

## **ESTIMATION OF AVERAGE LIFETIME VEHICLE MILES OF TRAVEL**

During the September 23, 2004 Board hearing on the proposed AB 1493 regulation, a representative of Sierra Research, Inc. (SRI) commented that the Air Resources Board (ARB) staff had overestimated the miles traveled (VMT) in a vehicle's average lifetime. The assertion was that this had in turn resulted in an overestimation of lifetime fuel savings and an underestimation of the payback period for vehicle owners. Overnight, the ARB staff performed a preliminary evaluation of the SRI written testimony, and acknowledged the following day that there appeared to be merit in the comment. Staff also stated that further evaluation of this issue was needed, including an assessment of the impact on mobile air conditioning credits which use VMT as an input. However, staff also showed that use of the lower estimate of lifetime VMT provided by SRI would not substantially affect operating cost savings or the payback period. The Board left open the possibility of modifying the method and the VMT estimate as a 15-day change, following further review.

After careful examination of this issue, we find that the method used by ARB staff still results in the best available estimate of average lifetime VMT. Though staff examined other approaches for making this estimate, we did not arrive at a method that is superior to that presented in the staff report. Staff also found that the alternative approach recommended by SRI is likely to result in a significant underestimation of lifetime VMT. For reasons explained below, we believe that the method used in the staff analysis results in a reasonable estimate of average lifetime VMT, and that no change to the MAC credit is necessary.

### **ARB Staff Methodology**

ARB staff has defined average vehicle lifetime as the number of years after introduction of a new model year when 50 percent of those vehicles have been retired from service, while 50 percent remain in service. To ascertain this age, staff used vehicle survival rates from California's motor vehicle emissions model, EMFAC2002, Version 2.2 (Apr03). The rates, derived from the Department of Motor Vehicles registration database, represent the fraction of vehicles of each vehicle age remaining on the road and incurring mileage. For passenger cars, the 50 percent fraction is reached in 16.09 years; for light-duty trucks it is reached in 18.63 years.

Staff then used mileage accrual rates, expressed as annual miles traveled as a function of vehicle age, to determine average lifetime VMT. Accrual rates are derived from odometer readings by Smog Check technicians for the Bureau of Automotive Repair (BAR); they are found in the WEIGHT output file of EMFAC2002. ARB staff summed the average annual mileage accrual over the 16.09 years to get a lifetime VMT of 202,329 for passenger cars, and over 18.63

years to get a lifetime VMT of 223,969 for light-duty trucks. SRI has pointed out that vehicles that accumulate high mileage rapidly, and then drop out of the fleet early, tend to skew accrual rates upward for vehicles that last 16 years. Data are not available to separate such vehicles from the databases used to calculate annual accrual, and ARB staff agrees that its consequent lifetime VMT estimates are likely to be high. However, we believe these estimates are not unreasonably high, for reasons discussed below.

Data from BAR, cited in the current draft Smog Check report (April 2004, found at <http://www.arb.ca.gov/msprog/smogcheck/smogcheck.htm>), indicate that only a small portion of the fleet, approximately 3 percent, accumulates more than 25,000 miles per year. ARB staff examined the BAR data further and found that, for any given model year, high annual mileage vehicles are at most 5.5 percent of the total. Staff then conducted a sensitivity test that assumed 4 percent of passenger cars accumulated 40,000 miles per year over five years of useful life (200,000 miles). When accrual rates are adjusted by removing these miles, the lifetime VMT for a 16-year-old car changes from 202,000 miles to 194,000 miles, a reduction of just under 4 percent. The BAR data thus indicate that the impact of high annual mileage vehicles on the ARB staff estimate of lifetime VMT is small.

In addition, accrual rates represent *averages* among many thousands of vehicles for each year of age. As discussed, the BAR data indicate that a small portion of vehicles accumulate high mileage quickly and leave the fleet early. Other vehicles accumulate miles slowly and may last much longer than 16 years. In both cases vehicles have a lifetime VMT that results in substantial cost savings, since cost is tied to miles driven. Vehicles also drop out of the California fleet for reasons other than accumulation of high mileage. Some vehicles leave the fleet early due to accidents, in which case their owners may or may not fully recover higher purchase costs. Vehicles that simply leave the state, on the other hand, would continue to accrue mileage at reduced cost. Regardless of why the passenger car fleet of a given model year declines by one-half after 16 years, higher purchase costs will be, *on average*, recovered within six years (as discussed below).

