electric vehicles

May 20, 2017 by Nancy Owano, Tech Xplore

(Tech Xplore)—What about that technology focused on charging electric vehicles while they are moving, not standing still?

Could real breakthroughs in dynamic charging make electric vehicles a more attractive option that drivers would be eager to try? Specifically, would it eliminate range anxiety?

Qualcomm thinks that is the way to go. They have demonstrated a dynamic electric vehicle charging (DEVC) system. Qualcomm Technologies announced the testing of the wireless DEVC system that involves charging from the road **surface**.

Reuters reported Thursday that the dynamic charging test took place in France. Reuters said that the test involved two Renault Kangoo vehicles driving over embedded pads. A charge was transferred to the car batteries "at up to 20 kilowatts at highway **speeds**."

Qualcomm Technologies demonstrated simultaneous charging, in which two vehicles on the same track can charge dynamically at the same time. The vehicles can pick up charge in both directions along the track, and in reverse.

This was a 100-meter test track.

Qualcomm Dynamic Electric Vehicle Charging (DEVC)

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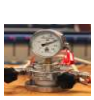
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"This test road is modular," said *The Drive*, "with four power supplies—one for each 25-meter **section**. Each length has 14 sub-modules which contain magnets and power conversion circuitry. The test vehicles were equipped with receivers in the underbody to magnetically pick up the charge and convert it to DC power."

Mike Kissin, director, engineering, Qualcomm New Zealand, said they have technology that speaks to the power conversion, magnetics, control and communications—and safety.

He said they split the project into three phases: concept design and prototyping in Auckland; the manufacturing in Munich; finally, installation and testing in France.

(Actually, Kissin is the presenter in a video titled Qualcomm Dynamic Electric Vehicle Charging (DEVC) where he discussed the system.)

In theory, the idea is quite attractive as it implies the vehicle could run indefinitely. In practice, *MIT Technology Review* raised questions about costs. Still, said the article, the idea might make sense in bus routes with standardized routes and it may make sense for "robotic taxi fleets," if they stick to well defined routes "and only deviate from charging **strips** for a mile or two at a time."

Lee Mathews in *Geek.com* also raised the consideration of costs. "One major hurdle that has to be overcome before we'll be taking advantage of an inductive **road**. It's a tad on the expensive side right now." Mathews, however, said the picture could change. "Things in the EV world are changing at an incredibly rapid pace, though, and Korea actually did something similar for electric buses four years ago… so it could happen sooner than we think."

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More information: **www.qualcomm.com/news/releases … ric-vehicle-charging**

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The third concern is efficiency, since running miles and miles and thousands of individual power supplies idle takes considerable amounts of power that is simply wasted, especially when there's nobody driving.

Would the chargers switch on only when the traffic is high enough to warrant it, or would they have to remain on all evening and all night to wait for one driver in the small hours?

The direct cost can be reasonable, but the indirect cost of powering it might not. It also does a number of the electric grid because traffic peaks at the same times as electricity demand in general.

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"only deviate from charging strips for a mile or two at a time." - MIT Technology Review

I don't know why the ranges cited in the article seem to imply the vehicles would have only minimal batteries, only the charging road for power. Why not have at least 10-20% of the battery capacity today (typically 250mi) so up to 25-50 miles? If reducing battery size (so cost, and weight that reduces efficiency and so reduces range) isn't necessary, charging roads could be separated by dozens or hundreds of miles but still extend range reliably.

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The press release is really about just a demo of multiple cars charging on the same road.

I expect that actual public deployment would deliver power only to actually charging vehicles. And that it would begin in stretches of high (chargeable) traffic. I'd also think its efficiency would benefit from integrating other necessary infrastructure, like standard electric power transmission/distribution. And possibly PV. Integrating more productive infrastructure makes the expense of the system more efficiently used for all purposes.

I do think this system makes more sense supporting truck fleets than just arbitrary vehicles. Shipping operators can commit to their well understood traffic routing levels, identifying "charging runs" in optimal road segments, and contracting Power Purchase Agreements to finance the deployment. Tesla's announced truck initiative is a good complement to this infrastructure, bringing others to compete.

Eikka:
The third concern

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There's an interesting opportunity for cars with batteries to *discharge* into a version of these "charging" roadways when they prefer to sell at high demand times. Building out

the dis/charge roads as integrated with grid transmission/distribution would increase the robustness of the grid for matching storage to demand, encouraging charging during low demand. If the charging surfaces can be PV (or just alternate with PV) sharing the rest of the infrastructure, the whole system becomes more efficient in energy, space, time and accessibility. Since electric cars are already pretty computerized, and Internet could be carried in the charging roadways, a realtime market fully integrating all those batteries could make it far more efficient in those valuable ways. And by adding mobile batteries, more resilient as well.

