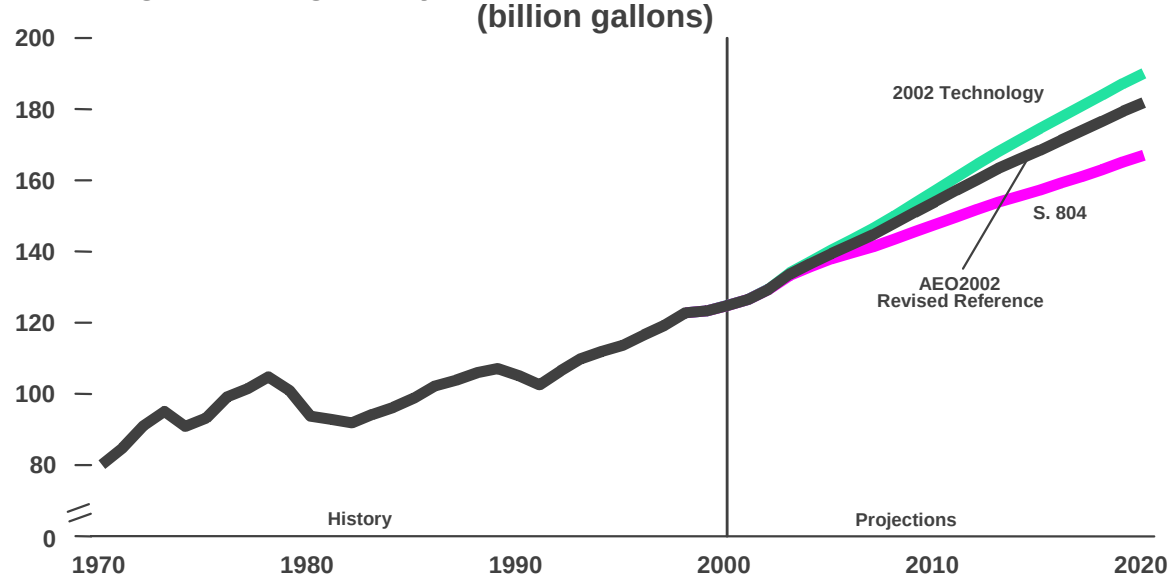
Source: National Energy Modeling System runs: s804base.d020702b, s804cafe.d020802a, and s804advd.d021102a.

Table 6. Summary of S. 804 Case Impacts (2005, 2010, 2015, 2020)

	2005	2010	2015	2020
Light Vehicle Energy Use (billion gallons)				
AEO2002 Revised Reference Case	139.4	154.0	168.5	181.8
S. 804 Case	137.9	147.6	157.3	167.1
Percent Change	-1.1	-4.1	-6.4	-7.7
Light Vehicle CO_2 Emissions (MMTCe)				
AEO2002 Revised Reference Case	331.2	366.0	400.3	432.1
S. 804 Case	327.7	350.9	374.0	397.3
Percent Change	-1.1	-4.1	-6.6	-8.0
Net Petroleum Imports (million barrels per day)				
AEO2002 Revised Reference Case	12.58	14.30	15.32	16.69
S. 804 Case	12.49	13.91	14.71	15.86
Percent Change	-0.7	-2.7	-4.0	-5.0
Average New Light Truck Fuel Economy (mpg) [1]				
AEO2002 Revised Reference Case	21.13	21.79	22.30	22.28
S. 804 Case	23.10	25.56	26.74	26.48
Percent Change	9.3	17.3	19.9	18.9
Average New Light Truck Price[2] (thousands of 2000 $)				
AEO2002 Revised Reference Case	24.94	25.23	25.42	25.60
S. 804 Case	25.07	25.83	26.47	26.73
Percent Change	0.5	2.4	4.1	4.4
Average New Light Truck Horsepower[2]				
AEO2002 Revised Reference Case	217	237	246	252
S. 804 Case	211	203	195	206
Percent Change	-2.8	-14.3	-22.0	-18.3
Average New Light Truck Weight[2] (pounds)				
AEO2002 Revised Reference Case	4380	4554	4684	4784
S. 804 Case	4217	4053	3884	3984
Percent Change	-3.7	-11.0	-17.1	-16.7

Source: National Energy Modeling System runs: s804base.d020702b and s804cafe.d020802a.
[1] Light trucks less than 10,000 pounds gross vehicle weight.
[2] Light trucks less than 8,500 pounds gross vehicle weight.

Figure 16. Light-Duty Vehicle Fuel Use in Three Cases, 1970-2020 (billion gallons)



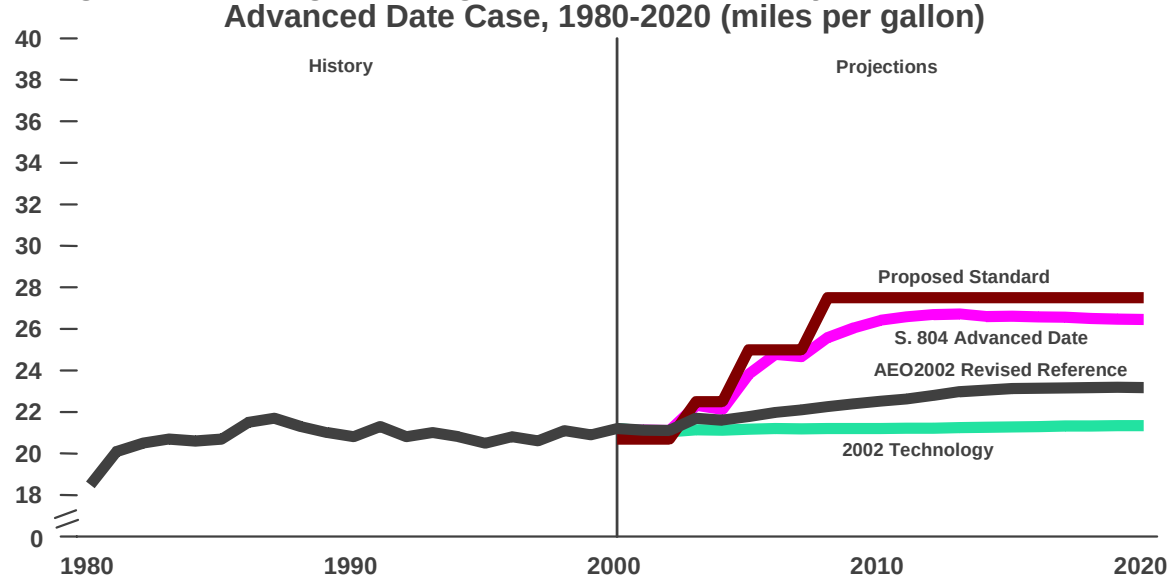
Source: National Energy Modeling System runs: s804cafe.d020802a, s804base.d020702b, and ltrkiten.d102501a.

S. 804 Advanced Date Case

The Case described above, the S. 804 Case, uses the same advanced conventional technology assumptions used in the AEO2002 Revised Reference Case. This case, S. 804 Advanced Date Case, assumes earlier introduction dates for eight advanced conventional technologies including: light weight materials, drag reduction, electronic transmission controls, engine friction reduction, camless valve actuation, variable valve timing, low rolling resistance tires, engine accessory improvements, and gasoline direct injection. The introduction date of these technologies was moved forward by three to four years so that they would be available when the proposed CAFE standard begins in 2003. This reflects a very optimistic scenario and is provided to illustrate CAFE compliance sensitivity to technology introduction dates.

By advancing the introduction dates, manufacturers are provided technologies that better enable them to meet the S. 804 proposed CAFE standards. As shown in Figure 17, even with these more optimistic technology assumptions, the CAFE standards are not met when Class 2b vehicles are included. However, in this case, light trucks less than 8,500 pounds GVW do meet the CAFE standard in all years except 2008 and 2009. Although Class 2b vehicles show significant improvement over the forecast with fuel economy increasing from 14.2 mpg in 2000 to 18.2 mpg in 2020, including these vehicles in the estimation of CAFE achieved results in light trucks not meeting the standard. The cumulative CAFE fines imposed on manufacturers are reduced $2.6 billion compared to the S. 804 Case to a total of $7.4 billion.

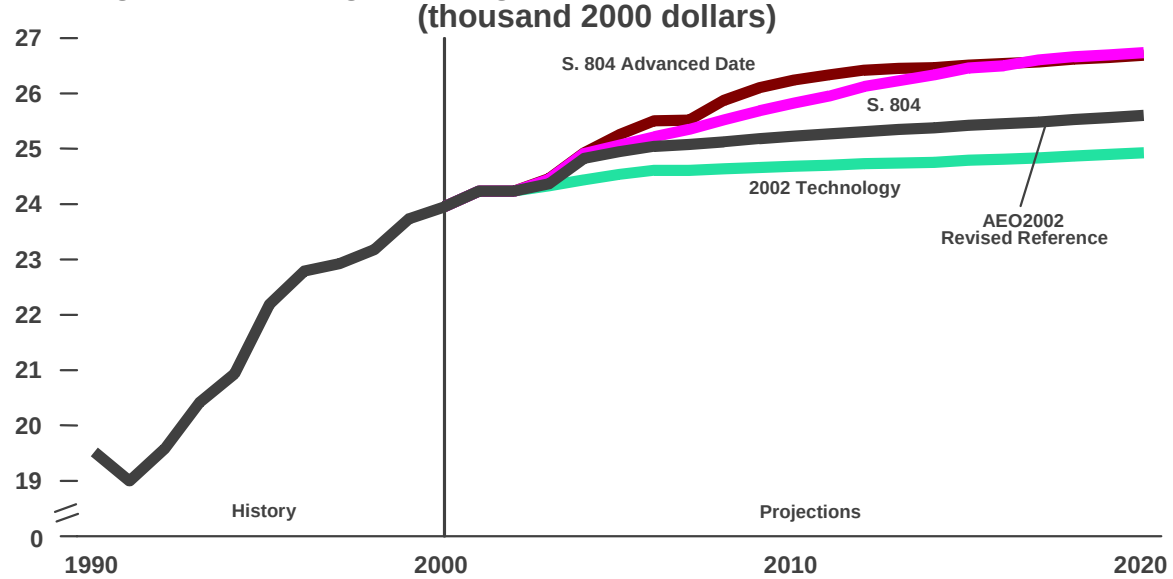
Figure 17. Average New Light Truck Fuel Economy Achieved in the S. 804 Advanced Date Case, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s804advd.d021102a, s804base.d020702b, and ltrkiten.d102501a.

Compared to the AEO2002 Revised Reference Case, new light truck costs increase by $1,013 by 2010, and then level off through the projection period to $1,116 (2000 dollars) by 2020 (Figure 19). The early availability of advanced technology drives vehicle cost above the S. 804 Case prior to 2010, but the economies of scale achieved through higher production levels slightly reduces vehicle cost by 2020 (Figure 18). The economic impact associated with increased vehicle sales is discussed in the section titled *Macroeconomic Impacts.*

Figure 18. Average New Light Truck Prices in Four Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s804cafe.d020802a, s804advd.d021102a, s804base.d020702b, and ltrkiten.d102501a.

For the S. 804 Advanced Date Case, in 2020, horsepower decreases 18.3 percent from 252 to 206 in the AEO2002 Revised Reference Case, and the average weight of a light truck is 825 pounds less than the AEO2002 Revised Reference Case, a decrease of 17.2 percent. Compared to a 2000 light truck, weight decreases 297 pounds or 7.0 percent. In the S. 804 Advanced Date Case, the horsepower to weight ratio grows to 0.052 by 2020, slightly higher than the ratio achieved in the S. 804 Case. This is due to increased penetration of advanced conventional technologies.

For the S. 804 Advanced Date Case, light truck fuel use is lower than the S. 804 Case. By 2020, annual fuel savings exceed 15 billion gallons (Table 7). The reduction in highway fuel demand is projected to reduce net petroleum imports by 5.2 percent (860 thousand barrels per day) by 2020 compared to the AEO2002 Revised Reference Case. The projected decrease in imported petroleum fuels results in a 1.9 percent decrease ($0.48 per barrel) in world oil prices by 2020. By 2020, carbon equivalent emissions are reduced 35.6 million metric tons, a decrease of 8.2 percent in light vehicle emissions.