### **Sierra Research Methodology**

At the Board hearing, the SRI representative indicated that the average lifetime VMT of light-duty cars and trucks is approximately 155,000 miles. The method SRI used to arrive at this estimate is described in detail in their report No. SR2004-09-04, attached as Appendix C to the comments of the Alliance of Automobile Manufacturers. SRI's method is based on odometer readings of vehicles scrapped as part of the ARB pilot scrappage program. The vehicle scrappage program, however, is specifically restricted to vehicles *in running condition* that are purchased from the owner. It is reasonable to assume that

many of these vehicles would continue to accumulate miles in the absence of the financial incentive of a scrappage program.

In addition, because these data are based on single odometer readings, the matter of odometer rollover must be considered. For example, a current 16-year-old scrapped vehicle may show 60,000 miles, because only 5 figures are displayed on the odometer. It may be assumed that the vehicle has actually driven 160,000 miles. Or was it driven 260,000 miles? It is difficult to identify which vehicles should receive an adjustment, and in practice the adjustment for odometer rollover is biased toward lower VMT. The SRI report states (page C3-8) that odometer readings were “adjusted (upward) as needed to obtain a conservative estimate of the true final mileage in consideration of odometer rollover.” In stating that adjustments are conservative, and that no adjustment was required for vehicles showing readings of 60,000 or more, SRI acknowledges that the attempt to correct for odometer rollover still results in underestimation of the average lifetime VMT for scrapped vehicles.

For these reasons, ARB finds the alternative method put forward in the SRI analysis is likely to substantially underestimate average lifetime VMT. ARB staff does not find that SRI provides compelling evidence that our estimates of average lifetime VMT are substantially overestimated.

### **Impact on Operating Cost Savings**

To accurately measure the lifetime VMT of an average 16-year-old vehicle would require reading the odometer of every 16-year-old car on the road in California, adjusting correctly for odometer rollover, and averaging all of those readings. Since this is an impossible task, we must rely on a methodology that provides the best approximation of this value. In staff’s opinion, the best alternate method continues to be use of the accrual rates from the EMFAC model.

In staff’s September 24 presentation to the Board in response to the SRI comments, we provided the results of a sensitivity analysis for the lifetime operating cost savings and payback period. Using the SRI estimate of 155,000 miles for average lifetime VMT, we calculated lifetime operating cost savings of \$2,142 (based on gasoline price of \$1.74/gallon in 2004 dollars) and a payback period of 5.9 years. These figures compare to the results presented in the staff’s August 6, 2004 Initial Statement of Reasons (ISOR), showing lifetime operating cost savings of \$2,691 and a payback period of 5.6 years for light duty vehicles subject to the regulation. Thus, even with SRI’s low estimate of lifetime miles traveled, the regulation is very cost effective to consumers and has a reasonable payback period.

Finally, there is a paradox in SRI’s assertion that including high mileage vehicles in the calculation causes an overestimation of the regulation’s benefits.

Consumers accumulating high annual mileage would still receive the operating cost savings for each mile traveled, and would in fact have a shorter payback on investment than those consumers accumulating fewer miles per year. Whether miles are accumulated quickly or slowly, consumers will experience substantial benefit over the respective lifetimes of their vehicles.

### **Impact on MAC Credits**

Staff has also examined the impact on another component of the regulation that uses average lifetime VMT, the credits for reducing directly emitted hydrofluorocarbons (HFCs) from vehicle air conditioning systems.

The direct emission credits for improved mobile air conditioning (MAC) systems and alternative refrigerants as presented in the ISOR were developed using several data sources and simplifying assumptions. These are believed to render a conservative credit methodology for system improvements. That is, the MAC credits are intended, in part, to promote the use of improved MAC technology. As such, the regulation provides credits that modestly exceed the true environmental value of the actions that generate those credits.