Eikka:
It also

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"There's an interesting opportunity for cars with batteries to *discharge* into a version of these "charging" roadways when they prefer to sell at high demand times"

I think that would not make sense, as the round-trip efficiency would be terrible. Nearly half the energy could be lost.

"I don't know why the ranges cited in the article seem to imply the vehicles would have only minimal batteries"

Cost reasons. If the cars can charge continuously, having more batteries brings unnecessary cost. Having charging roads and large batteries is a double expense. Half and half is just a bad compromize.

Eikka not rated yet May 20, 2017

"I expect that actual public deployment would deliver power only to actually charging vehicles."

Any such system has a stand-by power demand, and needs to use power to actually detect when a car is driving over the road. A single car will drive over each section of the road in about a second, and there are 3,600 seconds in an hour, and 86,400 seconds in a day, so even in relatively heavy traffic the road sections are going to be idle for a great deal of the time.

Thousands or millions of standby power supplies planted in the roads every 25 meters start to draw significant amount of current just to stay online.

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" Why not have at least 10-20% of the battery capacity today (typically 250mi) so up to 25-50 miles?"

The reality of electric vehicles today is closer to 25-50 miles than 250 miles, exactly because of the cost of the batteries. Sure, there are cars that genuinely achieve the range, but they're well beyond the means of the average consumer to buy, and even where affordable they make little economical sense because of their lower utility and shorter lifespan. The common EV that is at the upper end of the price range for a car for the masses can do about 75 miles and a third of the price is in the batteries.

That's the part that the charging road is supposed to amend - by having 10% of the batteries on-board so the price of the car could be dropped by a third and become instantly competetive with regular vehicles. That however means the car would only have 7-8 miles of electric autonomy, similiar to modern hybrids.

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It's telling much that even Tesla won't offer a warranty on the batteries beyond 8 years. That's because the high energy density lithium chemistries do not last for more than a decade in use. Meanwhile the average age of a car in the US is about 11 years, which requires that most cars make it to 20 years or more.

A 10 year old used electric car with a dead battery isn't worth a damn. A 10 year old

regular car in reasonable condition will still serve you another 10 years. That's why electric cars actually cost you twice as much as the sticker price would suggest.

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At 8 years the Tesla battery will just start to decline not just die. It'll probably go past 11 years with over 70% capacity. Most gas cars that don't get a major mechanical overhaul in 10-11 years function at far less than 70% capacity.

In the Tesla price/performance class the average age of a car is much less than the 11 year overall average, probably under 5 years. In the first buyer's possession anyway - there are of course a lot of classic premium cars on the road for much of a century. There will be classic Teslas - the cost of keeping these on the road is largely immaterial to their chain of owners.

Besides at $19-28K for a battery replacement job a $75K Tesla is worth far more than a damn.

But most importantly 11 years after the first Teslas were sold (2019) the battery tech and replacement costs will be much less, and a couple years after that much less again. And that's about the timeframe that these charging roads could be deployed.

Eikka:
It's telling

daqddyo not rated yet May 21, 2017

Wait a minute. I've got to stop now and then to visit a discharge facility for my body system, stretch my legs and to get a snack. My car could get a charge up at the same time at these stations.
Scooting ahead continuously on a long trip without a break results in drowsy drivers (unless we all use "driverless" cars).

Eikka not rated yet May 21, 2017

"It'll probably go past 11 years with over 70% capacity."

The weardown process of lithium batteries is exponential. It goes slowly to about 70% and then the capacity starts to collapse. Maybe it does go to 11 years, but at year 12 the battery will show significant signs of age.

http://batteryblo...les2.jpg

This is also a good thing, since the car will maintain somewhat reasonable driving range up to the full lifespan of the battery.

"Most gas cars that don't get a major mechanical overhaul in 10-11 years function at far less than 70% capacity."

Apples to oranges. Electric cars need such overhauls too, because all the brakes, suspension, shocks, joints, etc. wear down the same and the car would become dangerous to drive. To make a correct comparison, it's rare to make a full engine overhaul to a 10 year old car.

Eikka not rated yet May 21, 2017

"Besides at $19-28K for a battery replacement job a $75K Tesla is worth far more than a damn."

That would be insanity to the average person, who doesn't need a luxury car and could buy an entire new vehicle for $19k. The Tesla is not a people's car, and even if its cost goes down it still won't become one, so it's irrelevant to the question.

Think along the lines of a Nissan Leaf. 75-85 miles of (real) range when new, 50-60 miles at 10 years of age, and beyond that it's effectively broken: a battery replacement costs a third of the price of the new vehicle. A regular second hand car in good condition is worth less at that age, so the Leaf would be literally worthless - the most you could sell it for is scrap.