Table 7. Summary of S. 804 Advanced Date Case Impacts (2005, 2010, 2015, 2020)

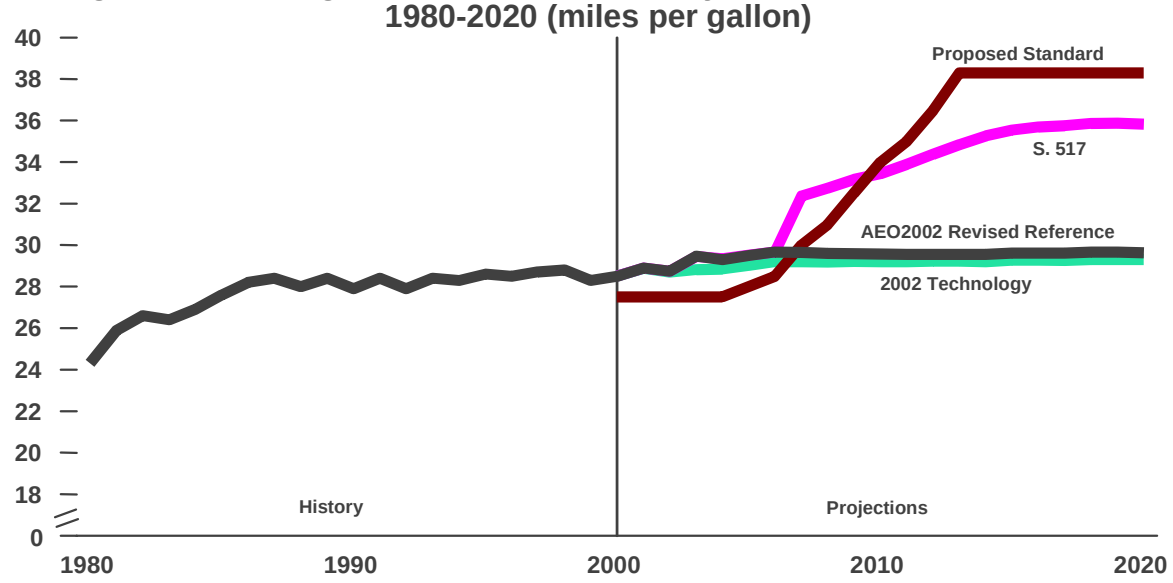
	2005	2010	2015	2020
Light Vehicle Energy Use (billion gallons)				
AEO2002 Revised Reference Case	139.4	154.0	168.5	181.8
S. Advanced Date Case	137.7	146.6	156.2	166.8
Percent Change	-1.2	-4.8	-7.0	-7.9
Light Vehicle CO_2 Emissions (MMTCe)				
AEO2002 Revised Reference Case	331.2	366.0	400.3	432.1
S. Advanced Date Case	327.2	348.4	371.5	396.6
Percent Change	-1.2	-4.8	-7.2	-8.2
Net Petroleum Imports (million barrels per day)				
AEO2002 Revised Reference Case	12.58	14.30	15.32	16.69
S. 804 Advanced Date Case	12.47	13.83	14.65	15.83
Percent Change	-0.9	-3.3	-4.4	-5.2
Average New Light Truck Fuel Economy (mpg) [1]				
AEO2002 Revised Reference Case	21.13	21.79	22.30	22.28
S. 804 Advanced Date Case	23.81	26.41	26.61	26.47
Percent Change	12.7	21.2	19.3	18.8
Average New Light Truck Price[2] (thousands of 2000 $)				
AEO2002 Revised Reference Case	24.94	25.23	25.42	25.60
S. 804 Advanced Date Case	25.25	26.24	26.52	26.69
Percent Change	1.2	4.0	4.3	4.2
Average New Light Truck Horsepower[2]				
AEO2002 Revised Reference Case	217	237	246	252
S. 804 Advanced Date Case	209	203	204	206
Percent Change	-3.7	-14.3	-17.1	-18.3
Average New Light Truck Weight[2] (pounds)				
AEO2002 Revised Reference Case	4380	4554	4684	4784
S. 804 Advanced Date Case	4166	3966	3935	3960
Percent Change	-4.9	-12.9	-16.0	-17.2

Source: National Energy Modeling System runs: s804base.d020702b and s804advd.d020702a.
[1] Light trucks less than 10,000 pounds gross vehicle weight.
[2] Light trucks less than 8,500 pounds gross vehicle weight.

S. 517 Case

For the S. 517 Case, the provision requires that both car and light truck CAFE standards are increased such that by year 2013 a combined light vehicle fuel economy standard of 35 mpg is obtained. The provision requires the Department of Transportation (DOT), after consultation with the Environmental Protection Agency (EPA), to prescribe the standards needed to ensure compliance. If the DOT fails to provide the required standards, the provision provides default standards for cars and light trucks. For cars, the default CAFE standard increases from 27.5 mpg in 2004 to 38.3 mpg in 2013, an increase of 39.3 percent (Figure 19). The default light truck CAFE standards require that fuel economy increase from 20.7 mpg in 2004 to 32 mpg in 2013, an increase of 54.6 percent (Figure 20). The default fuel economy standards outlined in S.517 were used for this analysis.

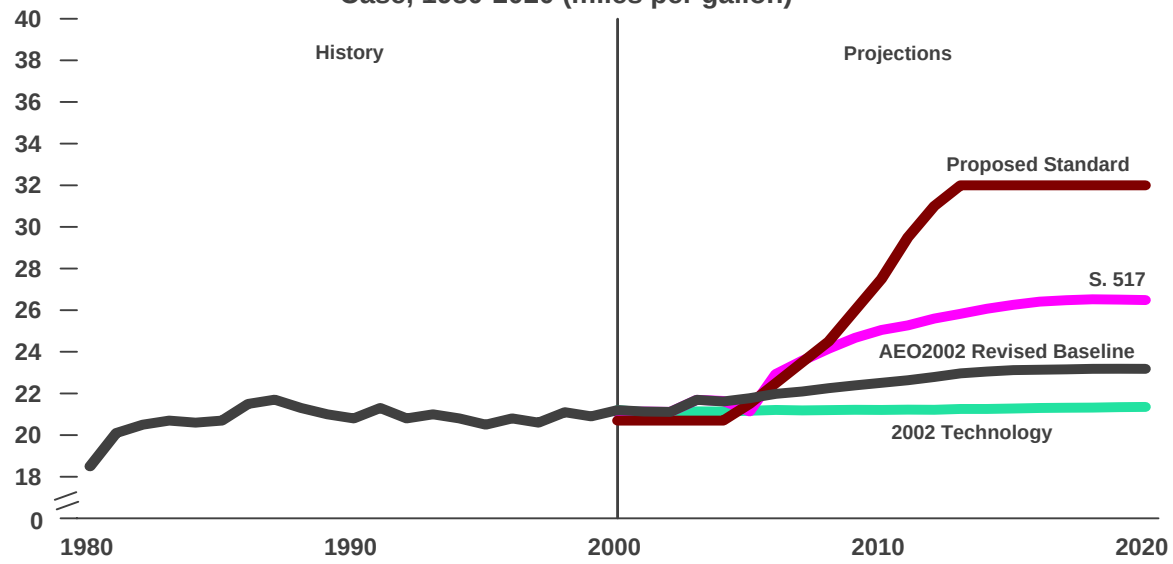
Figure 19. Average New Car Fuel Economy Achieved in the S. 517 Case, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

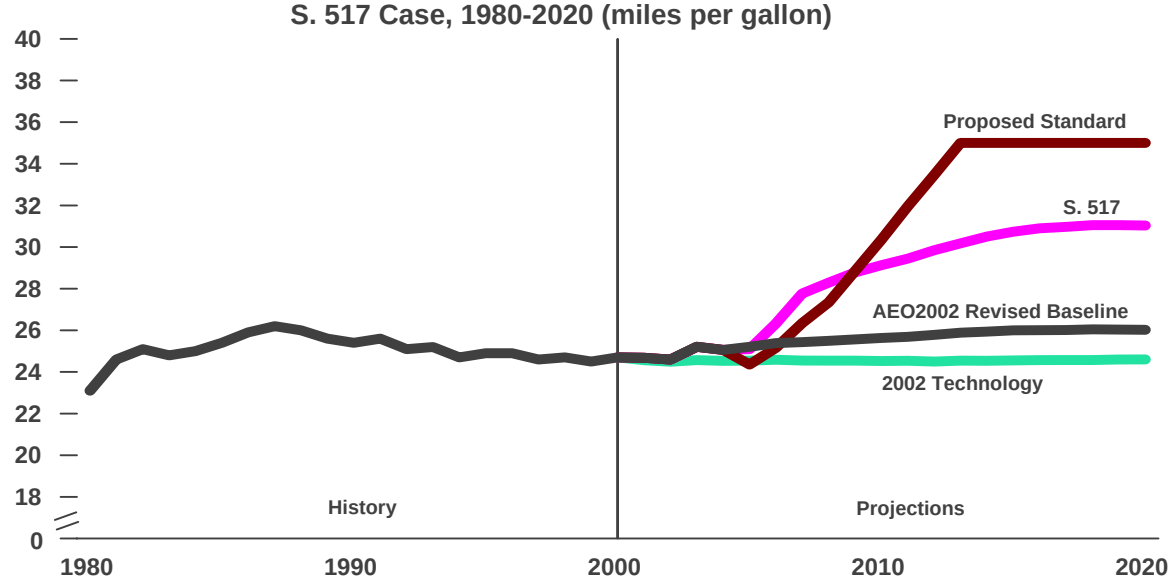
For light trucks, as in the S. 804 Case, the provision increases the average vehicle weight rating of trucks covered under CAFE to not more than 10,000 pounds GVW. This increases the burden vehicle manufacturers face in meeting the new standards. These vehicles are typically used in commercial applications and are purchased for their unique towing and hauling capability. Although not addressed in this analysis, requiring that these vehicles meet the more stringent fuel economy standard, thus increasing the vehicle cost, will likely push consumers into the next largest size class (Class 3 vehicles) where fuel economy standards would not apply.

Figure 20. Average New Light Truck Fuel Economy Achieved in the S. 517 Case, 1980-2020 (miles per gallon)



Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

Figure 21. Average New Light-Duty Vehicle Fuel Economy Achieved in the S. 517 Case, 1980-2020 (miles per gallon)

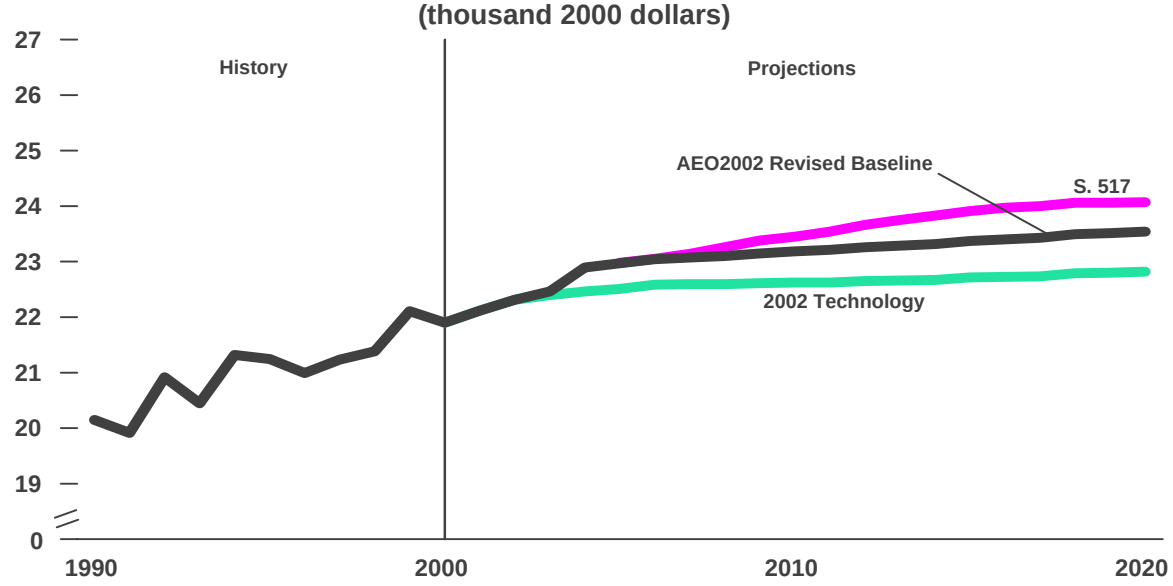


Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

Analysis of this provision shows that the required 2013 CAFE standards will not be achieved for either cars or light trucks. For cars, the standards are met through 2009 after which, fuel economy continues to increase to a peak of 35.9 mpg in 2018 (Figure 19), failing to achieve the required minimum by 2.3 mpg. Light trucks (trucks less than 10,000 pounds GVW) meet the proposed standards through 2007, when fuel economy continues to climb to a peak of 26.5 mpg in 2018 (Figure 20). Light trucks 8,500 pounds GVW and less meet the CAFE standard through 2008 and peak at 29.7 mpg in 2018. The fuel economy of light trucks 8,500 pounds to less than 10,000 pounds GVW increases from 14.5 mpg in 2005 to a peak of 18.2 mpg in 2016. In 2013, the combined fuel economy achieved by cars and light trucks is 30.2 mpg, 4.8 mpg less than the required minimum. By 2020, the combined average increases to 31.0 mpg (Figure 21).

