

**Francis Clay McMichael,  
Lester B. Lave, and  
Chris T. Hendrickson**

# Electric Cars May Not Be Ready To Roll

**T**hree states have mandated the sale of zero-emission vehicles (ZEVs) beginning in 1998. In 1992 a research team was formed at Carnegie Mellon University in Pittsburgh, Pennsylvania, to examine the environmental implications of these mandates during the life of the proposed vehicles. ZEVs are likely to be powered by lead-acid batteries at first, although other battery types or technologies not using toxic metals might be used in the future. The study findings indicated that producing and recycling these batteries would result in significant lead releases to the environment: total emissions 4 to 60 times higher than the emissions of comparable vehicles using leaded gasoline.

The Carnegie Mellon study became a lightning rod for criticism by electric vehicle proponents, from accusations that the authors were irresponsible to assertions that they had made errors no high school chemistry student would make. The pleasure of being noticed was tempered by the venom of the attention. To be sure, there is a good deal of uncertainty concerning battery performance, vehicle efficiency, and the environmental discharges of various lead processes. However, focusing on current data instead of speculating about the future makes these uncertainties manageable.

## ENVIRONMENTAL AND ENERGY BENEFITS OFFSET BY RISKS

California, New York, and Massachusetts have required that 2 percent of model year 1998 cars must be zero-emissions vehicles—in other words electric cars. The percentage increases after 1998. However, these mandates may be revised in view of problems with the manufacture of appropriate vehicles. Electric vehicles emit no air pollution at the point of use, although the energy must be generated somewhere. A large electric generation plant located away from the city should shift the location of emissions and achieve lower emissions than

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*Francis Clay McMichael is Blenko Professor of Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania. Lester B. Lave is Higgins Professor of Economics, Graduate School of Industrial Administration, Carnegie Mellon University. Chris T. Hendrickson is Professor and Associate Dean of Engineering, Carnegie Mellon University.*

conventional vehicles. Unfortunately, the focus on ozone precursors is too narrow. The Carnegie Mellon study included an expanded scope of analysis to consider the life-cycle consequences of producing and reprocessing lead-acid batteries. Smelting and recycling the lead for these batteries will result in substantial discharges of lead, a neurotoxin that contributes to reduced cognitive function and other health and behavioral problems, particularly during early human development.

Lead air emissions from automobile tailpipes have been virtually eliminated in the United States in response to EPA regulations. Eliminating tetra-ethyl lead from U.S. gasoline greatly reduced the blood-lead levels in children. Most current alternatives to lead battery technologies also involve metals such as nickel and cadmium, which are carcinogens. Introduction of these toxic metals into automobile production could reverse the progress made in removing lead from the environment during the past 25 years.

Lead discharges, expressed in milligrams per kilometer traveled, result from the handling and processing of lead for batteries. The best estimate of the current discharges (including solid waste, waste water, and air emissions) is that primary lead processing releases about 4 percent of its production to the environment, secondary or scrap production releases about 2 percent, and the manufacturing sector releases up to about 1 percent of the lead processed. Although direct air and water emissions of lead pose a greater danger than solid waste, exposure can also come from solid waste that is subject to weathering and leaching.

A formidable calculation is required to associate health problems with lead discharges—even air emissions. As a simple benchmark, the study compared the lead discharges for an electric vehicle to those stemming from a comparable car using leaded gasoline—which is banned in the United States. Electric vehicle total lead discharges for the study example were six times higher than a comparable car burning leaded gasoline; air emissions alone would be roughly the same as those for a lead-fueled car.

It is mystifying to us that some critics assert that only air emissions are relevant for health and the environment. Dismissing nonair discharges is inappropriate because numerous exposure pathways exist. If solid waste is exposed to natural processes at or near the surface, it will certainly add to human exposures for centuries.

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### **Erosion, continued from page 13**

hydraulic mulch. TxDOT's *Standard Specifications for the Construction of Roadways and Bridges* calls for the seed and fertilizer to be mixed and applied to the slope together. In a separate step the mulch is applied on top of the seed-fertilizer mixture.

TTI's research team did not find sufficient evidence to support TxDOT's assumption that the two-step application process is better for vegetation establishment than a one-step process. At the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory, the adopted two-step application process is being tested in tandem with a one-step process that involves mixing seed, fertilizer, and mulch and applying them all at once. During the two years that TTI has been conducting mulch research there has been no significant difference in the results between the two types of application. If these findings do not change, TxDOT could begin to reduce costs by applying the one-step application process.

### **Storm Water Management For Construction Sites**

Activities that disturb land—such as construction and maintenance operations within highway rights-of-way—are necessary to meet transportation demands. If not treated promptly, erosion-related impacts can include habitat changes, accelerate erosion, and cause sediment losses that increase pollutant loads.

During the past 20 years, a proliferation of erosion- and sediment-control products and methods have been developed, but industry methods have not kept up with the rapid changes in Environmental Protection Agency standards. Education, testing and application vary

widely among regions. To meet the stringent environmental requirements placed on agencies today, designers need appropriate guidance on planning, designing and selecting the best management practices for construction sites.

TTI researchers developed a strategy for selecting management practices on the basis of a fundamental understanding of erosion principles. Using data such as erosion production factors, vegetative measurements, and soil erodibility factors generated at the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory, as well as existing literature, a comprehensive PC-based computer program was developed. This program gives users the guidance they need to select the best management practice and generates reports for the storm water pollution prevention system (*please see sidebar on page 13*).

## **PROVIDING USEFUL RESULTS TO INDUSTRY**

The research conducted at the TxDOT/TTI Hydraulics and Erosion Control Laboratory is producing information previously unavailable to the erosion industry and the transportation community. Researchers at the laboratory are concerned with finding economical, effective erosion- and sediment-control measures for the range of applications encountered within highway rights-of-way. As transportation agencies face strengthened federal regulations regarding erosion- and sediment-control, and storm water managers search for answers to erosion-related problems, TTI research is playing a key role in providing solutions for both.

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### **Electric Cars, continued from page 14**

Some critics admit that the 1998 model electric vehicles will not be attractive from an environmental, performance, or economic perspective. However, the requirement is viewed as a beginning, forcing automobile makers to improve the technology. The impending 1998 requirement means that automobile makers are spending hundreds of millions of dollars on near-term battery technology that is bad for the environment. Instead, resources could be devoted to developing more attractive technologies that will not be available for some years.

Research and development should focus on promising technologies that do not require the processing of large quantities of toxic materials. Forcing the sale of lead-acid or other available technology (and the

associated recharging infrastructure) does not seem like the best option given the inherent limitations. There are many reasons to force investment in advanced technologies but few, if any, for requiring large numbers of electric vehicles to be sold in model year 1998.

Battery-powered vehicles using near-term technologies do not deliver the promised environmental benefits. It is hoped that environmentally benign and effective technologies such as practical fuel cells will appear soon. In the meantime the 1998 mandates are premature.

*For a summary of the study's findings, contact Francis C. McMichael, Carnegie Mellon University, Department of Civil & Environmental Engineering, 5000 Forbes Avenue, Porter Hall 119, Pittsburgh, Pennsylvania 15213-3890.*