DESIGN FOR RECYCLING

Under Extended Producer Responsibility

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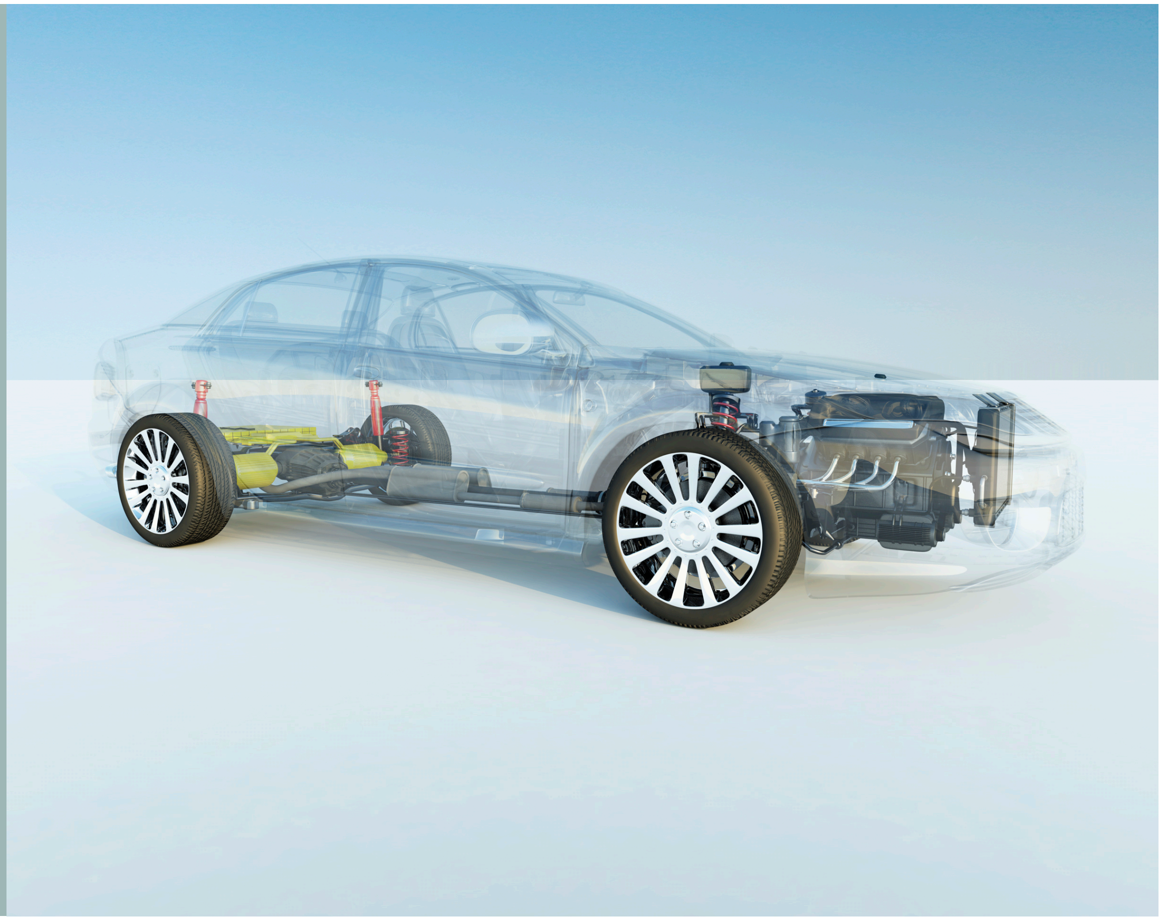