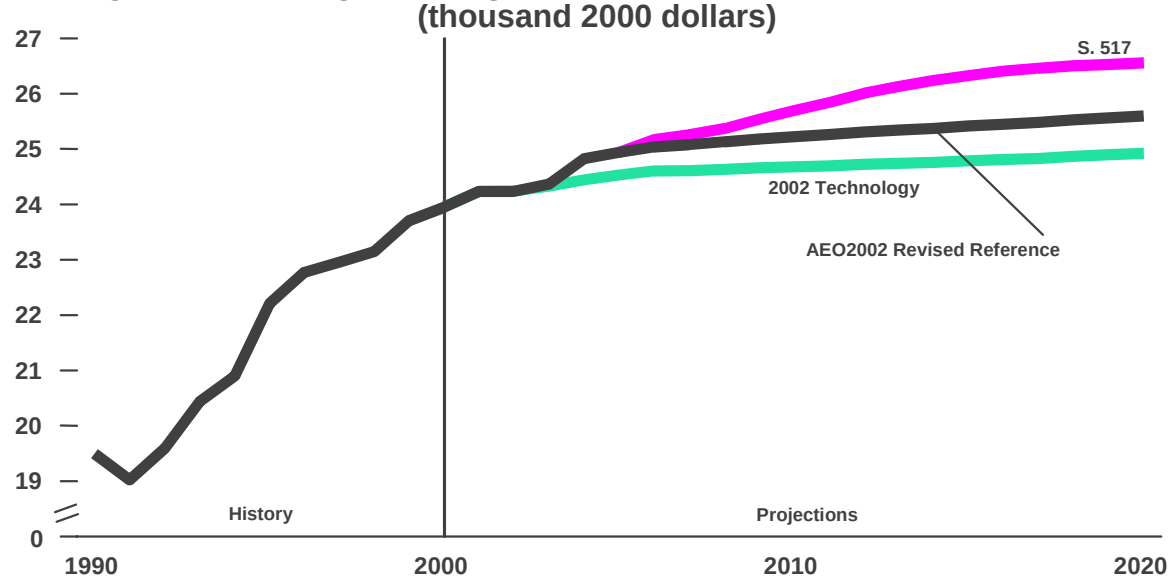
The projections made for the S. 517 Case show that vehicle manufacturers would pay $40 billion in CAFE fines over the projection period. In addition, projections show that compared to the AEO2002 Revised Reference Case the incremental cost of a new car would be $535 higher and light trucks would be $961 higher in 2020 (Figure 31). The costs projected for cars and light trucks are shown in Figure 22 and Figure 23, respectively. The lower light truck incremental cost reported in this case reflects reduced cost for advanced technologies due to the increased production levels realized through production increases due to the implementation of these technologies in cars. The economic impacts of this analysis are discussed in the section titled *Macroeconomic Impacts*.

Figure 22. Average New Car Prices in Three Cases, 1990-2020 (thousand 2000 dollars)



Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

Figure 23. Average New Light Truck Prices in Three Cases, 1990-2020 (thousand 2000 dollars)

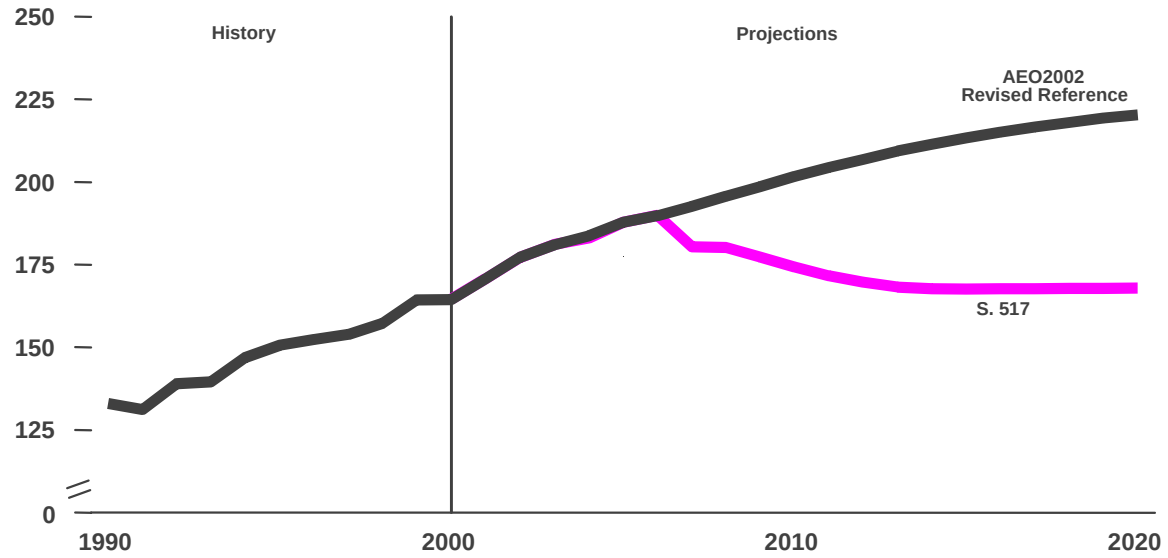


Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

To achieve the fuel economy projected in this analysis, vehicle weight and horsepower are impacted significantly. For cars, horsepower relative to the AEO2002 Revised Reference Case decreases from 220 on average to 168 in 2020 (Figure 24). This is only a slight increase over the 2000 average of 165. Weight is also reduced significantly compared to the AEO2002 Revised Reference Case, decreasing from 3359 pounds to 2723 pounds in 2020 (Figure 25). This is a 364 pound (11.8 percent) decrease relative to a model year 2000 car. Light trucks also experience significant changes relative to the reference. Horsepower decreases from 252 to 206 in 2020 (Figure 26), but this projection still reflects a 6.8 percent increase over model year 2000 levels. Light truck vehicle weight decreases from 4,784 pounds to 3,936 pounds in 2020 (Figure 27), which is similar to a model year 1994 light truck.

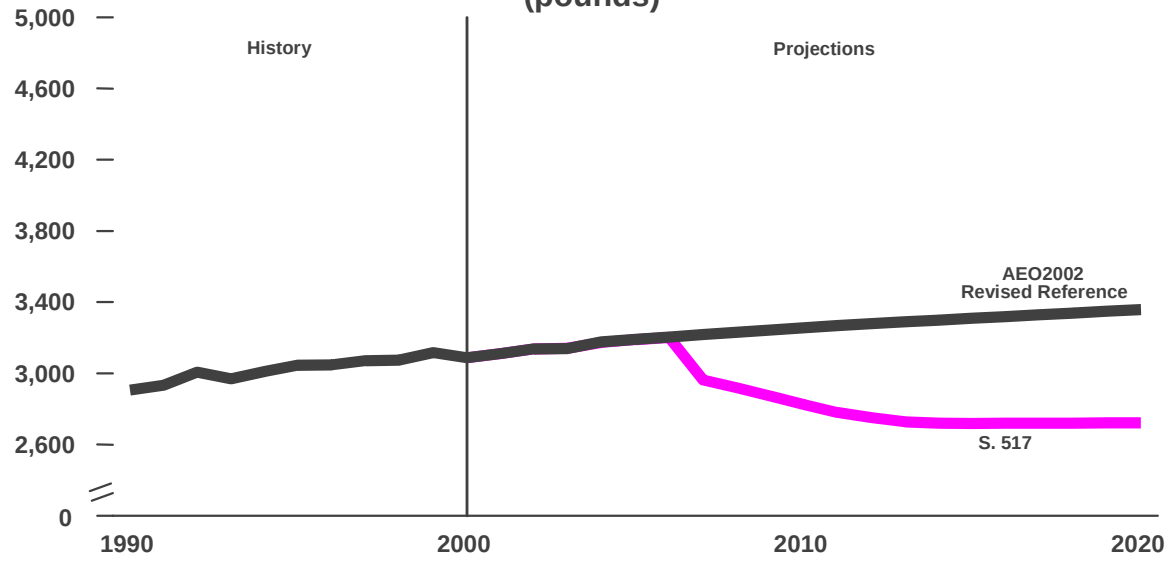
For the S. 517 Case, reductions in light vehicle fuel use are increased over the S. 804 Case. By 2020, annual fuel savings exceed 22 billion gallons (Table 8). The light vehicle energy use projected for this case is shown in Figure 28. The reduction in highway fuel demand is projected to reduce net petroleum imports by 7.7 percent (1.3 million barrels per day) by 2020 compared to the AEO2002 Revised Reference Case. The projected decrease in imported petroleum fuels results in a 2.7 percent decrease ($0.67 per barrel) in world oil prices by 2020. By 2020, carbon equivalent emissions are reduced 53 million metric tons, a decrease of 12.3 percent in light vehicle emissions.

Figure 24. Average New Car Horsepower for Two Cases, 1990-2020



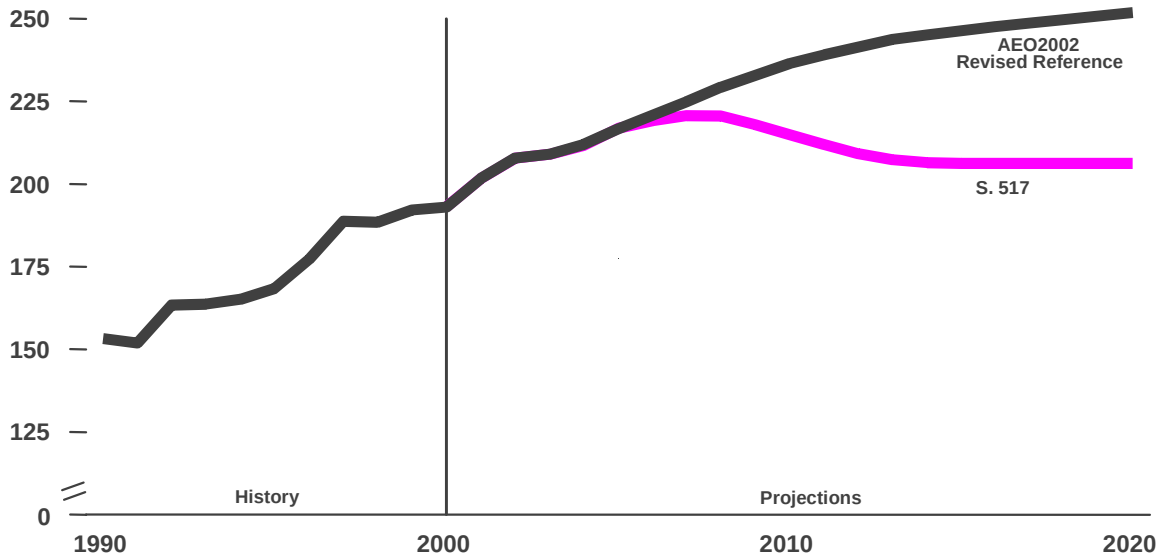
Source: National Energy Modeling System runs: s804base.d020702b and s517cafe.d022502a.

Figure 25. Average New Car Weight for Two Cases, 1990-2020 (pounds)



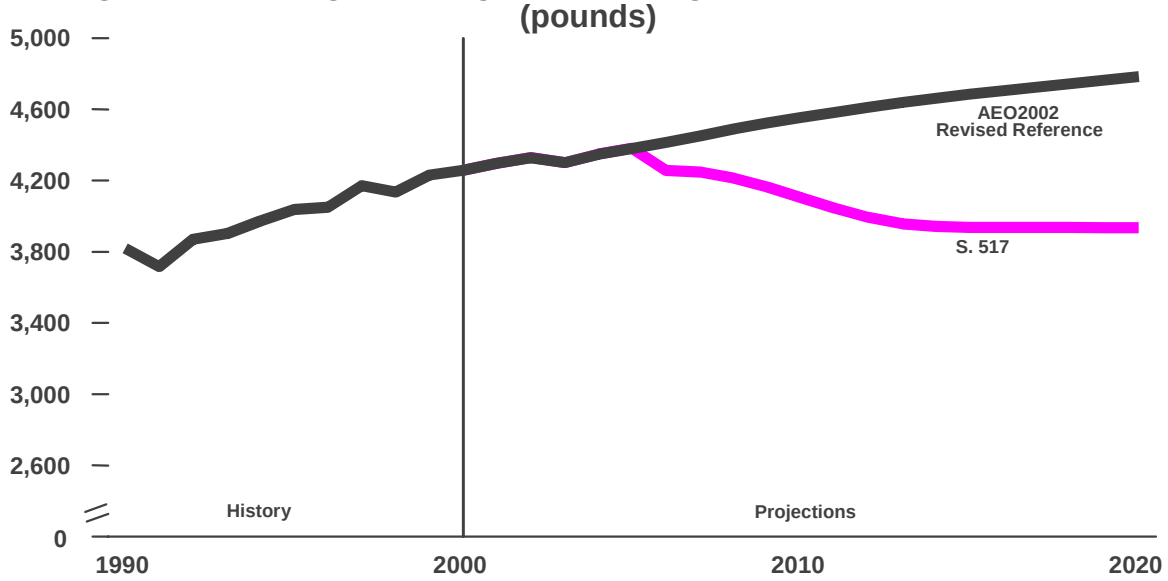
Source: National Energy Modeling System runs: s804base.d020702b and s517cafe.d022502a.

