

**Comments on the Center for Automotive Research (CAR) June 2011 Report  
“The U.S. Automotive Market and Industry in 2025”**

June 17, 2011

The Center for Automotive Research (CAR) issued a report on June 11, 2011 titled “The U.S. Automotive Market and Industry in 2025.” This is a fuller statement of a forecast contained in a presentation made by CAR in December 2010. The ICCT published a critique of that presentation in March, 2011. Based on our initial review of the full report, while it is clear that CAR has corrected some computational errors, our criticisms of their cost analyses remain substantially unchanged.

The cumulative effect of the errors and questionable assumptions in the CAR analysis is to dramatically overestimate the vehicle price and significantly underestimate the available technology associated with potential greenhouse gas/CAFE standards. If CAR had used a more credible analytical approach and representative estimates for technology and cost, it would have found very significant CO<sub>2</sub> and fuel efficiency benefits at moderate cost, with savings to consumers and positive impacts on industry and employment.

The following paragraphs detail the most significant shortcomings we find with the CAR report.

1. The single largest problem is that the report uses the 2010 NAS CAFE report data for 2025 vehicles. This is despite several explicit statements in the NAS report constraining the applicability of its technology and cost data to the very near term, e.g.:
  - "Tables S-1 and S-2 show the committee’s estimates of fuel consumption benefits and costs for technologies that are commercially available and can be implemented within 5 years. The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page S-1]
  - “Again, except where indicated otherwise, the cost estimates provided are based on current conditions and do not attempt to estimate economic conditions and hence predict prices 5, 10, or 15 years into the future.” [NAS report page S-6]
  - "The cost estimates represent estimates for the current (2009/2010) time period to about 5 years in the future." [NAS report page 9-8]
2. The report ignores technologies not featured in the NAS report. As the NAS report only assessed current technologies, CAR’s technology assumptions also fail to address specific technologies that will play a critical role in attaining 2025 CAFE targets. Chief among these are cooled/boosted EGR—which can extend the efficiency of SI (spark ignition) engine technology beyond levels associated with turbocharged, downsized, GDI technology—and P2 hybrid vehicle technology—which can deliver powersplit hybrid type efficiency impacts at considerably reduced cost.

3. The report disregards the potential for increases in fuel economy technology benefits relative to those estimated by NAS for current conditions, despite the fact that the NAS report explicitly acknowledged such potential.
4. The report disregards the impact of air conditioning credits on the target CAFE level, despite the fact that such credits are included in the 2012–2016 standards and were proposed in the 2010 regulatory Notice of Intent related to 2017–2025 greenhouse gas (GHG) and CAFE standards. On page 18, CAR does acknowledge that the A/C credit used by EPA reduces the required rate of CO<sub>2</sub> reductions by about one percent for each scenario. CAR also analyzed the vehicle market based on CAFE requirements modified for the A/C credits in Appendix I, but ignored the A/C credits in the analyses in the main report. In Appendix 1, CAR calculated that including the A/C credits would reduce the cost of the 3% scenario by \$305, 4% scenario by \$1,250, 5% by \$1,100, and 6% by \$2,764. And this is despite an increase of \$300 per vehicle assumed by CAR for the air conditioning improvements; the actual cost will be far less than this.
5. The report factors in \$1,500 for the potential cost of future safety equipment. Not only is this inappropriate for an analysis of CAFE impacts, but CAR compounds the error by entirely ignoring benefits that would accrue from that additional safety equipment.
6. The report assumes little learning or cost reduction in the future, especially for CAR-identified “mature” technologies. This has the effect of keeping their 2025 cost estimates for SI technology only marginally lower than their 2008 cost estimates for the same technology. Technology is only mature until a “better mousetrap” comes along, and for obvious reasons scientists and engineers are continually looking for a “better mousetrap.” Take for example, automatic transmission technology, which CAR identifies as mature. No more than a few years ago, the design of the Lepelletier gear system produced substantial transmission technology cost savings. To assume that technology—even mature technology—will not continue to advance is, at best, shortsighted. Even for HEVs and BEVs, CAR assumes only 5 years of cost reduction at 1.9%–2.2% per year. CAR also ignores the recommendation in the 2010 NAS CAFE report on costs: “As noted in Chapter 3, estimates based on teardown cost analysis, currently being utilized by the EPA in its regulatory analysis for light-duty vehicle greenhouse gas emissions standards, should be expanded for developing cost impact analyses.” [NAS report page 9-26]
7. The report assumes that costs for mass reduction will not change in future, despite the extended lead-time and associated ability for optimized system-wide redesign that it enables.
8. The report applies a fuel savings discount to “current year” mileage, resulting in an underestimate of fuel savings (a 9 percent underestimate given CAR’s assumed discount rate) relative to an analysis that discounts savings only “future year” mileage.
9. By directly using the NAS report pathways, the report includes the cost of powersplit hybrid systems instead of a basic parallel hybrid system. The NAS report listed the ISG hybrid as a 34% fuel consumption reduction at an RPE of \$3,325 and the powersplit as a 37% fuel consumption reduction at an RPE of \$5,187 (both for V6 engines). Thus, the report implicitly adds \$1,862 cost for a fuel economy reduction of only 3%.