INTRODUCTION

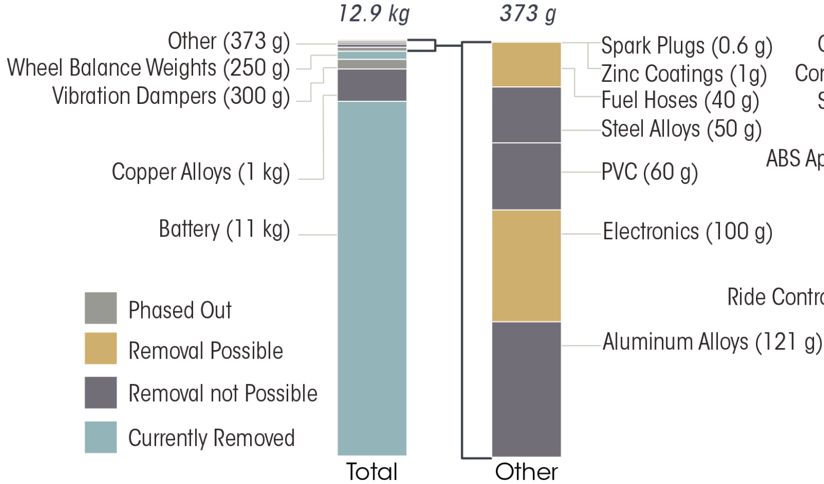
Automobiles are manufactured using a variety of environmentally harmful materials. These include lead, mercury, arsenic, antimony, tin, cobalt, chromium, nickel, silver, and copper. When they enter the waste stream at the end of a vehicle's life, these contaminants have the potential to cause harm to human health and the environment. Given the large number of cars that reach the end of their life each year, the quantity of these contaminants entering the environment is a cause for concern.

One solution is to remove contaminants at the end of life. End of life vehicles (ELVs) typically go to a dismantling facility, which removes all parts and materials that can be sold at a profit and sends the remaining materials to a shredding facility. The shredding facility then recovers ferrous and non-ferrous metals before sending the remaining waste to the landfill. Both dismantlers and shredders have the opportunity to remove contaminants before they are discarded into the environment.

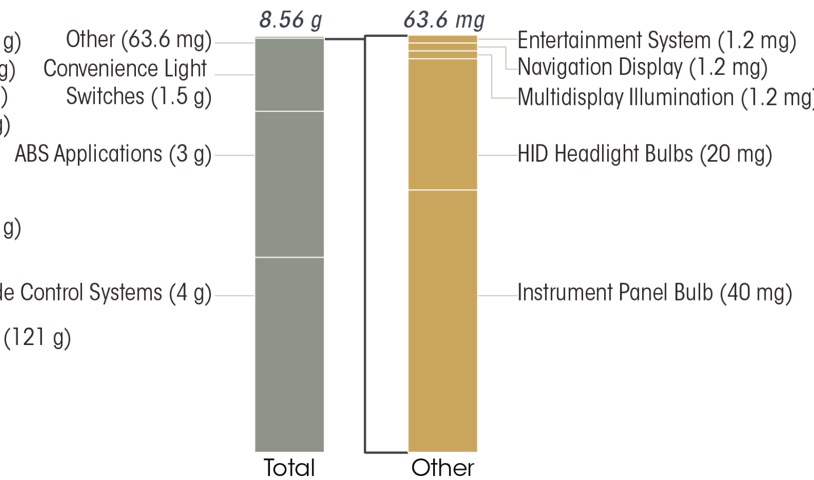
In the past, regulation of contaminants has been achieved through laws that prohibit actors from releasing contaminants into the environment. One example is the Resource Conservation and Recovery Act (RCRA). Such regulation puts the burden of removing contaminants on the end of life actors – the dismantlers and the shredders.

Unfortunately, end of life regulation does not motivate

Historic and Current Automotive Lead Uses



Historic and Current Automotive Mercury Uses



manufacturers to change their designs. In order to encourage better designs, a different solution is needed. One promising new approach has come to be called “extended producer responsibility” (EPR). EPR is a type of regulation that holds the manufacturer responsible for end of life outcomes. In practice, EPR requires manufacturers to either remove contaminants from their designs, or to pay for end of life treatment of their vehicles.

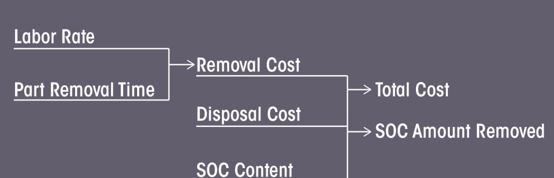
The European Union has pursued EPR aggressively with its End of Life Vehicles Directive. The ELV directive mandates that at least 95% of an automobile must be recyclable or reusable by January 2015. It also targets specific hazardous materials, such as lead, mercury, and cadmium, either banning their use or making manufacturers responsible for their safe removal at the end of life. This approach has significantly changed the role manufacturers play in the end of life process.