Figure 26. Average New Light Truck Horsepower for Two Cases, 1990-2020



Source: National Energy Modeling System runs: s804base.d020702b and s517cafe.d022502a.

Figure 27. Average New Light Truck Weight for Two Cases, 1990-2020 (pounds)



Source: National Energy Modeling System runs: s804base.d020702b and s517cafe.d022502a.

Table 8. Summary of S. 517 Impacts (2005, 2010, 2015, 2020)

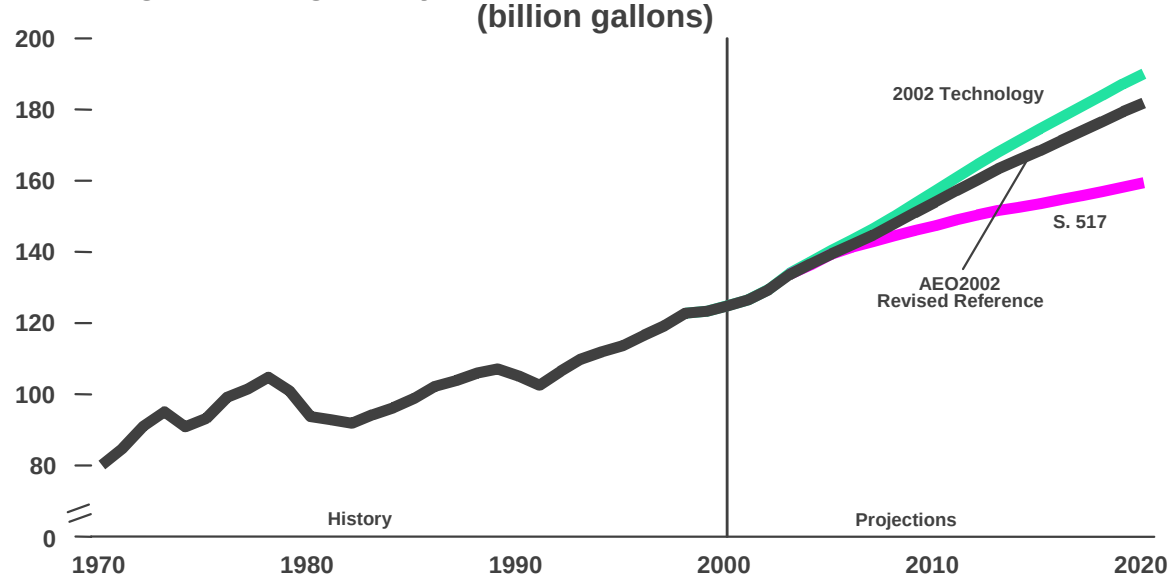
	2005	2010	2015	2020
Light Vehicle Energy Use (billion gallons)				
AEO2002 Revised Reference Case	139.4	154.0	168.5	181.8
S. 517 Case	139.4	147.4	153.5	159.4
Percent Change	0.0	-4.2	-8.6	-11.8
Light Vehicle CO_2 Emissions (MMTCe)				
AEO2002 Revised Reference Case	331.2	366.0	400.3	432.1
S. 517 Case	331.1	350.3	364.9	379.1
Percent Change	0.0	-4.2	-8.6	-11.8
Net Petroleum Imports (million barrels per day)				
AEO2002 Revised Reference Case	12.58	14.30	15.32	16.69
S. 517 Case	12.57	13.90	14.49	15.40
Percent Change	-0.1	-2.8	-5.4	-7.7
Average New Car Fuel Economy (mpg)				
AEO2002 Revised Reference Case	29.50	29.58	29.62	29.63
S. 517 Case	29.50	33.44	35.54	35.84
Percent Change	0.0	13.0	20.0	21.0
Average New Car Price (thousands of 2000 $)				
AEO2002 Revised Reference Case	22.97	23.19	23.37	23.54
S. 517 Case	22.98	23.45	23.91	26.56
Percent Change	0.0	1.1	2.3	2.3
Average New Car Horsepower				
AEO2002 Revised Reference Case	188	202	213	220
S. 517 Case	188	174	168	168
Percent Change	0.0	-13.9	-21.1	-23.6
Average New Car Weight (pounds)				
AEO2002 Revised Reference Case	3191	3257	3309	3359
S. 517 Case	3191	2826	2719	2723
Percent Change	0.0	-13.2	-17.8	-18.9
Average New Light Truck Fuel Economy (mpg) [1]				
AEO2002 Revised Reference Case	21.13	21.79	22.30	22.28
S. 517 Case	21.41	25.05	26.26	26.49
Percent Change	1.3	15.0	17.8	15.9
Average New Light Truck Price[2] (thousands of 2000 $)				
AEO2002 Revised Reference Case	24.94	25.23	25.42	25.60
S. 517 Case	24.94	25.70	26.33	26.56
Percent Change	0.0	1.9	3.6	3.8
Average New Light Truck Horsepower[2]				
AEO2002 Revised Reference Case	217	237	246	252
S. 517 Case	217	215	206	206
Percent Change	0.0	-9.3	-16.3	-18.3
Average New Light Truck Weight[2] (pounds)				
AEO2002 Revised Reference Case	4380	4554	4684	4784
S. 517 Case	4380	4105	3938	3936
Percent Change	0.0	-9.9	-15.9	-17.7

Source: National Energy Modeling System runs: s804base.d020702b and s517cafe.d022502a.

[1] Light trucks less than 10,000 pounds gross vehicle weight.

[2] Light trucks less than 8,500 pounds gross vehicle weight.

Figure 28. Light-Duty Vehicle Fuel Use in Three Cases, 1970-2020 (billion gallons)



Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a and ltrkiten.d102501a.

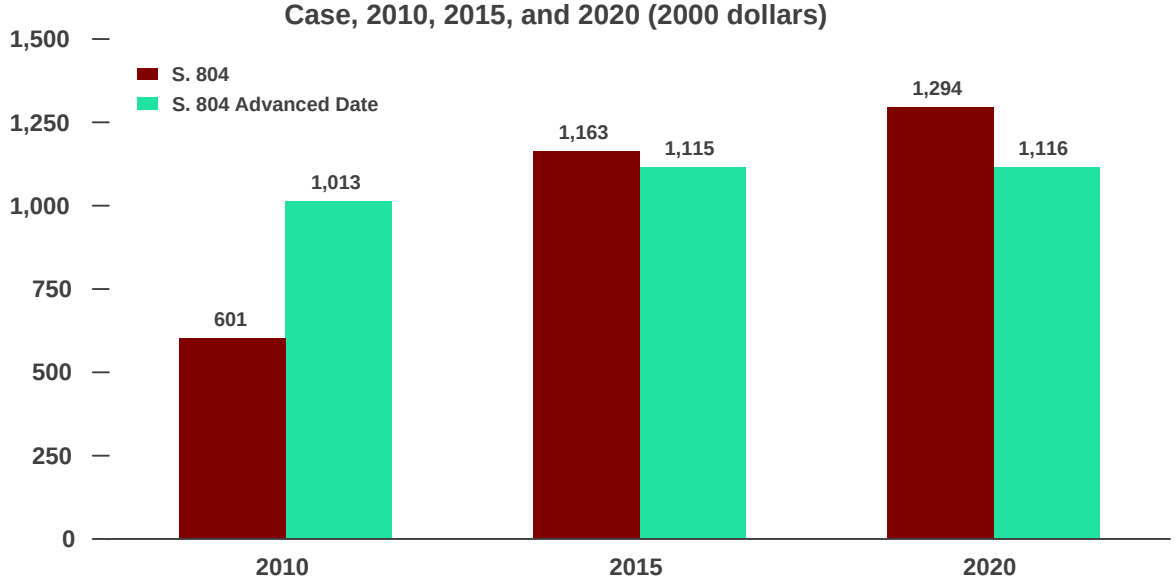
Macroeconomic Impacts

S. 804

Table 9 summarizes projected macroeconomic activity in three cases: the AEO2002 Revised Reference and two of the S. 804 cases, focusing on the impacts in 2010, 2015 and 2020. As can be seen, the macroeconomic impacts are relatively small. There are three major effects that influence the economy at the aggregate level. First, with stricter CAFE standards there is an increase in the average price of light duty trucks. The higher vehicle cost to the consumer has an adverse effect on the family budget. As a consequence, aggregate personal consumption expenditures are lower relative to the reference case. With higher prices, sales of light trucks for investment purposes are also lower and thus the initial impact on real investment is also negative. Second, with greater fuel efficiency and a decline in aggregate expenditures, there is a reduction in energy use in the economy due to a decline in oil demand. This decline in energy use reduces imports of oil, and domestic production also declines slightly. Third, as a result of a decrease in energy demand, energy prices decline relative to the reference case. This relative decline in energy prices sets into motion deflationary forces that stimulate aggregate demand over time, for all goods and services in the economy, including energy.

As described earlier, the incremental cost of light duty trucks for the two S. 804 Cases is shown in Figure 29. By 2010, the incremental cost for light trucks is $601 (expressed in 2000 dollars) in the S. 804 Case and $1,013 in the S. 804 Advanced Date Case. The S. 804 Advanced Date Case reduces the cumulative fines imposed on manufacturers for not achieving the standard under S. 804, but the price increase of the now available technology is higher. However, in the Advanced Date Case, the incremental cost levels off beyond 2010 and by 2020 is $1,116. While the S. 804 Case has initially lower incremental costs in 2010, these costs rise relatively more than the Advanced Date Case and by 2020 the incremental cost of a new light truck is $1,294.

Figure 29. Incremental Cost of Average New Light-Duty Trucks over Reference Case, 2010, 2015, and 2020 (2000 dollars)



Source: National Energy Modeling System runs: s804cafe.d020802a and s804advd.d021102a.

The effect of this incremental cost of new light trucks is reflected in decreased sales of light duty vehicles, including cars and trucks. The analysis assesses the change in light vehicle sales in the aggregate, but cannot assess shifts between cars and light trucks. Some economists believe that some consumers will purchase large cars rather than light trucks with reduced horsepower and weight. However, for this assessment, the projected changes in vehicle sales due to increased vehicle prices reported in this study are assumed to affect light trucks only.

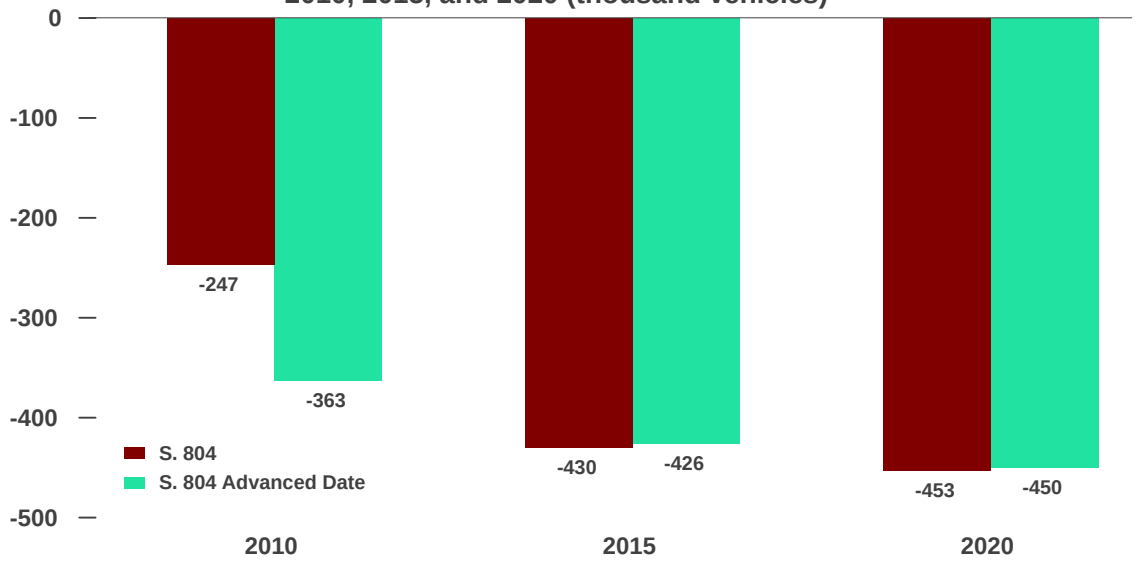
Sales of light duty trucks are lower, relative to the reference, in every year of the forecast. Of the two CAFE cases, the decrement in sales is greater under the S. 804 Advanced Date Case early in the forecast period, given the faster rise in incremental costs in this Case (Figure 30). In 2010 sales decline by 363 thousand vehicles in the S. 804 Advanced Date Case, relative to a reference projection for light duty vehicles of 17.3 million vehicles. By contrast, the S. 804 Case is projected to have a reduction of sales of 247 thousand units. However, by 2015 and 2020, the reduction in vehicle sales is slightly larger in the S. 804 Case. This is because the incremental cost of trucks continues to rise in the S. 804 Case while the S. 804 Advanced Case shows the incremental cost rising more slowly and then leveling off. By 2020, light truck sales are forecast to decline by 453 thousand vehicles in the S. 804 Case as compared to 450 thousand in the S. 804 Advanced Date Case. Over the 2003 to 2020 time period, sales of light duty trucks are 5.2 and 5.4 million units lower under the S. 804 and S. 804 Advanced Date Cases respectively, compared to the reference case.

