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Remote Sensing: A Simpler Way to Reduce Air Pollution

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THE COMMONWEALTH FOUNDATION

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ISSUE BRIEF

REMOTE SENSING: A SIMPLER WAY TO REDUCE AIR POLLUTION

INTRODUCTION

In the past 25 years the United States has spent large amounts of money to reduce emissions of new and in-use motor vehicles. For new vehicles, which now are required to contain strict pollution reduction technology, this has been an unqualified success with production vehicles now emitting less than four percent of the hydrocarbons (HC) and carbon monoxide (CO) of their pre-1970 counterparts.[1] This dramatic reduction has however, not had the anticipated result of reducing urban pollutant emission levels in many U.S. cities, especially for ozone. A body of evidence is growing which implicates the performance of the in-use vehicle fleet, and not new vehicles, as the one reason these air quality goals are not being met.[2-6]

In areas of the country which violate the federal air quality standards, the in-use vehicle fleet is required to submit to some type of scheduled emissions inspection with the goal of maintaining adequate emissions performance. These inspection and maintenance programs (I/M), which occur annually, biennially or on change of ownership, range from simple anti-tampering inspections performed at local garages to annual tailpipe and emissions component integrity inspections performed at a state or contractor run facility. Owners whose vehicles fail these inspections are required to comply with the local regulations or be unable to register or transfer title to their vehicle.

All of these programs aim to find the in-use gross polluting vehicle (these are the vehicles which are responsible for half of the on-road tailpipe emissions) which is emitting excessive amounts of pollutants and have it repaired.

Do the emissions tests currently mandated by the EPA meet this goal? The answer, unfortunately, is no. According to D.R. Lawson:[7]

> "The emissions test in an I/M program should be rapid, yet inexpensive, and should challenge the vehicle's emission control system. Ideally it should represent vehicle's emissions as they are driven in real-world conditions, and it should be capable of detecting emission defects as they occur."

One mandated test, which occurs on a treadmill every two years and is known as either I/M240 or ASM (Acceleration Simulations Mode), fails because it is not quite real-world, is costly, and certainly does not detect defects as they occur. Another mandated test (sometimes referred to as BAR84 or BAR90 because of the California standards which the test analyzers are certified to) is a schedule test performed while the car is idling. It is even less real-world than I/M 240 or ASM, but has the advantage of being less expensive than the treadmill test and therefore could be performed more often.

However, there are many problems with any scheduled testing protocol such as the test mentioned above. First, some vehicles have variable emissions which cause them to pass one day and fail the next, rendering a one-day snapshot meaningless. ***An even greater problem stems from these tests' scheduled nature. Because all drivers know in***

advance when their vehicle will be tested, they are motivated to either illegally disable or tamper with their pollution control systems after the test, so their vehicles are clean only one day out of the year, or they carry out an inexpensive "fix for the day of the test" when their vehicles really need an expensive repair bill to run cleanly for the entire year. Scheduled emissions tests also unfairly subject a car driven 60,000 miles a year to the same standards (and test cost) as one driven only 6,000 miles per year, even though a car that is driven more miles has a greater chance of its pollution control system breaking down during the year. Finally, many new programs allow new vehicles to be exempted from several years of testing. This is not only a subsidy for those who can afford today's expensive new cars, but neglects the fact that newer vehicles are driven more and even they can become gross polluters.

THE REMOTE SENSING SYSTEM

To avoid these problems, one needs a system which motivates owners to keep their cars low emitting year round. We believe that such a system could be devised based upon remote sensing rather than scheduled, centralized emissions tests.

Remote sensing is a system which carries out an emission test essentially identical to the tailpipe probe tests performed on treadmills and in garages, but does it in one second as the vehicle drives by while in actual use. Current remote sensing devices are capable of measuring CO, CO_2, HC, NO, vehicle speed and acceleration. A video camera can be used to take a picture of the vehicle if identification is needed. Remote sensing devices are portable, so they can be placed anywhere, anytime. The system has been shown to give correct readings of emissions at the instant the vehicle drives by through a number of double-blind tests.[8-10]

Remote sensing has many advantages over a scheduled testing regime. Because the tests are performed in random locations and on random days, gross polluters who tamper with their pollution control systems will be caught. This benefit alone should significantly reduce vehicle emissions. Furthermore, the system will identify vehicles whose pollution control systems have broken since their last scheduled test, permitting quicker repair of unknown problems and cutting air pollution further. Also, the system can account for actual driving conditions, so no penalty will be meted out to drivers whose vehicles are either accelerating hard or in a cold-start mode because its high emissions may be appropriate for that vehicle at that time, and thus unrepairable.

REMOTE SENSING WILL WORK

Field test results show that remote sensing will work. In California and in Colorado field tests, half the on-road CO emissions came from seven percent of the passing vehicles. California also investigated on-road gross polluters when pulled over for immediate inspection: 100 percent fail I/M 240 testing, emit an average of 84 grams/mile CO, and 62 percent show evidence of illegally tampered or disconnected emissions control systems.[8] ***Thus, the California field test showed that around one quarter of the on-road CO emissions came from people who were breaking the law and had not been caught by scheduled emissions tests.*** HC and NO statistics are similar. HC and CO gross polluters are often, but not always, the same vehicle.

