Pilot projects in cities from Tel Aviv to Detroit are testing electrified roads that charge the vehicles driving on them. Credit: Electreon.

These Routes Are Made for Charging

OVER THE PAST two years, the federal government has raced to turbocharge the transition from gas-powered vehicles to electric alternatives. The Biden administration wants EVs to make up half of new auto sales by 2030; last year's Inflation Reduction Act juices that goal through a $7,500 individual tax credit for eligible EV buyers. But the electric vehicle transition isn't just a consumer issue—it's an infrastructure challenge.

After all, a nation of EV drivers will depend on lots of places to charge up—and that system simply doesn't exist. While today's EV owners do an estimated 70 to 80 percent of their vehicle charging at home, that won't work for long-distance driving. So the Biden administration has declared a goal of 500,000 public EV chargers built out by 2030, along highways, around cities, and in rural areas, with the 2021 Bipartisan Infrastructure Law committing $5 billion to this nascent network.

But some experts say that if we come anywhere close to meeting the ambitious 2030 EV sales target, even that level of charging infrastructure won't be enough: the number of chargers needed would be closer to 2 million. Moreover, long-haul freight trucking, a crucial transportation category, poses special challenges—with some fascinating potential solutions.

"Most people, when they think about vehicle electrification, think, 'How do we replace the gas stations with charging stations?,'" says Tallis Blalack, managing director of the ASPIRE (Advancing Sustainability through Powered Infrastructure for Roadway Electrification) Engineering Research Center at Utah State University. But alternative, or supplemental, possibilities are emerging, including roads embedded with charging coils at periodic intervals that recharge the vehicles driving over them, in the manner of a phone sitting on a wireless charging pad—basically, electric avenues.

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The ASPIRE Engineering Research Center test track in North Logan, Utah, site of a roadway electrification demonstration project that uses wireless charging technology provided by Electreon. Credit: Courtesy of ASPIRE.

Sometimes referred to as "inductive charging," this technology has received less attention than the more traditional charging stations. But it's being actively piloted in multiple places across the United States, including Salt Lake City, Orlando, and Detroit, in various locations in Europe, and elsewhere in the world.

"We believe that passenger vehicles are well over the tipping point—those are being electrified, and despite the challenges, it's going to happen," Blalack says. But the story isn't so clear-cut when it comes to the trucks and heavy-duty vehicles that long-haul shipping relies on, and that may require a different way of thinking about EV infrastructure.

As Blalack points out, nearly half of US freight travels over 250 miles, most of it via truck, and medium- and heavy-duty trucks account for nearly a quarter of US transportation greenhouse-gas emissions. ASPIRE estimates that the cost of operating a freight truck could nearly double using long-range batteries and the fast-charging station options currently available. That's because long-range batteries for heavy-duty trucks are big, expensive, and heavy (cutting into payload space), and even fast charging—assuming it's available—can entail costly delays. With an electric road that provides charging on the go, trucks simply need a receiver for the charge. They could use smaller batteries that don't have to hold as much of a charge, and the cost would actually shrink, perhaps to as low as half the current cost of operating a diesel truck, according to ASPIRE.

The technology could be built out gradually, but advocates ultimately envision it being available across long sections of US highways. And it could charge properly equipped lighter trucks and passenger vehicles as well; drivers would decide whether to charge while in motion, paying via in-vehicle software or an app. In some cases, the process of fitting highways with charging coils could be paired with other needed upgrades and maintenance. The coils would be placed every few miles, with specifics depending on traffic patterns. The coil technology—the development of which dates to the 1990s, including work on wireless energy transfer at the University of Auckland, an ASPIRE partner—can also be used in static form; vehicles with receivers essentially just park over it, with no need for a charging post.

Clearly, any widespread build-out of electric roads would take years. But existing and pending pilot programs suggest incremental benefits and possibilities across different scenarios. ASPIRE, through its own Salt Lake City facilities and partnerships, is testing freight logistics and electric transit programs. It's also directly involved in several other pilot projects, including one from the Indiana Department of Transportation and Purdue University. A separate effort involves a new stretch of roadway west of Orlando that will include an electrified section to demonstrate how the technology can be part of new construction rather than a retrofit.

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Another example that has captured attention—in part because of its location in the heart of the American auto industry—involves a pair of electric roads in Detroit. The first, scheduled for completion this year, is a quarter-mile stretch near Michigan Central Station, a mobility innovation hub; the second, projected for next year, is a three-quarter-mile strip near downtown. Both will facilitate experiments with a variety of electric vehicles. "This pilot project will enable us to identify [potential] use cases," noted a Michigan Department of Transportation (MDot) spokesperson. "Some examples of use cases for wireless charging technology could be integrated into taxi and ride-sharing services, enabling vehicles to be charged while waiting for passengers, commercial vehicle queues at border crossings, static pad charging for transit and last-mile delivery stops, and in-motion charging for shuttle and transit routes."

So far, the technology has largely been left out of the big federal funding initiatives that have boosted EV infrastructure spending. ASPIRE works with state and local governments as well as private industry; the Detroit project is funded by MDot and Israeli tech company Electreon, which has been involved in a number of EV infrastructure projects in the United States and Europe. "Interest in wireless charging is greater now than at any point since Electreon was established in 2013," says Stefan Tongur, a vice president for the company. "Several countries in Europe have targets to electrify thousands of kilometers. . . . We are seeing interest and plans in other parts of the world too." Sweden, as an example, has conducted a variety of pilot programs, recently announced it would deploy the technology on a 21-kilometer highway linking Stockholm and Gothenburg over the next two to three years, and may commit to up to 3,000 kilometers of electric roads by 2035.

In the next five or so years, such pilots may be extended into more ambitious experiments, Blalack says, gradually adding roadway segments based on freight traffic patterns. By 2040, one ASPIRE roadmap suggests, that could include interstate highways.

ASPIRE has partnerships with multiple educational institutions, labs, government entities, and nonprofits that are engaged in a range of energy technology projects. The idea isn't so much to replace the charging station strategy; we'll definitely need to build that infrastructure too. But other options can help meet the EV challenge. As Blalack says, "Our charging solution has to be: all of the above."

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Embedding wireless charging coils in a road in Gotland, Sweden, for a demonstration project led by Electreon. Credit: Electreon.