One input to the credits calculation is an average VMT of 200,000 miles for the median vehicle lifetime of 16 years. This figure is used to translate direct lifetime refrigerant emissions as well as reductions from improvements to MAC systems into CO<sub>2</sub>-equivalent grams/mile emissions. Staff evaluated the impact that a change to the lifetime VMT could have on direct emission MAC credits associated with various technological alternatives. Fundamentally, a reduction of lifetime miles traveled results in an increase in the direct MAC credit. For example, reducing the lifetime VMT estimate by 10 percent would lead to an increase in the MAC refrigerant credit of about 11 percent.

The method developed by staff for determining credits associated with MAC refrigerant emissions includes simplifying assumptions, as described in the ISOR, that tend to produce a nominally higher credit. Staff determined that the assumptions were appropriate, given the limited and still developing data on direct refrigerant emissions from motor vehicles relative to the exhaustive data for motor vehicle tailpipe emissions. The key assumptions as well as the impact that they have on the credit are described below.

The first assumption concerns the methodology for establishing the direct MAC credits for alternative refrigerant systems. The methodology fully credits reductions resulting from the application of alternative refrigerants as if they impacted all lifetime emissions due to events other than leakage. That is, the credit for a system whose leakage would be reduced by 50 percent reflects that reduction in leakage even though the actual lifetime emission would be reduced by a lesser amount. A more refined analysis would discount the credit

attributable to the other events (e.g., sudden releases and emissions at scrap) that contribute to vehicle lifetime emissions. For example, the methodology currently provides an 8.5 CO<sub>2</sub>-equivalent grams/mile credit for employing low-leak technologies and HFC-152a refrigerant. However, the calculated leakage credit would be expected to be somewhat less than 8.5 grams CO<sub>2</sub>-equivalents per mile. That is because the result of a low-leak system is to increase the amount of refrigerant in the vehicle at the end of its useful life. Because only a fraction of the refrigerant in vehicles that are scrapped is recovered, the remaining refrigerant enters the environment. Therefore, the crediting methodology as presented in the ISOR tends to slightly overstate the benefits of an alternative refrigerant system.

A second simplification in the staff analysis includes the assumption of equal refrigerant charge in all systems. In reality, it is expected that systems that use alternative refrigerants will generally require less refrigerant charge than current HFC-134a systems. Less refrigerant in the system may result in less emissions or more frequent refrigerant recharging.

The third simplification in the analysis, as described in the ISOR, is the exclusion of light duty truck mileage and reliance on passenger vehicle miles of travel for calculating the direct MAC credit in terms of CO<sub>2</sub>-equivalent grams per mile. On average, light duty trucks have higher lifetime VMT. Therefore, if the credit methodology had included a separate VMT for light duty trucks and weighted them according to their representation in the light-duty fleet, the resulting credit would have been slightly lower than that presented in the ISOR. Staff believes that relying on passenger vehicle miles traveled is appropriate given our interest in developing a crediting methodology that is not likely to understate the benefits of improvements to the direct emissions from MAC systems.

For the reasons provided above and others as described in the ISOR, staff believes that the direct MAC credit methodology is already conservative with respect to the potential reductions associated with MAC improvements. We view this modest over-crediting as appropriate because it can prompt beneficial changes in the technology that may not otherwise take place, and will provide manufacturers with additional compliance options. We also believe that the simplifications are appropriate given the limited data regarding direct MAC emissions. Therefore, revisions in average lifetime VMT (i.e., reducing the 200,000 miles at 16 years of vehicle life) as recently suggested are not necessary with respect to the direct MAC crediting methodology, given its already conservative nature.

## **Conclusion**

During the Board hearing on the proposed AB 1493 emissions regulation, ARB staff committed to re-examine the estimates of average lifetime VMT used to

calculate both operating cost savings and credits for lower-emitting vehicle air conditioning systems. Having done so, staff finds that our methods, although likely to result in some overestimation of lifetime miles traveled, remain the best available means of making such estimates. We find our estimates to be reasonable given available data. We also find that even use of the estimates recommended by the commenter – estimates that we believe are too low – would not undermine the regulation’s positive cost-effectiveness. Finally, we have determined that adjustment to the air conditioning credits is not necessary even if lifetime VMT is on the high side, since the existing calculations employ simplifying assumptions that already provide for appropriately generous credits.