a day on a single battery charge would meet 95 percent of the need for a full-service urban vehicle in the United States. Present commercially available batteries, which have lead electrode plates in an acid solution, can't meet the range requirement.

NASA's Lewis Research Center undertook research toward a practical, economical battery with higher energy density. Borrowing from space satellite battery technology, Lewis came up with a nickel-zinc battery that promises longer life and twice the range of the lead-acid counterpart. Lewis researchers fabricated a prototype battery and installed it in an Otis P-500 electric utility van, using only the battery space already available and allowing battery weight equal to that of the van's conventional lead-acid battery.

In initial tests, the nickel-zinc battery delivered 190 stop-and-go driving cycles per charge, compared with 99 for the lead-acid battery. At a constant speed of 20 miles per hour—a test speed, not the ultimate expected—the nickel-zinc battery gave the van 55 miles on a single charge while the lead-acid battery yielded less than 30 miles.

Lewis is continuing research aimed at improving the nickel-zinc battery's performance, life and competitive cost. In a joint NASA-U.S. Postal Service field test program, nickel-zinc batteries will be installed in mail pickup and delivery vans. The Postal Service already has some 450 electric vans, and plans a large-scale expansion utilizing longer-range batteries.

NASA will further evaluate the new battery's potential for urban family use in a test vehicle. Lewis researchers feel that a nickel-zinc battery, producible within five years, could drive a car 120 miles at an average speed of 40 miles per hour on a single charge—exceeding the predicted requirement for a viable urban vehicle.

These toll booths, at the Evergreen Point Bridge near Seattle, Washington, have air purifiers whose design profited from NASA "clean room" airflow technology. The booth's airflow system retards infiltration of contaminated air and decreases the toll collector's inhalation of engine exhaust fumes.

Toll-Booth Purification

For many years, toll collectors on turnpikes and bridges have been subjected to a health hazard from engine-exhaust. Fumes are particularly strong at toll booths because drivers decelerate from high speeds then quickly accelerate after paying the toll. To counter the exhaust hazard, Washington state decided to equip its toll booths with air purifiers, but available purification systems were found unacceptable; they created severe drafts because uniform air flows could not be attained.

NASA's Technology Application Team at Stanford Research Institute searched available information and suggested a transfer of clean-room technology

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A section of Philadelphia's Elevated System is serving as an East Coast facility for testing a NASA-developed anti-corrosion coating which offers improvements over commercially available coatings. Salt spray makes corrosion a particular problem for coastal area structures and NASA's zinc-rich coating offers economies in easier application and longer life. The coating is also undergoing evaluation in the Northeast as a method of protecting road vehicles against corroding salts used as anti-icing measures.

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employing the use of the same laminar flow techniques found in environmental control systems of clean rooms used for contamination-free assembly of precision aerospace equipment. That information, from technology originally developed by NASA and the Energy Research & Development Administration was incorporated in the design of a prototype toll booth purifier.

The draft-free design includes a "diffusor", which blows clean air out the toll booth doorway, thus retarding the infiltration of contaminated air. The net effect is a decrease in the toll collector's inhalation of exhaust fumes. The Washington Department of Highways installed the prototype system in a toll booth at the Evergreen Point Bridge near Seattle. After a successful two-year test, the department now has equipped all 10 of the bridge's toll booths with the air purifiers.

Anti-Corrosion Coating

A spinoff with economic potential, because of very wide applicability, is a NASA-developed anti-corrosion coating. Because of exposure to salt spray, coastal or ocean structures—bridges, ships, oil rigs, and pipelines, for example—require more corrosion protection than is needed inland. One study showed that a coating with a 25-year lifetime inland was good for only four to six years in coastal areas.

Most anti-corrosion coatings are formulated of zinc or aluminum dust in an organic binder. Existing zinc-rich formulations require two coats. A longer-lasting, single coating is needed to counter rising maintenance costs.

NASA-Goddard developed a zinc-rich coating with a special binder that exhibits longer life and superior adhesion characteristics—so that only a single coat is required. Unlike conventional coatings, the NASA compound is easy to mix and it requires no