If we were in charge of the design of an I/M program, the first remote sensor would be used at a number of advertised freeway ramps. It would be accompanied by a billboard which alerts drivers to the status of their vehicle emissions. Drivers and the general public would be alerted through TV and press coverage that this system is a public service, there is no video camera, and no penalty for a high reading. Data suggests that 10 out of 12 passing vehicles would get a green (low CO), one an amber and one a red (high CO) reading. Carbon monoxide is targeted because research has shown it to be a good predictor of a vehicles maintenance level.

We anticipate that with the right PR, some honest citizens would repair their cars voluntarily if notified by the red readings. Embarrassment ("How come everyone else gets a green and I get a red?") coupled with PR about the gas mileage benefit, and the ensuing cost savings, that comes from a functioning emissions system might also have some effect. As a further public service one could emphasize the fact that the general public now can check that their mechanic has done a good job. With a throughput of 10,000 to 20,000 cars per week, this system also supplies real-time average emissions evaluation. If any repairs are carried out, the average readings obtained will go down with time. In this way the information system is self evaluating, except at least one other system needs to be set up at another location occasionally to act as a control for the known slow reduction of emissions expected to be caused by fleet turnover.

When the next remote sensor is available the public is alerted through the media that this remote sensor will be mobile and will inconvenience drivers who get "red" readings. The system will be accompanied by a police officer who will pull over your vehicle and an engineer who will look under your hood for illegal emissions system tampering. If disconnected or tampered equipment is found, then you will get a thirty day fix-it ticket which can only be eliminated from your record by reporting to a referee station within thirty days with no tampered or disconnected equipment. This would enforce the laws which most states already have, making tampering illegal.

Lawyers drafting a model remote sensing law for California suggest that after 30 days a five dollar fine be levied per further day without evidence of repair for the next 100 days, payable upon the owner's next attempt to register a vehicle. Vehicles pulled over without valid registration would be ticketed on the spot. As a side-benefit, using remote sensing to identify gross polluters will help identify unregistered vehicles since some unregistered vehicles are that way because they could not pass the emission test. Under this model law, untampered on-road gross polluting vehicles would be sent a letter and an explanatory brochure and thereby required to take (and pay for) an out of cycle emission test. That is a great incentive to keep your car out of the "red" category, i.e. to not drive an on-road gross polluter.

Another advantage to remote sensing is that an on-road emissions monitoring program would provide the data from which changes in on-road emissions can be determined without resort to the uncertainties of computer modelling. Even though the program will be able to evaluate its own performance, research data still permits us to estimate the emissions reduction achievable from remote sensing. This data shows that for every 1,000 vehicles, we can expect that there will be 42 gross polluters with tampered or disconnected pollution reduction systems, and 28 gross polluters with faulty but untampered control systems. The most optimistic assumption is that all 70 of these vehicles are repaired so that they emit no more pollutants than the average of the 930 lower emitting vehicles. That would achieve a 43 percent reduction in on-road exhaust emissions (on a mass basis per gallon of fuel used). To the extent that the repaired vehicles get poorer mileage than modern vehicles, and their mileage improves upon repair, the per mile emissions reduction is more than 43 percent. Even if the program is only one quarter as successful as this optimistic projection, the emissions reductions will be measurable and more than 10 percent of current emissions levels, and the only action we will be taking is enforcing the currently unenforced law against tampering with emissions control equipment. Note that even so, tampering which does not result in on-road gross polluters will not be discouraged.

Many questions need to be addressed to form a complete system. For instance, how long is a repeat on-road gross polluting vehicle exempt after passing (by whatever means) a referee I/M test, and what sort of follow-up I/M test should be used. We believe that the current arguments about I/M partly arise because there has been a confusion in the system design between an identification test and a repair verification test. They have been the same test with the same cut points. This makes little sense. If a cut point of six percent CO identifies a broken car on BAR90 or on remote sensing, then the vehicle should be repaired to whatever the average vehicles of its age group emit, which in many cases is less than one percent CO. If a vehicle is found to have been either tampered with or be a gross polluter by remote sensing, the repair could be verified by means of a test like ASM or IM240 with a cut point which requires the vehicle to be well within the envelope of normal operation for its model year.

Enforcement at levels well above the legal standard is quite common in speed limit cases.

Fifty mph in a 30 mph limit zone will bring a ticket much more likely than 35 mph in the same location. Both are above the standard, but one brings in the person you really want. Gross polluter programs using remote sensing have the capability to be finely tuned in the same way.

CONCLUSION

In the long run it is the motivation of owners and the skill of the repair industry which lowers on-road emissions. A program which pays attention to those needs will succeed while one which does not will not. One advantage of adopting a remote sensing based program is that the program will generate data with which its success (or lack there of) can be measured. If the billboard and the tamper pullover enforcement provide enough MEASURED emission reductions to meet the goal then no tickets in the mail (either to clean or dirty cars) are needed. If the program does not provide enough on-road emissions reductions to meet the desired I/M goal then more energetic programs such as gross polluter enhanced I/M may be a component of the contingency plan.

A successful pollution reduction program could be based on the concepts of informing the public, motivating continuous attention to low emissions, penalizing tampering and high on-road emissions and ensuring quality repair of gross polluters. Wise legislation and enforcement along these lines could exceed the program goals without subjecting anyone to scheduled testing and without massive real-estate and equipment investment.

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