Table 9. Projected Macroeconomic Impacts of S. 804 (2010-2020)

Projection	2010	2015	2020
Real Gross Domestic Product			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	12309	14399	16530
S. 804	12292	14379	16519
S. 804 Advanced Date	12282	14380	16527
Real Gross Domestic Product			
(Percent Change from Revised Reference)			
S. 804	-0.14	-0.14	-0.07
S. 804 Advanced Date	-0.22	-0.13	-0.02
Real Consumption Expenditures			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	8255	9547	10999
S. 804	8241	9532	10988
S. 804 Advanced Date	8235	9532	10994
Real Consumption Expenditures			
(Percent Change from Revised Reference)			
S. 804	-0.16	-0.16	-0.10
S. 804 Advanced Date	-0.24	-0.16	-0.05
Real Investment Expenditures			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	2517	3254	3957
S. 804	2515	3254	3962
S. 804 Advanced Date	2512	3255	3961
Real Investment Expenditures			
(Percent Change from Revised Reference)			
S. 804	-0.08	0.01	0.15
S. 804 Advanced Date	-0.17	0.05	0.11
Real Trade Balance			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	-296	-256	-347
S. 804	-298	-264	-356
S. 804 Advanced Date	-300	-264	-352
Real Trade Balance			
(Change from Revised Reference)			
S. 804	-2.6	-8.6	-8.9
S. 804 Advanced Date	-4.3	-8.8	-4.1
Consumer Price Index			
(Index, 1982-4=100)			
AEO 2002 Revised Reference	227.5	263.6	314.1
S. 804	227.3	262.8	312.0
S. 804 Advanced Date	227.4	262.6	311.6
Consumer Price Index			
(Percent Change from Revised Reference)			
S. 804	-0.07	-0.31	-0.68
S. 804 Advanced Date	-0.03	-0.39	-0.79
Sales of Light Vehicles			
(thousands of units)			
AEO 2002 Revised Reference	17337	17818	18283
S. 804	17091	17388	17830
S. 804 Advanced Date	16974	17392	17833
Sales of Light Duty Vehicles			
(Change from Revised Reference)			
S. 804	-247	-430	-453
S. 804 Advanced Date	-363	-426	-450
Non-agricultural Employment			
(thousands employed)			
AEO 2002 Revised Reference	145283	150401	154698
S. 804	145069	150168	154507
S. 804 Advanced Date	144957	150179	154588
Non-agricultural Employment			
(Change from Revised Reference)			
S. 804	-214	-233	-192
S. 804 Advanced Date	-325	-222	-111

Source: National Energy Modeling System, runs s804base.d020702b, s804cafe.d020802a, s804avdv.021102a.

Figure 30. Decline in Sales of Light-Duty Trucks from Reference Case, 2010, 2015, and 2020 (thousand vehicles)



Source: National Energy Modeling System runs: s804cafe.d020802a and s804advd.d021102a.

From a macroeconomic perspective, declining real consumption and investment expenditures dominate the early part of the forecast period and introduce cyclical behavior in the economy, resulting in small output and employment losses through 2010. In 2010, real GDP is forecast to be 0.14 percent lower in the S. 804 Case relative to the reference and the S. 804 Advanced Date Case is 0.22 percent lower. Accompanying this, non-agricultural employment declines by 214 thousand and 325 thousands jobs, respectively under the two Cases. This represents a percentage reduction in employment of between 0.15 percent and 0.22 percent of total non-agricultural employment in the economy.

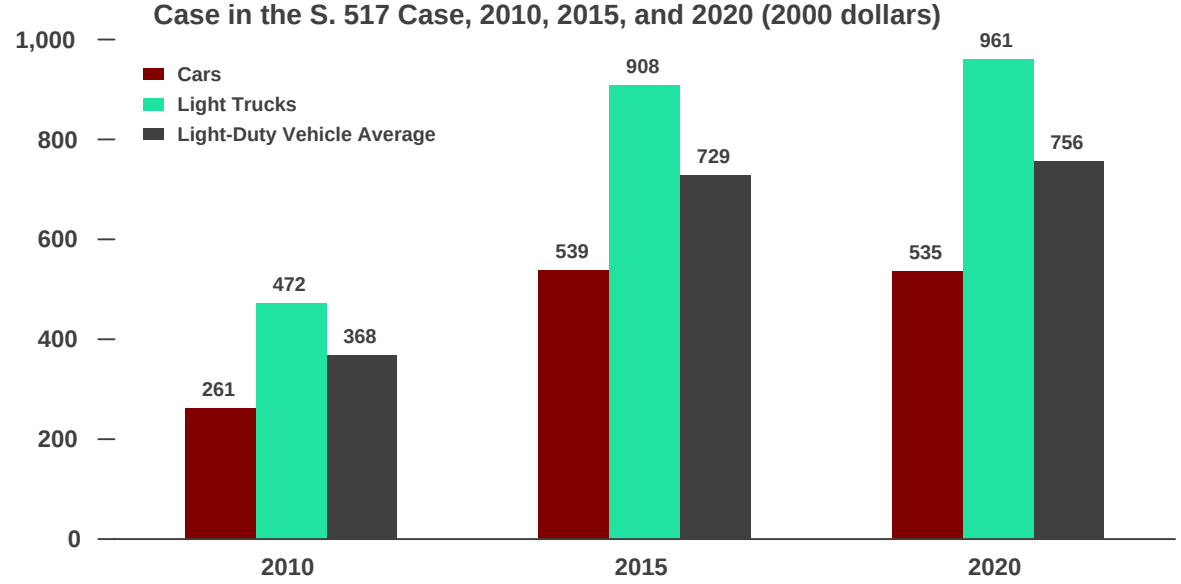
Further into the forecast period, the impacts on the economy are moderated as the incremental cost of light trucks in both cases begins to level off, and with the decline in the world oil price relative to reference levels. Investment, the most volatile component of GDP, initially declines in response to the decline in aggregate demand early in the forecast. With the economy reaching its peak GDP loss between 2010 and 2015, investment activity rebounds strongly in anticipation of increasing aggregate demand. The level of investment activity by 2020 is actually greater than in the reference forecast, making up some of the lost capital stock precipitated by the early loss in aggregate demand. In the long run, the economy is expected to recover and move back toward the reference growth path. By 2020, real GDP is still 0.07 percent below the reference in the S. 804 Case, but the path is beginning to return to the reference. The S. 804 Advanced Date Case is more cyclical, in part because of the initial larger, then subsequent smaller incremental cost path relative to the S. 804 Case. Also, when the economy is adversely affected earlier, such as in the S. 804 Advanced Date Case, there is a strong tendency of the economy to attempt to return to its natural long-run growth path. This results in a strong rebound, in response to the strong decline early in the forecast period.

The net effects on the trade balance are influenced by opposing sets of pressures – those which affect the oil import bill directly and those that influence other traded goods and services. The initial reduction in gasoline demand results in a reduction in imported oil. This lower demand for gasoline leads to a slight decline in the world price of oil, which stimulates the demand for energy and reduces domestic production slightly. On balance, energy demand is expected to be lower and the oil import bill reduced. However, with a reduction in oil imports and aggregate demand, there is pressure on U.S. export commodities due to the resultant foreign exchange rate depreciation, which may offset the reduction in the oil import bill. As a result of these opposing tendencies, it is difficult to predict the direction of the trade balance. The results indicate that the trade balance generally deteriorates.

S. 517

Since the S. 517 Case applies to both cars and light trucks, the price of each is expected to increase. Figure 31 shows the incremental cost for cars, light trucks and the average for all light-duty vehicles. Moreover, the profile of the price path is different from the two S. 804 Cases discussed above. The incremental costs in the S. 517 Case commence later, but rise steadily through the forecast. In 2010, the incremental cost for light-duty vehicles in the S. 517 Case is about even with the overall incremental cost of light-duty vehicles in the S. 804 Case, at $368 and $361 respectively, but below the $505 incremental cost in the S. 804 Advanced Date Case. However, by 2015 the average incremental cost of light duty vehicles is higher than both of the S. 804 cases, and this trend continues through 2020. In 2020, the incremental cost of light-duty vehicles is $756 in the S. 517 Case, as compared to $630 for the S. 804 Case and $542 for the S. 804 with Advanced Date Case. This different cost profile has an impact on the size and duration of the economic impacts associated with the S. 517 Case.

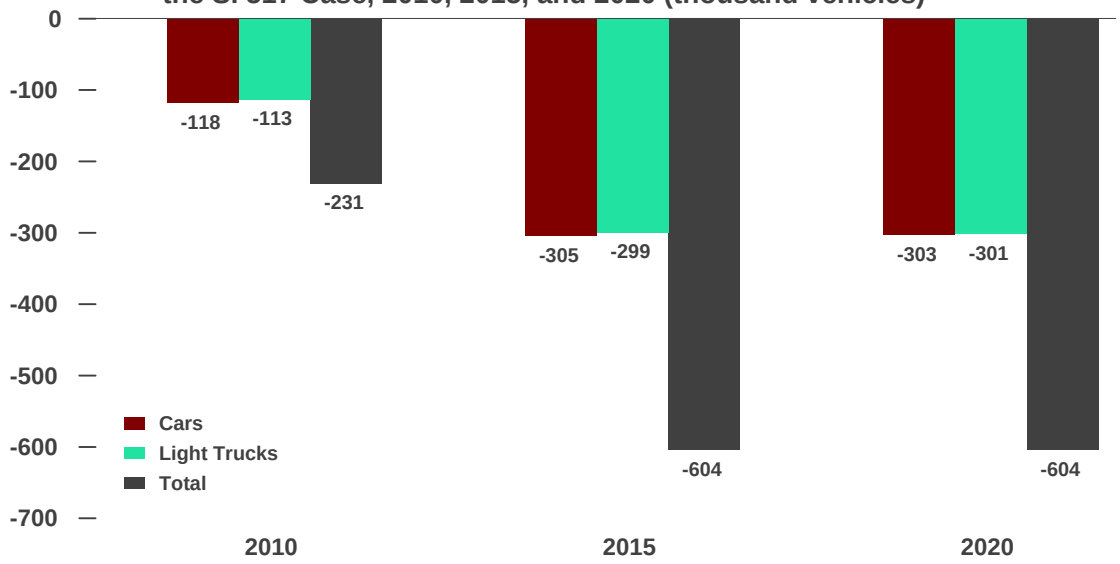
Figure 31. Incremental Cost of Average New Light-Duty Vehicles over Reference Case in the S. 517 Case, 2010, 2015, and 2020 (2000 dollars)



Source: National Energy Modeling System run s517cafe.d022502a.

Figure 32 shows the effect on light duty vehicle sales for both cars and light trucks. In the aggregate, light duty vehicle sales decline at a slower rate early in the reference forecast. By 2010 sales are down relative to the forecast by 231 thousand vehicles, about the same as in the S. 804 Case. However, by 2015, with the incremental cost of light duty vehicles above both of the S. 804 cases, new vehicle sales decline by 604 thousand and by 2020 are also lower than the reference case by 604 thousand vehicles.

Figure 32. Decline in Sales of Light-Duty Vehicles from Reference Case to the S. 517 Case, 2010, 2015, and 2020 (thousand vehicles)



Source: National Energy Modeling System run s517cafe.d022502a.

The impact on the economy is small through 2010 (Table 10). By 2010, real GDP is projected to be 0.14 percent lower than the reference, almost the same impact as under the S. 804 Case. However, with the steady increase in the incremental cost of new light duty vehicles from 2010 through 2020, the economy continues to worsen and by 2015 is 0.30 percent lower than the reference. The economy begins to rebound past 2015, but by 2020 is still 0.15 percent lower. By 2015, the peak loss in non-agricultural employment is 453 thousand jobs, 0.30 percent of the total non-agricultural employment in the economy. By 2020, with the economy beginning to recover, non-agricultural employment is still down by 293 thousands jobs (0.19 percent).

Present Value of Impacts

Table 11 provides the sum of the discounted changes (billions of dollars discounted at 7 percent) in real GDP and personal consumption expenditures over the entire 18-year forecast period for the S. 804 Case, the S. 804 Advanced Date Case, and the S. 517 Case. These can be viewed as summary measures of the net effects on the macroeconomy. To provide perspective about the magnitude of losses, these discounted values are also expressed as percentages of the total discounted sum of values of real GDP and consumption over the same period. These percentages imply that the losses in real GDP and personal consumption expenditures are small.