By comparison, the United States has no national end of life vehicle policy. Individual states have taken steps to regulate manufacturers, but these scattered efforts fell short of a comprehensive EPR policy. Nevertheless, it is likely that the automobile recycling infrastructure in the US will eventually be required to comply with policies similar to the EU’s End of Life Vehicle Directive. Therefore, extended producer responsibility and its economic implications are a very real concern for the domestic auto industry.

OBJECTIVE

Compute the cost of removing lead and mercury at the dismantling phase of an end of life vehicle.

Model Description



Our model uses the labor rate and part dismantling times to estimate the disassembly cost, the weight of the contaminated part to calculate disposal cost, and contaminant content data to determine the quantity of contaminants removed.

APPROACH

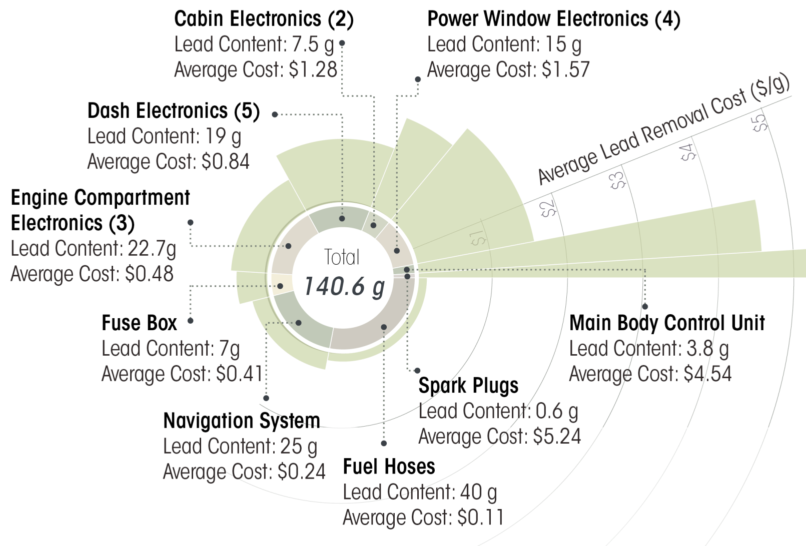
Manufacturers faced with extended producer responsibility need to compare the cost of removing contaminants from their designs with the cost of removing those contaminants at the end of life. In order to make these costs more visible, we created a model of end of life costs that includes both disassembly and disposal costs at the dismantling phase of the life cycle. We applied our model to lead and mercury in the 2010 Toyota Camry. As the best selling passenger car in North America, the Toyota Camry is reasonably representative of the US auto fleet.

RESULTS

We found that 141g of lead exist in parts which can feasibly be removed, but which are not currently removed from vehicles at the end of their life. Most of this lead is contained in electronic control units, but lead also exists in fuel hoses, the fuse box, and spark plugs. The cost to remove and dispose of all the feasible lead-containing parts is $93.77. We also found that an additional 61mg of mercury can feasibly be removed. Removable mercury exists in the instrument panel, display screen, and headlamps. The cost to remove and dispose of these parts is $12.34 per vehicle. Across the entire 2010 Camry fleet, this amounts to 46 metric tons of lead, which can be removed at a cost of $31M, and 20kg of mercury, which can be removed at a cost of $4M.