Eikka not rated yet May 21, 2017

Seriously. Talking about $75k - $100k cars when discussing electric mobility is "let them eat cake" level of ivory tower ignorance.

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You're excluding the middle. A $19-28K battery replacement on an 11 year old $75K Tesla is not equivalent to replacing the engine on an 11 year old ICE car. The ICE car engine replacement typically costs as much as, or more than, the replacement cost of the entire car (I've done it 4 times on different cars for non-financial reasons). Brakes, suspension, shocks, joints are not nearly as major a renovation as replacing the engine - they're akin to replacing the battery, much less than 25-38% of the new purchase price, and each done separately along the years (cash flow benefit). And there's an expected market for used EV batteries in applications that don't require their full capacity/performance, so the net replacement cost will be even lower.

We're talking about Teslas because you cited the 8 year warranty vs the 11 year average age of a US car. I disagreed citing reasons for that argument. A Leaf or other cheaper EV is a different argument.

Eikka:
The weardown

Eikka not rated yet May 21, 2017

"not equivalent to replacing the engine on an 11 year old ICE car."

You're making a false comparison. The 11 year old Tesla is not worth $75k anymore either, and the same issue you identified applies: the battery is worth more than the entire rest of the car. That's the point: an EV with a broken battery is practically worthless.

"And there's an expected market for used EV batteries in applications that don't require their full capacity/performance"

Again, there is practically no performance left in the batteries once their best-by date is gone. They're only good for recycling.

As a personal experience of lithium batteries, I recently replaced a 9 year old lithium battery that was operating nearly perfectly up to the 8 year mark, and the last year saw the performance simply collapse. By the time it was done the pouch was bloated and I was actually worried it might explode.

Eikka not rated yet May 21, 2017

The problem with the weardown of lithium cells is that the cells break down over time on their own, regardless of use. There are slow chemical reactions that lock the lithium away in different unwanted compounds, which increases the internal resistance of the battery, which increases the amount of wear it experiences when it is charged and discharged.

So the old battery starts to break down faster and faster towards the end of its life.

" A Leaf or other cheaper EV is a different argument."

No, it's the same argument. EVs don't make economic sense in any price class - the more expensive ones even less so. They start to make sense if you can eliminate the cost of the battery, which is how we get to the point of the electric road, and the reason to assume that the cars would have minimal autonomy outside of it.

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A used 3-5 year old Nissan LEAF costs about $12.5K:
http://www.cbsnew...-sparks/

It cost about $30K new, so net is about $17.5K. It saves an average of about $4K a year, so after 4 years the $16K savings nets a TCO of about $1.5K. Maybe that's really $5K if all costs are included, including the cost of executing the resale etc.

A $30K ICE after 4 years isn't seeing those operating savings, so its (pre-resale) TCO is about ($30K+16K-3.5K=) $42.5K. For its net TCO to beat a LEAF's its resale value must be $35.5K, 18% higher than new, so impossible (even leaving lots of margin for error in all these estimates). So the economics look pretty good.

And of course that's leaving the full costs of ICE fuel, like the damage from its pollution, externalized as we currently do.

Eikka:
No, it's the same

Eikka not rated yet May 28, 2017

"A used 3-5 year old Nissan LEAF

You're still not making the same comparison, you're just shifting goaposts. At 3-5 years the battery is still working. At 8-10 years it's not, while the ICE car is.

The ICE car gets double the lifespan because by the time the battery of the EV has gone, there's no sense in dropping a new battery in a 10-year-old car. It's worthless, it goes for scrap. Meanwhile the ICE car goes on for another 10 years.

The real total cost is the cost of two cars versus one car, where the EV as compared to a similiar regular car costs anywhere from 50-100% more to begin with.

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Eikka:
You're still

Well, the 8-10 years goalposts you set by the Tesla warranty, which I already successfully rebutted. You've abandoned that argument without even acknowledging that.

There are no 8-10 year old LEAFs, and the first couple-few years units aren't nearly as good as the 3-5 year old ones. On the available data, a LEAF offers more economical TCO than an ICE does. Since the LEAF's performance gets better every year, and batteries are both cheaper and less frequent to replace every year, by 2021 an 11 year old LEAF looks like it will be even more economical. In fact it will have paid for itself in gas savings, even excluding the non-battery maintenance savings, which is hard for an ICE to beat

Look, you also tried to claim that a car worth 33% of its new price was "wortheless", and didn't acknowledge that. I don't know why I have to constantly make my point successfully while you're free to just say things I demonstrate are wrong.

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