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TECH TALK

THE POWER ON THE ROAD

BY GARY BEERS • FOR ENERGY PIPELINE

THE JOY OF A LENGTHY ROAD TRIP in your electric car is likely dampened by the nagging need to make a "recharge" stop every hundred miles or so. But what if you could drive hundreds of highway miles without stopping to recharge your electric car?

Soon, that nonstop trip may be possible due to technology that supports electric recharging lanes for electric cars (Figure 1). When the electric car runs low on power, the driver moves into the recharging lane and, when full power is restored, it moves back into the regular highway lane. Before leaving the highway, this process is repeated to ensure the car is fully-powered for traveling on a street network to reach a destination - or a fixed power station to recharge before reaching the destination.

E-WAY PROJECTS IN ASIA, EUROPE, AND UNITED STATES

The term "e-ways" was coined by a magazine writer for roadways with dedicated re-charging lanes (Ditch the cord, let the road charge your EV. Keith Barry, WIRED, 2010).

There are several pilot applications of E-way projects involving limited routes for buses or trams in various countries (South Korea, Germany, Italy, Netherlands, United States and England).

Operating e-ways are in service in several locations in the United States. In 2015, a multi-million federal/state funded, four-year project resulted in the completion of a Salinas-Monterey trolley in California. In Utah, all-electric shuttle buses are in use at universities and hospitals with plans underway for other mass transit applications.

Several European countries and companies are investing millions to advance this technology and conduct extensive off-road trails of electric re-charging lanes. England is completing a feasibility study to investigate possible options and will follow-up with an off-road and highway trails. Their study includes assessment of reduction in environmental impacts and of financial charging mechanisms for energy received by users of the e-ways. England has committed to spending $710 million in the next five years to advance this technology. A German company (Ingenieurgesellschaft Auto und Verkehr, IAV) is the leader in conducting substantial field-based research on embedding the technology in roadways and is constructing a full-scale charging road.

CONTINUOUS INDUCTION CHARGING

The technology involves inductive loops buried in the roadway that generate a magnetic field to wirelessly supply electric cars with energy. This contactless transfer of energy, which is about 90 percent efficient, is enabled by taking advantage of the Maxwell electromagnetic laws, whereby an electric current flowing through a conductor (i.e., charge plates in the road) generates a magnetic field. In the case of alternating current, this induces a voltage in a second generator (in the electric vehicle), even though the two generators are not in contact with one another. Using precisely controlled frequencies of the applied alternating current, high-efficiency energy transmission from the sending to the receiving

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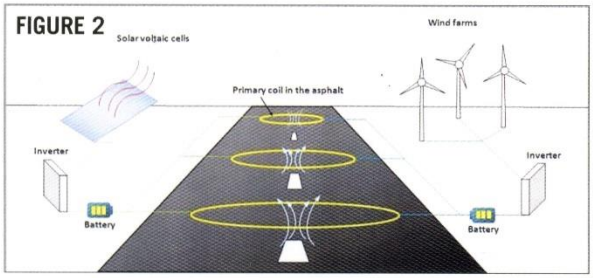
FIGURE 1

Electric Re-charging Lane. Illustration for Energy Pipeline.

electrical circuits is ensured (Drawing Power from the Road, Darren Quick, GIZMAG, 2009). The benefits of this wireless system of energy supply include being insensitive to weather, free of mechanical wear, and reduction in the size of batteries in the electric cars (Drawing Power from the Road, Darren Quick, GIZMAG, 2009).

On a smaller scale, this electromagnetic induction technology has been used for decades in automobile plants and large warehouse facilities where robotic floor conveyor vehicles are supplied with power and automatically steered using this technology. In fact, electric phones and toothbrushes are wirelessly recharged using this technology.



"Green Dream" - Use of Renewable Energy to Power Recharging Lanes. Illustration for Energy Pipeline.

IS CONCEPT TOO EXPENSIVE FOR HIGHWAYS?

Technological advances in electric vehicles and in highway construction are necessary before electric re-charging lanes are a reality.

Electric cars are now being upgraded. In the next few years, Toyota will offer cars that are capable of wireless charging and "within a decade, wireless charging could be the leading way of charging EVs." (Navigant Research).

Wireless charging stations, based on this technology, are available for owners of electric cars and buses, where the vehicle is parked over a charging plate, rather than being plugged into a power supply.

However, the development and field testing of electric recharging lanes in highways is just starting and initial implementation will take decades. Certainly, an investment of billions of dollars will be necessary to install new electric re-charging lanes or to modify existing lanes. However, the subsequent operations/maintenance and environmental costs would be significantly reduced if these unique lanes received their power from renewable energy sources (Figure 2), rather than from generators using fossil fuels.