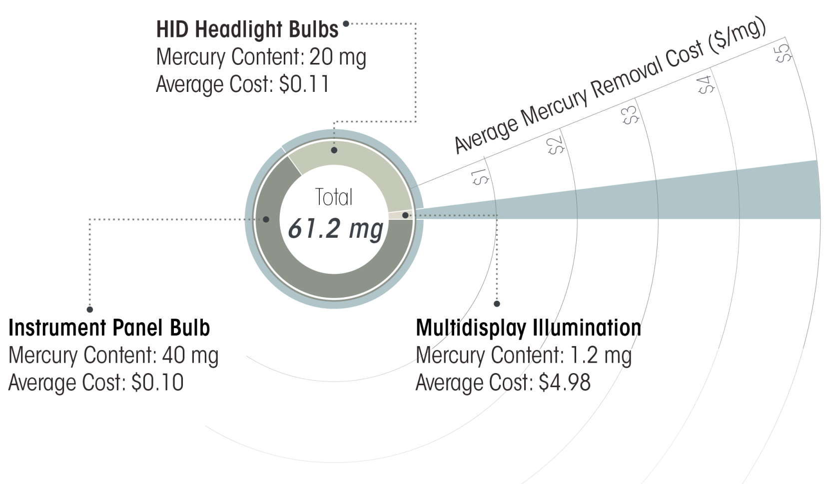
Removing Lead

Total Cost per Vehicle: ***$93.77***



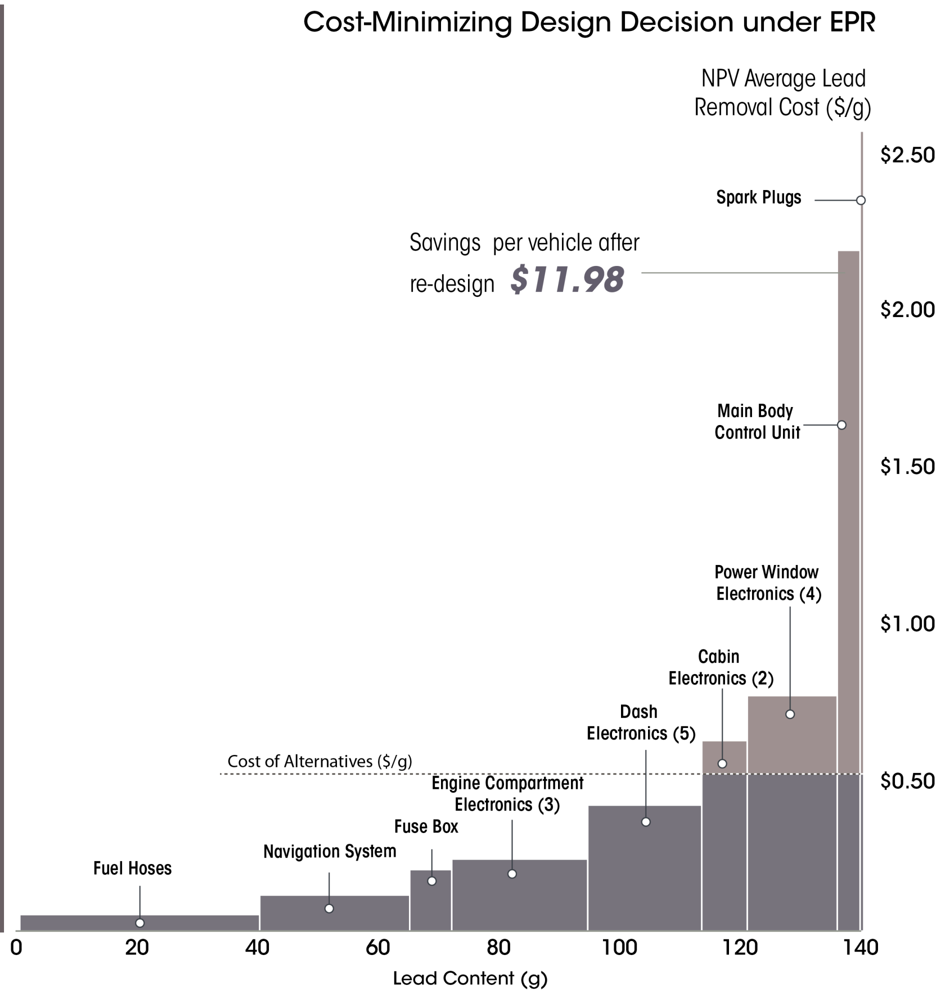
Removing Mercury

Total Cost per Vehicle: ***$12.38***



CONCLUSION

These results can be used to guide the manufacturer decision process; they illustrate the threshold against which design costs should be measured. If costs associated with retooling and redesign are less than these ELV costs, then design changes are economically preferable. Manufacturers can use this approach to determine the most efficient contaminant mitigation strategy. Furthermore, manufacturers can use these results to estimate the costs they face under extended producer responsibility.



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