Table 10. Projected Macroeconomic Impacts of S. 517 (2010-2020)

Projection	2010	2015	2020
Real Gross Domestic Product			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	**12309**	**14399**	**16530**
S. 517	**12292**	**14356**	**16505**
Real Gross Domestic Product			
(Percent Change from Revised Reference)			
S. 517	**-0.14**	**-0.30**	**-0.15**
Real Consumption Expenditures			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	**8255**	**9547**	**10999**
S. 517	**8242**	**9517**	**10980**
Real Consumption Expenditures			
(Percent Change from Revised Reference)			
S. 517	**-0.16**	**-0.31**	**-0.18**
Real Investment Expenditures			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	**2517**	**3254**	**3957**
S. 517	**2514**	**3248**	**3961**
Real Investment Expenditures			
(Percent Change from Revised Reference)			
S. 517	**-0.11**	**0.19**	**0.11**
Real Trade Balance			
(Billion 1996 Dollars)			
AEO 2002 Revised Reference	**-296**	**-256**	**-347**
S. 517	**-298**	**-269**	**-363**
Real Trade Balance			
(Change from Revised Reference)			
S. 517	**-2.7**	**-13.1**	**-15.2**
Consumer Price Index			
(Index, 1982-4=100)			
AEO 2002 Revised Reference	**227.5**	**263.6**	**314.1**
S. 517	**227.5**	**263.3**	**312.0**
Consumer Price Index			
(Percent Change from Revised Reference)			
S. 517	**-0.01**	**-0.14**	**-0.68**
Sales of Light Vehicles			
(thousands of units)			
AEO 2002 Revised Reference	**17337**	**17818**	**18283**
S. 517	**17107**	**17214**	**17678**
Sales of Light Duty Vehicles			
(Change from Revised Reference)			
S. 517	**-230**	**-604**	**-604**
Non-agricultural Employment			
(thousands employed)			
AEO 2002 Revised Reference	**145283**	**150401**	**154698**
S. 517	**145076**	**149948**	**154405**
Non-agricultural Employment			
(Change from Revised Reference)			
S. 517	**-207**	**-453**	**-293**

Source: National Energy Modeling System runs: s804base.d020702b, s517cafe.d022502a.

Table 11. Present Discounted Values of Changes in GDP and Consumption (Billion 1996 Dollars discounted at 7 Percent from 2003-2020)

Variable	Present Value of Changes (2003-2020)	% of Total (2003-2020)
Real GDP, S. 804 Case	-134	-0.11
Real GDP, S. 804 Advanced Date	-141	-0.11
Real GDP, S. 517	-170	-0.14
Real Consumption, S. 804	-105	-0.13
Real Consumption, S. 804 Advanced Date	-111	-0.13
Real Consumption, S. 517	-123	-0.15

Source: National Energy Modeling System, runs d020102a, d020802a, d021102a, d022502a.

Alternative Fuels Provisions

Table 12 summarizes the alternative fuels legislation examined in this report.

Table 12. Summary of Proposed Alternative Fuels Legislation

S. 1766		H.R. 4	
Section	Requirements	Section	Requirements
811	Requires dual fuel vehicles in Federal fleet to use alternative fuels for 75 percent of fuel by 2005. Includes enclosed 3-wheel electric vehicles as AFVs	205 206	Increases AFVs to 85 percent of Federal fleet purchases by 2006. Includes hybrid vehicles as an AFV Eliminates petroleum fuel consumption in the Federal fleet by the end of FY2009
812	Single passenger AFVs allowed in HOV lanes	151	Single passenger AFVs and hybrid vehicles allowed in HOV lanes
814	Provides grants for demonstration and commercial application of alternative fuel school buses and ultra-low sulfur diesel buses to replace pre-1977 buses and pre-1991 diesel buses	2142	Provides grants for demonstration and commercial application of alternative fuel school buses and ultra-low sulfur diesel buses
815	Establishes cooperative agreements to develop fuel cell power school buses	2143	Establishes cooperative agreements to develop fuel cell power school buses
816	Authorizes $260 million over 2003-2006 for 814 and 815. Specifies maximum of $25 million for fuel cell school buses	2144	Authorizes $300 million over 2002-2006 for 2142 and 2143. Specifies maximum of $25 million for fuel cell school buses

S. 1766[15]

The alternative fuel provisions of S. 1766 have two main purposes: increase the use of alternative fuels in Federal fleets and fund a large demonstration program aimed at using alternative, fuel cell, and ultra-low sulfur diesel school buses.

Section 811. Increased use of alternative fuels by Federal fleets
The section amends the Energy Policy and Conservation Act (EPCA) to require that dual-fueled vehicles be operated such that by September 30, 2003, at least 50 percent of total fuel used in such vehicles will be from alternative fuels.[16] The percentage will increase to at least 75 percent of total fuel used in dual fueled vehicles by September 30, 2005. Under current regulations, dual fueled or flexible fuel vehicles qualify as alternative fuel vehicles (AFVs) even if they consume only gasoline. This provision would require such vehicles to actually use alternative fuels for 75 percent of their consumption by 2005.

This section also amends EPCA to include as a "dedicated vehicle" three-wheeled enclosed electric vehicles with a vehicle identification number.

The impact of Section 811 would be similar to the requirements in Executive Order 13149 (April 21, 2000) to use "alternative fuels to meet a majority of the fuel requirements" of AFVs. In effect, Section 811's main provisions would place into law the requirements included in existing Executive Orders. Consequently, little, if any, additional impact on future transportation energy relative to the Reference Case is expected.

Estimated alternative fuel consumption by Federal agencies was 5.8 million gallons in 1999, which was 1.7 percent of total U.S. alternative fuel consumption of 339.3 million gallons (Table 13). At the same time, Federal agencies accounted for about 276 million gallons of gasoline consumption, which amounts to 0.2 percent of total U.S. gasoline consumption. Overall, alternative fuels make up about 0.3 percent of the combined total of alternative fuels plus gasoline.

[15] For purposes of discussing S. 1766, the following Sections have been reviewed: 811, 812, 814, 815, 816, and 819. Sections 817 and 818 which provide biodiesel fuel use credits and specifies required renewable fuel content of motor vehicle fuels are discussed in a separate response, *Summary of Renewable Fuels Standard/MTBE Cases Requested by the Senate Energy Committee*.
[16] Section 301 of the Energy Policy Act of 1992 (EPACT) defines alternative fuel to include methanol, ethanol, natural gas, liquefied petroleum gas, hydrogen, coal-derived liquid fuels, fuels derived from biological materials, and electricity.

Table 13. Estimated Consumption of Transportation Fuels, 1999 (million gasoline-equivalent gallons)

	Federal Agencies	State and Local Agencies	Private	Total US
Alternative Fuels	5.8	78.0	255.5	339.3
Motor Gasoline	275.9	1,878.8	124,944	127,183
Notes: Federal agencies' gasoline data is for FY1999. Sources: Federal Agencies gasoline: General Services Administration, *FY1999 Federal Fleet Report*, www.policyworks.gov/vehicles ; Others' Alternative Fuel: Energy Information Administration, web address: www.eia.doe.gov/cneaf/alternate/page/datatables, table 13; State Agencies' Petroleum, Federal Highway Administration, *Highway Statistics 1999*, Table MF-13; Private petroleum derived by subtraction from the U.S. total in Energy Information Administration, *Annual Energy Outlook 2002*, DOE/EIA-0383(2002), (Washington, DC, December 2001) Table A7.				

The type of fuel consumed by dual fuel vehicles in the Federal fleet must be estimated because specific data are not available. Table 14 separates the Federal AFV fleet into two categories, Dedicated and Non-Dedicated. Dedicated AFVs use only alternative fuel; Non-Dedicated AFVs may use an alternative fuel as well as non-alternative fuel. Most of the Non-Dedicated AFVs use compressed natural gas (CNG) or liquefied petroleum gas (LPG) as the alternative fuel. The Flexible Fuel AFVs in Table 11 consist of those Non-Dedicated AFVs that use either E85 or M85. These Flexible Fuel AFVs probably consume very little of the alternative fuel, relying almost entirely on gasoline for fuel.

Federal agencies' inventory of AFVs was about 24 thousand in 1999 (Table 10), with flexible fuel vehicles accounting for almost 40 percent of the alternative fuel vehicles in the Federal fleet. As an upper bound estimate, assume that all flexible fuel vehicles in 1999 consumed only gasoline. If these vehicles consumed the average gallons of gasoline per car,[17] 5.1 million gallons of gasoline would be consumed. If it were required that 75 percent of fuel used in flexible fuel vehicles be alternative fuels, the Federal fleet alternative fuel consumption would be increased by 3.8 million gallons, with a corresponding decrease in gasoline consumption. With these assumptions, the flexible fuel requirement would have reduced 1999 Federal fleet petroleum consumption by 1.4 percent. Since the alternative fuel consumed contains 15 percent gasoline, carbon emissions would be reduced by 1.2 percent.

[17] The average gasoline gallons per gasoline-fueled vehicle was 557 gallons in 1999. Computed from Tables 17 and 19 in General Services Administration, *FY1999 Federal Fleet Report*, www.policyworks.gov/vehicles.

Table 14. Estimated Number of Alternative Fuel Vehicles, 1999

	Dedicated	Non-Dedicated	Total	Flexible Fuel
Federal Agencies	1,731	22,403	24,134	9,141
State and Local Agencies	NA	NA	77,515	12,201
Total US	NA	NA	406,841	41,428

NA = Not available.
Note: For purposes of this table, flexible fuel is defined as Non-Dedicated M-85 and E-85 vehicles.
Sources: Federal Agencies: Energy Information Administration, web address: www.eia.doe.gov/cneaf/alternate/page/datatables, tables 6, 20, and 22; State and Local: U.S. Department of Energy, Oak Ridge National Laboratory, *Transportation Energy Data Book*, Edition 19, September 1999, Table 9-2.

Section 812. Exception to HOV passenger requirements for alternative fuel vehicles
This provision would allow single passenger alternative fuel vehicles to use HOV lanes, as some States already do. Presumably, this would increase the incentive to purchase AFVs to some extent. However, allowing single passenger vehicles in HOV lanes could lead to additional congestion in the HOV lanes, which would lead to increased overall fuel consumption. On balance, the impact on fuel consumption of the HOV exception cannot be quantified but is likely to be minimal.

Section 814. Green school bus pilot program
The proposed legislation would provide grants for the demonstration and commercial application of alternative fuel school buses and ultra-low sulfur diesel[18] school buses to replace buses manufactured before model year 1977 or diesel-powered buses manufactured before 1991. The section further specifies that 20 percent to 25 percent of the funds granted must be for ultra-low sulfur diesel school buses.

Authorized funding for this program is shared with the funding for the fuel cell bus program described in Section 815. This means that over the 2003-2006 period, at least $235 million and as much as $260 million is authorized for the green school bus pilot program.

It has been estimated that 30 States have no pre-1977 school buses.[19] For most others, the percentage of pre-1977 school buses is 1 to 2 percent. A major exception is California's school bus fleet, which is estimated to have 9 percent pre-1977 buses (2,180 vehicles). In light of the small number of affected buses, the overall impact of reducing the use of pre-1977 buses would be minimal, although perhaps significant for some State fleets.

[18] Possible effects of the transition to ultra low-sulfur diesel are discussed in Energy Information Administration, *The Transition to Ultra-Low-Sulfur Diesel Fuel: Effects on Prices and Supply*, SR/OIAF/2001-01, (Washington, DC, May 2001).

[19] Source: www.schoolbusfleet.com.

While there is some uncertainty about the number of school buses in service the *Transportation Energy Data Book*, an authoritative source, reports there were approximately 592 thousand school buses in service in 1999 (Table 15),[20] that consumed 76 trillion Btu (608 million gallons gasoline-equivalent) of transportation fuel. However, since the number of pre-1991 diesel-power buses in the school bus fleet is not known, no further evaluation of the impact of this provision can be done.

Table 15. School Bus Fleets, Selected Data, 1999

	Number (thousand)	Energy Use (trillion Btu)
Alternative Fuel School Buses	3.9	NA
Total School Buses	592.0	76.3
Sources: Alternative Fuel School Buses: Energy Information Administration, web address: www.eia.doe.gov/cneaf/alternate/page/datatables, table 24; Total School Buses: U.S. Department of Energy, Oak Ridge National Laboratory, *Transportation Energy Data Book*, Edition 21, September 2001, Table 8-13.		

Section 815. Fuel cell bus development and demonstration program
This section establishes a program for cooperative agreements with the private sector to develop fuel cell-powered school buses. The program will also include at least two different local government entities currently using natural gas-powered school buses to demonstrate (along with the fuel cell developers) the use of fuel cell-powered school buses. The funding is not to exceed $25 million over the 2003-2006 period.

Because it is difficult to relate levels of funding for research, development, or demonstration programs directly to specific improvements in the characteristics, benefits, and availability of energy technologies, the overall impact of this proposal cannot be assessed. In general increased research, development, and demonstration would be expected to lead to advances, but it is impossible to determine which programs would or would not be successful or how successful they might be.