10. The report uses a baseline 2008 fuel economy of 27.5 mpg to assess fuel savings. NHTSA reports 27.1 mpg for 2008 and EPA reports 26.3 (EPA’s numbers exclude the FFV credit that is part of NHTSA’s official fuel economy calculations)

11. Finally, the report includes large numbers of BEVs and PHEVs in its scenarios, instead of first increasing HEV sales. This not only overstates vehicle costs, but also the costs of charging equipment, which CAR calculated to be \$40/vehicle for the 3% scenario, \$175 for 4%, \$348 for 5%, and \$1,105 for 6%. The HEV constraints put in table 4 (page 15) are unrealistic. As they admit on page 22, "An alternative to this scenario (assuming no PEV market penetration) would require over 80 percent HEV market share—also drastic by today’s predictions." 80% market share of HEVs in 2025 is far less drastic than 64% market share of PHEVs in 2025. Rather than constraining HEV shares while letting PHEV shares unrestricted, CAR should restrict the PHEV market share.

### **Overall Impacts on Costs and Benefits**

The table below summarizes some of the important changes from CAR’s December 2010 presentation to the June 11, 2011 report. It also shows, for purposes of comparison, the net vehicle price changes if all errors were corrected and 2025 technology benefit and cost estimates from NHTSA/EPA were used instead of the current technology benefit and cost estimates from the 2010 NAS report.

### **Summary Table: Costs and Benefits Calculations**

CAFE Scenario	RPE	5 Year Fuel Savings (\$3.50/gal)	Payback (years)	Actual mpg	CAFE Achieved (w/ AC credits)
<b>CAR Analyses from December 2010 presentation</b>					
41.7 mpg	\$5,840	\$1,690	20 +	47.6	51.8
49.8 mpg	\$7,281	\$2,223	20 +	54.0	59.5
60.1 mpg	\$9,147	\$2,693	20 +	61.9	69.3
<b>CAR Analyses from June 11, 2011 Report</b>					
47.0 mpg	\$5,244	\$3,451	8 +	47.0	51.2
51.0 mpg	\$6,770	\$3,885	9 +	51.0	55.8
56.0 mpg	\$8,214	\$4,363	10 +	56.0	62.0
62.0 mpg	\$11,290	\$4,865	12 +	62.0	69.4
<b>EPA/NHTSA 2025 analyses in the Joint Technical Report for the 2017-25 Notice of Intent (best pathway)</b>					
3% per year (1)	\$1,070 (2)	\$3,620	1.2 (3)	43.2	46.7
4% per year (1)	\$1,700 (2)	\$4,182	1.7 (3)	47.1	51.3
5% per year (1)	\$2,400 (2)	\$4,710	2.2 (3)	51.4	56.3
6% per year (1)	\$3,100 (2)	\$5,193	2.7 (3)	56.0	62.0

(1) Scenario uses CAR discount assumptions and elasticity estimate for the CAR 41.7 mpg scenario. The EPA/NHTSA data is recalculated using 2008 as the baseline year instead of 2016, so the RPE and the fuel savings are larger than those calculated by EPA/NHTSA in the NOI for 2016 to 2025.

(2) Includes \$300 adjustment from 2016 to 2008 baseline.

(3) EPA-estimated payback periods relative to a 2016 baseline are 1.4, 1.9, 2.5, and 3.1 years for the 3%, 4%, 5%, and 6% scenarios respectively.

Note that the actual mpg achieved, in the second to last column, is much higher than presented by CAR for the December 2010 presentation. This reflects corrections for the

mathematical errors in this set of numbers. The last column shows the much higher CAFE level achieved when the air-conditioning credits are included, which CAR did not incorporate into either analysis.

The last set of values in the summary table reflect the use of the EPA/NHTSA analyses for the 2017–25 Notice of Intent, as the best example of the much lower costs and payback period when the numerous technology improvements and cost reductions expected over the next 15 years are included.

CAR’s June 11, 2011 report makes significant improvements to the calculation of fuel savings. While there are still some minor errors, the overall fuel savings are close to those calculated by EPA and NHTSA for the NOI, indicating that the major problems have been corrected. However, CAR’s costs do not differ substantially from those in their December 2010 presentation, indicating that the major problems with their cost analyses have not been addressed.

It is important to use estimates of future technologies and technology benefits and costs. Using 2010 data to evaluate 2025 vehicles is equivalent to examining 1995 vehicles to assess 2010 vehicles—an approach no one would propose or seek to defend, given the radical technological changes that occurred over that period. In fact, due to rapid improvements in computer simulations and computer-aided design, the pace of technology innovation is likely to increase in the future. Any assessment of 2025 technologies and costs must be forward looking and must not rely upon current estimates.

NHTSA and EPA have, by far, the best data, information, and expertise for assessing future technologies and costs. They are immersed in analyses of 2025 and have received extensive input from manufacturers, as well as doing their own studies. For example, EPA has conducted a very large study with Ricardo to assess future technology benefits using detailed simulation analysis and has contracted with FEV and Monro to assess technology costs using tear-down analyses, as recommended in the 2010 NAS CAFÉ report. NHTSA and EPA understand how rapidly technology is developing and are the only organizations that are trying to assess where technology will really be in 2025, instead of relying on outdated studies. They are in the best position to determine what is cost-effective by 2025.

The last set of values in the summary table are based upon the estimates in the Joint Technical Report for the 2017-25 Notice of Intent, but with the data recalculated using 2008 as the baseline year instead of 2016. The results show that CAR’s costs are three to five times higher than the careful 2025 analyses conducted by NHTSA and EPA. Using unbiased assumptions and proper data for 2025 vehicles, the payback period is less than 2 years for 4% per year CAFE increases and less than 3 years for 6% per year CAFE increases.