Section 816. Appropriations for 814 and 815
As noted above, the fuel cell bus program cannot exceed a total of $25 million, with the remainder going to the green school bus pilot program. The total authorization for the fuel cell bus and green school bus pilot programs for 2003 to 2006 is as follows:

$50 million in 2003;
$60 million in 2004;
$70 million in 2005;
$80 million in 2006.

[20] The total number of school buses is estimated at 448.3 thousand by www.schoolbusfleet.com.

Section 819. Neighborhood electric vehicles
This provision would amend the Energy Policy Act of 1992 (EPACT) to allow some electric vehicles that are not intended to be used on highways to count as alternative fuel vehicles for Federal fleet purposes. This is consistent with Section 811, which would include enclosed three wheel vehicles. In the absence of data on such vehicles, no evaluation of likely impacts can be done.

Table 16 summarizes the potential energy impacts of the S. 1766 provisions.

Table 16. Summary of Potential Impacts of Proposed Alternative Fuels Legislation

S. 1766		
Section	Requirements	Potential Impact
811	Requires dual fuel vehicles in Federal fleet to use alternative fuels for 75 percent of fuel by 2005. Includes enclosed 3-wheel electric vehicles as AFVs	Increase Federal alternative fuels consumption by 3.8 million gallons (66 percent increase over 1999 consumption of 5.8 million gallons). This reduces Federal fleet gasoline consumption by a corresponding amount, or 1.4 percent of total. The reduction of 3.8 million gallons of gasoline would reduce total U.S. gasoline consumption by 0.003 percent. Not estimated.
812	Single passenger AFVs allowed in HOV lanes	Not estimated.
814	Provides grants for demonstration and commercial application of alternative fuel school buses and ultra-low sulfur diesel buses to replace pre-1977 buses and pre-1991 diesel buses	Total school bus consumption was about 608 million gallons gasoline equivalent in 1999. Likely to have minimal energy impact due to small number of buses involved.
815	Establishes cooperative agreements to develop fuel cell power school buses	Not quantified.
816	Authorizes $260 million over 2003-2006 for 814 and 815. Specifies maximum of $25 million for fuel cell school buses	See above.

H.R. 4[21]

Section 151. High Occupancy Vehicle Exception
This provision would allow single passenger hybrid or alternative fuel vehicles to use HOV lanes. This provision differs from Section 812 of S. 1766 by including hybrid vehicles. However, allowing single passenger vehicles in HOV lanes could lead to additional congestion, which would lead to increased overall fuel consumption. On balance, the impact on fuel consumption of the HOV exception cannot be quantified but is likely to be minimal.

Section 205. Hybrid Vehicles and Alternative Vehicles
Currently, Section 301 of EPACT requires AFVs to be 75 percent of new Federal vehicle acquisitions (police, emergency, and military are excepted from the rule). This provision would amend EPACT to increase the percentage AFVs required by the following amounts:

5 percent in 2004 and 2005
10 percent in 2006 and later years.

This means that the total percentage AFVs would increase to 80 percent in 2004-2005 and to 85 percent thereafter.

Current regulations do not include hybrid vehicles as AFVs for purposes of EPACT compliance. Section 205 would also amend EPACT to specify that hybrid vehicles would count as AFVs. While the impact of this provision cannot be evaluated quantitatively, it would increase the potential market for hybrid vehicles in the Federal fleet.

Section 206. Federal Fleet Petroleum-Based Nonalternative Fuels
The purpose of this provision is to reduce the Federal fleet purchases of petroleum-based nonalternative fuel vehicles over the model years 2004-2010 such that the Federal fleet fuel consumption will be totally reliant on alternative fuels by the end of fiscal year 2009.

Estimated alternative fuel consumption by Federal agencies was 5.8 million gallons in 1999, compared with estimated US total alternative fuel consumption of 339 million gallons (Table 9). In the same year, Federal fleets consumed 276 million gallons of petroleum for transportation use. If all Federal fleet petroleum consumption were converted to alternative fuels,[22] then U.S. alternative fuel consumption in 1999 would have been 81 percent higher, amounting to 615 million gallons. This eventuality would have resulted in alternative fuels accounting for 0.5 percent of total U.S. gasoline and alternative fuel transportation fuels.

The feasibility of achieving 100 percent alternative fuel use by 2009 is difficult to assess. However, at the end of FY1999, there were 554 thousand gasoline or diesel fueled vehicles in the Federal fleet.[23] In the same fiscal year, 58 thousand gasoline or diesel-fueled vehicles were

[21] For purposes of reviewing H.R. 4, the following Sections have been reviewed: 151, 205, 206, 2101-2105, 2131-2133. Section 153 which would provide biodiesel credits is discussed in a separate response, *Summary of Renewable Fuels Standard/MTBE Cases Requested by the Senate Energy Committee*.

[22] Emergency, police, and military vehicles are exempt.

[23] General Services Administration, *FY1999 Federal Fleet Report*, Table 17, www.policyworks.gov/vehicles

purchased.[24] If the bulk of the purchases were to replace retired vehicles rather than to expand the fleet, the existing fleet of gasoline or diesel vehicles could be replaced in 10 years.

Section 2101-2105. Alternative Fuel Vehicle Acceleration Act of 2001
The purpose of these sections is to establish competitive grant pilot programs to provide not more than 15 grants to State and local governments to acquire alternative fuel vehicles, including ultra-low sulfur diesel vehicles. Flexible fuel vehicles that could operate solely on petroleum-based fuels are explicitly excluded. The maximum amount of any grant cannot exceed $20 million. A total of $200 million would be authorized for this program.

State agencies' fleets are estimated to have consumed 1.9 billion gallons of gasoline in 1999 (Table 9). During the same period, these fleets contained about 78 thousand alternative fuel vehicles (Table 10). However, of that total, only about 14 thousand were non-petroleum AFVs.[25] If the entire $200 million was available to purchase alternative fuel vehicles that cost an average of $15 thousand each,[26] 13,333 alternative fuel vehicles could be added to State and local agencies' fleets, almost doubling the number of non-petroleum AFVs. If these vehicles average the same gallons per year as the Federal fleet average (557 gallons per year), petroleum consumption would fall 7.4 million gallons or 0.4 percent of State and local agencies' 1999 gasoline consumption.

Section 2131-2133. Secondary Electric Vehicle Battery Use
The proposed legislation would establish a research, development, and demonstration program for the secondary use of batteries where the original use of such batteries was in electric vehicles. The secondary uses specified include utility and commercial power storage, and power quality.

Funding to be authorized for the secondary electric vehicle battery program is as follows:
$1 million in 2002;
$7 million in 2003 and 2004.

Because it is difficult to relate levels of funding for research, development, or demonstration programs directly to specific improvements in the characteristics, benefits, and availability of energy technologies, the overall impact of this proposal cannot be accessed.

Sections 2141-2144. Clean Green School Bus Act of 2001
The provisions of this section parallel the provisions in S. 1766, sections 814-816. Any potential impacts would be similar.

The following summarizes the concordance between the two bills:
section 2142 is similar to S1766, section 814, efficiency grants
section 2143 is similar to S1766 section 815, fuel cell bus

[24] General Services Administration, *FY1999 Federal Fleet Report*, Table 18, www.policyworks.gov/vehicles
[25] Computed from U.S. Department of Energy, Oak Ridge National Laboratory, *Transportation Energy Data Book*, Edition 19, September 1999, Table 9-2.
[26] The midsize AFV sedan listed by the General Services Administration is $14,516, excluding GSA fees, for model year 2002. http://www.fss.gsa.gov/vehicles/buying/PDF/2002afvs.pdf

section 2144 authorizes $40 million for 2002, and for 2003-2006, it authorizes the same amounts as S1766, section 816.

The proposed authorization for the Clean Green School Bus Act of 2001 for 2002 to 2006 is as follows:

$40 million in 2002;
$50 million in 2003;
$60 million in 2004;
$70 million in 2005;
$80 million in 2006.

Table 17 summarizes the potential energy impacts of the alternative fuels provisions of H.R. 4.

Table 17. Summary of Potential Impacts of Proposed Alternative Fuels Legislation

H. R. 4		
Section	Requirements	
205 206	Increases AFVs to 85 percent of Federal fleet purchases by 2006. Include hybrid vehicles as an AFV. Eliminates petroleum fuel consumption in the Federal fleet by the end of FY2009.	Together, these two provisions would require the Federal fleet to use only alternative fuels. Replacing the 276 million gallons of gasoline consumed by the Federal fleet would have increased total U.S. alternative fuels consumption by 81 percent to 615 million gallons. This would have displaced 0.5 percent of total U.S. gasoline consumption.
151	Single passenger AFVs and hybrid vehicles allowed in HOV lanes	Not quantified.
2142	Provides grants for demonstration and commercial application of alternative fuel school buses and ultra-low sulfur diesel buses	Total school bus consumption was about 608 million gallons gasoline equivalent in 1999. Likely to have minimal impact on energy consumption.
2143	Establishes cooperative agreements to develop fuel cell power school buses	Not quantified.
2144	Authorizes $300 million over 2002-2006 for 2142 and 2143. Specifies maximum of $25 million for fuel cell school buses	

Uncertainties

The fuel economy projections presented in this report reflect a continuation of consumer purchase patterns by vehicle size class and type (car versus light truck). Because it is projected that significant changes will occur in vehicle weight, horsepower, and price to meet the CAFE

standards examined in this report, it is likely that these changes will affect consumer purchase patterns. To compensate for lighter vehicles, consumers may decide, for safety reasons, to move to larger size classes. But increased vehicle costs may force consumers into smaller less expensive vehicles. In addition, significant sales shifts may occur between cars and light trucks. In the S. 517 Case, the projected reduction in car weight may influence more consumers to purchase light trucks. It is also likely that increasing the maximum gross vehicle weight rating of vehicles covered under CAFE to less than 10,000 pounds will serve to push the sales of these types of vehicles to the next largest size class where they would not be subject to fuel economy regulation.

Although many light trucks are now used as passenger vehicles, performance attributes like towing and hauling capability have remained relatively consistent, while vehicle acceleration has increased significantly. Increasing the CAFE standards for light trucks will have significant impacts on both the cost and performance attributes of these vehicles. The availability of advanced technology will be critical to maintaining vehicle performance while also increasing vehicle fuel economy at an acceptable price. Depending upon the availability of technology and its effect on vehicle price and performance, light trucks meeting the new CAFE standards could be viewed as either superior or inferior products. If manufacturers opt to minimize price impacts and produce light trucks with significantly reduced performance to achieve the new CAFE standards, then consumers may view the product as inferior and opt to purchase a midsize or large car to meet their needs. If advanced technology becomes available and manufacturers produce light trucks that meet the new CAFE standard and maintain performance attributes with slightly higher vehicle costs, then consumers may view this product as superior, resulting in more consumers shifting their next vehicle purchase to light trucks.

Appendix A

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510-6150
ENERGY.SENATE.GOV

December 20, 2001

Dr. Mary Hutzler
Acting Administrator
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC, 20585

Dear Acting Administrator Hutzler:

The Senate is considering comprehensive legislation to update U.S. national energy strategy in light of the volatility of energy markets in calendar year 2000 and the growing energy security concerns in light of recent events that highlight our dependence on foreign imported oil. To this end, there have been several legislative proposals introduced in the 107th Congress on the subject of national energy policy, and the Majority Leader has indicated that the Senate will debate energy policy early in the next session of Congress. Our decisions will benefit from an analysis of the strengths and weaknesses of the various energy policy proposals that have been introduced to date.

With that in mind, I request that the Energy Information Administration (EIA) analyze the potential costs and benefits of proposed legislation to update and revise our national energy strategy, namely, H.R. 4 as passed by the House of Representatives in August 2001, and S. 1766 as proposed by Senators Daschle and Bingaman earlier this month. I understand that EIA has the ability to conduct such analysis, including the use of both sectoral and economy-wide energy models. Using the most recent *Annual Energy Outlook 2002* as a reference case, I ask that EIA assess the impacts of these energy policy proposals on, at minimum:

- macroeconomic indicators (jobs, Gross Domestic Product, trade balance, etc.);
- energy supply and demand by fuel and process;
- energy prices to consumers (residential, industrial, and commercial) by fuel;
- dependence on foreign oil imports and impacts on energy security;
- impacts on energy infrastructure (transmission, pipelines, refineries, etc.); and
- emissions of greenhouse gases and air pollutants.

As the Daschle/Bingaman bill (S. 1766) contains several "placeholders" reserved for future legislative proposals, I ask that for the purposes of your analysis, you include for Section 801 of S. 1766, S. 804, introduced by Senators Feinstein, Snowe and Reed making changes to the Corporate Average Fuel Economy (CAFE) program. For Section 1821 of S. 1766, use the provisions contained in S. 1746, introduced by Senator Reid on nuclear facility security. Also, to ensure a consistent comparison, please exclude from your analysis of H.R. 4 the amendments to the tax code contained in Division C of that bill. I expect to request from EIA a follow-up analysis of the tax-related proposals contained in H.R. 4 and an expected Senate Finance Committee mark at a subsequent date.

When assessing the costs and benefits of these legislative proposals, please be sure to point out which specific policy actions have the most significant positive or negative impacts on the factors outlined above. In order to inform our deliberations on national energy policy which are due to begin in the next several weeks, I ask that the requested information be made available by January 23, 2002. In addition, I request that a briefing of your results prior to release of any written report.

If you have any questions regarding this request, or desire further clarification with respect to translating legislative proposals into assumptions you will use in your analysis, please contact Bryan Hannegan with my Senate Energy and Natural Resources Committee staff at 224-7932. Thank you for your timely attention to this request, and for your efforts to ensure that our Nation's energy policy decisions are informed with the best available analysis.

Sincerely,

Frank H. Murkowski

Frank H. Murkowski
Ranking Member

United States Senate

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510-6150
ENERGY.SENATE.GOV

February 6, 2002

Dr. Mary Hutzler
Acting Administrator
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC, 20585

Dear Acting Administrator Hutzler:

As a follow-up to my letter of December 20, 2001 in reference to analysis of comprehensive energy legislation, please find below additional information to assist you in your analysis of key portions of S. 1766 and H.R. 4 identified as follows:

Renewable Portfolio Standard (RPS): For H.R. 4, assume no changes in current law. For S. 1766, assume a 2.5% mandate for new renewable electricity starting in 2005, increasing 0.5% each year through 2020 (10% new renewables by 2020). In addition, please provide analysis of a new scenario that reflects a 20% RPS by 2020 under the same provisions as in S. 1766. Key analysis questions include: whether or not such amounts of new renewable energy are possible with reasonable technology improvements, what renewable technologies benefit most, whether consumer retail electricity costs are affected by the RPS, and how the higher incremental costs of renewable electricity generation are absorbed by generators, utilities and/or consumers. Also, please describe the effect of the civil penalty imposed for failing to meet the RPS and whether that affects estimates of renewable electricity production, economic impacts, and macroeconomic effects.

Alaska Oil Production: For S. 1766, please provide your baseline Annual Energy Outlook 2002 (AEO) forecast without production from ANWR and compare it with several scenarios for H.R. 4: (1) median USGS ANWR production estimate and AEO 2002 world oil prices; (2) high-range USGS ANWR production estimate and AEO 2002 world oil prices; (3) high-range USGS estimate, using your "High Oil Price" side case; and (4) high-range USGS estimate, using your AEO 2002 "High Technology" side case that assumes rapid transportation technology development. Key variables to consider include the percentage of U.S. foreign oil dependence, and a summary of crude oil supply, demand, and disposition.

Alaska Natural Gas: For H.R. 4, assume no changes in law. For S. 1766, please analyze the impact of the proposed $10 billion loan guarantee (Sec. 6501-6512) on project economics and timing of construction assuming that the "over the top" route for the pipeline is prohibited (Sec. 701). Key analysis variables should include: the date at which natural gas from Alaska is first delivered to market in the Lower 48, the impact of the pipeline on the price of natural gas, and the sensitivity of these variables to higher or lower natural gas prices in the U.S. market.

Automobile Fuel Economy Standards (CAFE): For H.R. 4, assume increases in CAFE standards for model years 2004 through 2010 so as to decrease total gasoline consumption by 5 billion gallons over that period of time. For S. 1766, assume the adoption of provisions of S. 804 (Feinstein) – require 25 mpg for SUVs and light trucks produced between model years 2005 and 2007 and 27.5 mpg for SUVs and light trucks produced thereafter. Use as a reference case technology frozen at model year 2002 levels and performance, and assume further no change in fuel economy for passenger vehicles. Please analyze a second case which assumes a 5% increase in fuel economy standards over model year 2000 levels by model year 2005 for both passenger vehicles and SUVs/light trucks, with a further 5% increase for all vehicles by model year 2010. In all cases, please provide analysis on total net costs to consumers (e.g. up-front additional costs minus life-cycle fuel economy savings), macroeconomic effects on non-agricultural jobs, whether such fuel economy goals can be meet through reasonable technology assumptions, and estimates of carbon dioxide emissions.

Renewable Fuels/MTBE: For H.R. 4, assume no change in current law, and use the Annual Energy Outlook 2002 reference forecast as the base case. For S. 1766, assume a renewable fuel standard of 2.3 billion gallons renewable fuel by 2004 increasing per Section 818 of the legislation to 5.0 billion gallons by 2012. Include in your analysis of S. 1766 a ban on MTBE within four years and assume that, given the opportunity to opt out of the 2% oxygenate requirement, California RFG and East Coast RFG areas do so. Also, please analyze a third case where the renewable fuel standard is as proposed in Section 818 of S. 1766, but assume complete repeal of the 2% oxygenate standard, and that States are given the ability to ban MTBE if they wish starting in 2003 or 2004. Key analysis variables should include effects on motor gasoline and RFG prices and fuel imports, GDP, and energy expenses, and estimates of carbon dioxide emissions.

Air Conditioning/Heat Pump Standard: For H.R. 4, assume a 12 SEER/7.4 HSPF standard for air conditioners and heat pumps manufactured for Federal agency use only on or after date of enactment, and for S. 1766 assume a 13 SEER/7.7 HSPF standard enacted for all air conditioners and heat pumps manufactured on or after January 23, 2006. Key analysis variables include: electricity savings, net energy cost savings (increased up-front stock cost minus life cycle energy bill savings), and carbon dioxide emissions evaluated relative to the current 10 SEER standard.

Other Provisions: Pursuant to my letter of December 20, 2001, please also provide qualitative analyses for the following provisions:

Price-Anderson Act	S. 1766 (Sec 501-508) and H.R. 2983
Energy R& D	S. 1766 (Sec. 1211-1245) H.R. 4 (Corresponding provisions in Division B)
Other Consumer Product Standards	S. 1766 (Sec. 921- 929) H.R. 4 (Sec. 142-143)
Alternative Fuel Programs	S. 1766 (Sec. 811, 812, 814-819) H.R. 4 (Corresponding provisions in divisions A,B)
Hydro Relicensing	S. 1766 (Sec 301-308) H.R. 4 (Sec. 401- 402)

Pursuant to your conversations with my Energy Committee staff, I understand that your analysis will be issued in phases once available, starting with the Air Conditioning/Heat Pump Standard analysis delivered to me on January 23, 2002. As the Senate appears to be moving towards consideration of S. 1766 during the week of February 11th, I hope you can deliver as many of these phases as you and your staff are able to complete prior to that time and brief interested staff and Senators as appropriate at the earliest opportunity.

If you have any further questions regarding this request, or desire further clarification, please contact Bryan Hannegan with my Senate Energy and Natural Resources Committee staff at 224-7932. Thank you for your continued timely attention to this request, and for your efforts to ensure that our Nation's energy policy decisions are informed with the best available analysis.

Sincerely,

Frank H. Murkowski

Frank H. Murkowski
Ranking Member

-----Original Message-----
From: Bryan_Hannegan@energy.senate.gov
[mailto:Bryan_Hannegan@energy.senate.gov]
Sent: Thursday, February 21, 2002 4:37 PM
To: Hutzler; Mary
Subject: CAFE Provisions in S. 517

Mary -- per our phone discussion earlier today, attached is the revised Sec. 801 of the Daschle/Bingaman energy bill (S. 1766, now S. 517) that we would like EIA to analyze as part of our December 20, 2001 request for analysis of the bill. You are welcome to use this email as documentation of our request in lieu of a formal letter.

Bryan Hannegan, Staff Scientist
Committee on Energy and Natural Resources
United States Senate

SEC. 801. AVERAGE FUEL ECONOMY STANDARDS FOR PASSENGER AUTOMOBILES AND LIGHT TRUCKS.

(a) INCREASED STANDARDS.- Section 32902 of title 49, United States Code, is amended-

(1) by striking "Non-Passenger Automobiles.- " in subsection (a) and inserting "Prescription of Standards by Regulation.- "; and

(2) by striking "(except passenger automobiles)"in subsection (a) and inserting "(except passenger automobiles and light trucks)";

(3) by striking subsection (b) and inserting the following:

"(b) STANDARDS FOR PASSENGER AUTOMOBILES AND LIGHT TRUCKS.-

"(1) IN GENERAL.- The Secretary of Transportation, after consultation with the Administrator of the Environmental Protection Agency, shall prescribe average fuel economy standards for passenger automobiles and light trucks manufactured by a manufacturer in each model year beginning with model year 2005 in order to achieve a combined average fuel economy standard for passenger automobiles and light trucks for model year 2013 of at least 35 miles per gallon.

"(2) ANNUAL PROGRESS TOWARD STANDARD REQUIRED.- In prescribing average fuel economy standards under paragraph (1), the Secretary shall prescribe appropriate annual fuel economy standard increases for passenger automobiles and light trucks that-

"(A) increase the applicable average fuel economy standard ratably over the 9 model-year period beginning with model year 2005 and ending with model year 2013;

"(B) require that each manufacturer achieve-

"(i) a fuel economy standard for passenger automobiles manufactured by that manufacturer of at least 33.2 miles per gallon no later than model year 2010; and

"(ii) a fuel economy standard for light trucks manufactured by that manufacturer of at least 26.3 miles per gallon no later than model year 2010;

and
"(C) for any model year within that 9 model-year period does not result in
an average fuel economy standard lower than-
"(i) 27.5 miles per gallon for passenger automobiles; or
"(ii) 20.7 miles per gallon for light duty trucks.
"(3) DEADLINE FOR REGULATIONS.- The Secretary shall promulgate the regulations required by paragraphs (1) and (2) in final form no later than 18 months after the date of enactment of the Energy Policy Act of 2002.
"(4) DEFAULT STANDARDS.- If the Secretary fails to meet the requirement of
paragraph (3), the average fuel economy standard for passenger automobiles and
light trucks manufactured by a manufacturer in each model year beginning with model year 2005 is the average fuel economy standard set forth in the following
tables:
"For model year The average fuel economy standard for passenger automobiles is:
"2005 28 miles per gallon
"2006 28.5 miles per gallon
"2007 30 miles per gallon
"2008 31 miles per gallon
"2009 32.5 miles per gallon
"2010 34 miles per gallon
"2011 35 miles per gallon
"2012 36.5 miles per gallon
"2013 and thereafter 38.3 miles per gallon

"For model year The average fuel economy standard for light trucks is:
"2005 21.5 miles per gallon
"2006 22.5 miles per gallon
"2007 23.5 miles per gallon
"2008 24.5 miles per gallon
"2009 26 miles per gallon
"2010 27.5 miles per gallon
"2011 29.5 miles per gallon
"2012 31 miles per gallon
"2013 and thereafter 32 miles per gallon

"(5) COMBINED STANDARD FOR MODEL YEARS AFTER MODEL YEAR 2010.- Unless the
default standards under paragraph (4) are in effect, for model years after model
year 2010, the Secretary may by rulemaking establish-
"(A) separate average fuel economy standards for passenger automobiles and
light trucks manufactured by a manufacturer; or
"(B) a combined average fuel economy standard for passenger automobiles and
light trucks manufactured by a manufacturer.";
(4) by striking "the standard" in subsection (c)(1) and inserting "a standard";
(5) by striking the first and last sentences of subsection (c)(2); and
(6) by striking "(and submit the amendment to Congress when required under

subsection (c)(2) of this section)" in subsection (g).

(b) DEFINITION OF LIGHT TRUCKS.-

(1) IN GENERAL.-- Section 32901(a) of title 49, United States Code, is amended by adding at the end the following:

"(17) 'light truck' means an automobile that the Secretary decides by regulation-

"(A) is manufactured primarily for transporting not more than 10 individuals;

"(B) is rated at not more than 10,000 pounds gross vehicle weight;

"(C) is not a passenger automobile; and

"(D) does not fall within the exceptions from the definition of 'medium duty passenger vehicle' under section 86.1803-01 of title 40, Code of Federal Regulations.".

(2) DEADLINE FOR REGULATIONS.- The Secretary of Transportation-

(A) shall issue proposed regulations implementing the amendment made by paragraph (1) not later than 1 year after the date of the enactment of this Act; and

(B) shall issue final regulations implementing the amendment not later than 18 months after the date of the enactment of this Act.

(3) EFFECTIVE DATE.- Regulations prescribed under paragraph (1) shall apply beginning with model year 2007.

(c) APPLICABILITY OF EXISTING STANDARDS.- This section does not affect the application of section 32902 of title 49, United States Code, to passenger automobiles or non-passenger automobiles manufactured before model year 2005.

(d) AUTHORIZATION OF APPROPRIATIONS.- There are authorized to be appropriated to the Secretary of Transportation to carry out the provisions of chapter 329 of title 49, United States Code, $25,000,000 for each of fiscal years 2003 through 2015.