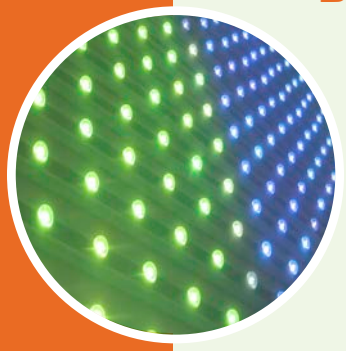

Electric Vehicles and the Tipping Point:
Battery Technology, Gas Prices, and Infrastructure

Excerpted from ***Powering the People 2011***

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The EDISON FOUNDATION | INSTITUTE FOR Electric Efficiency

Advancing energy-efficiency and demand response among electric utilities.

Electric Vehicles and the Tipping Point: Battery Technology, Gas Prices and Infrastructure

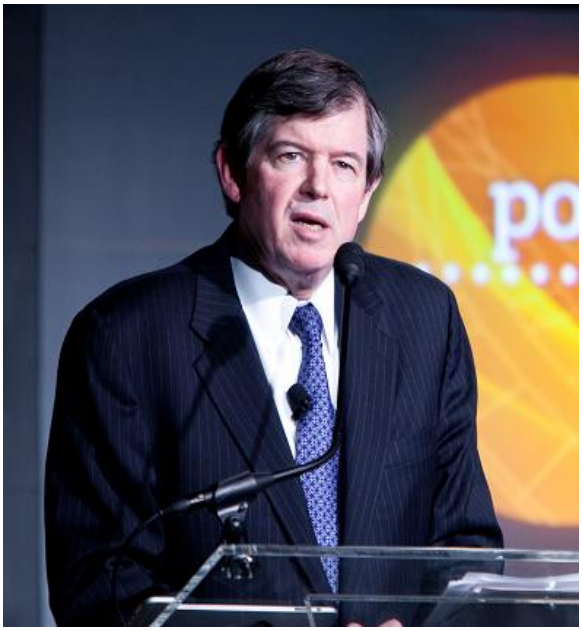
The coming paradigm shift toward electric transportation and its timing will depend on government policy, global politics, developing a robust supply chain – and ultimately on customer response.

Moderator: **Tony Earley**, Executive Chairman, DTE Energy Co.
Ted Craver, Chairman, President, and CEO, Edison International; **Nancy Gioia**, Director, Global Electrification, Ford Motor Co.; **Britta Gross**, Director, Global Energy Systems and Infrastructure Commercialization, General Motors; **Don Karner**, President and CEO, ECOtality North America; **Jim Piro**, President and CEO, Portland General Electric.

This discussion is an edited version of an Electric Vehicles panel discussion featured at The Edison Foundation's "Powering the People" conference, held in Washington, D.C., March 3. We thank Lisa Wood and the Institute for Electric Efficiency for the opportunity to present this valuable information and insight.

Tony Earley: Being from Detroit, I know a little bit about the automotive industry. I also know a bit about the utility industry. I've been in the utility industry for 25 years, and I have been on the board of Ford Motor Company for two years. For both industries this is one of the most exciting times that anyone can remember.

One of the interesting things about both of these industries, which you may not know, is



Moderator Tony Earley, Executive Chairman, DTE Energy

that just over 100 years ago, Henry Ford worked for my company, Detroit Edison. He was an engineer working in the power plants. My predecessor, then CEO of the company, called him in and wanted to promote him. Lore has it that he said, "Henry, you have got to stop playing around with those new-fangled machines in the machine shop or you've got to quit." So Henry Ford quit and started Ford Motor Company and the rest is history. He innovated and started a revolution in a way that made travel universal.

Today we are about to see a similar seismic change in transportation. Today electric power is at the threshold of transforming the transportation sector. Outside we have the new Nissan LEAF, Chevrolet Volt, and the Ford Transit-Connect.

> [Video feed and demo of electric vehicles.]

Earley: There's something very special about electric vehicles. It's the near-silent ride, the immediately available torque that makes it a great car by anyone's standards. The way it accelerates is awesome. There's no transmission, so the accelerator pedal feeds electricity directly to the motor. When you step on that pedal the car literally jumps ahead.

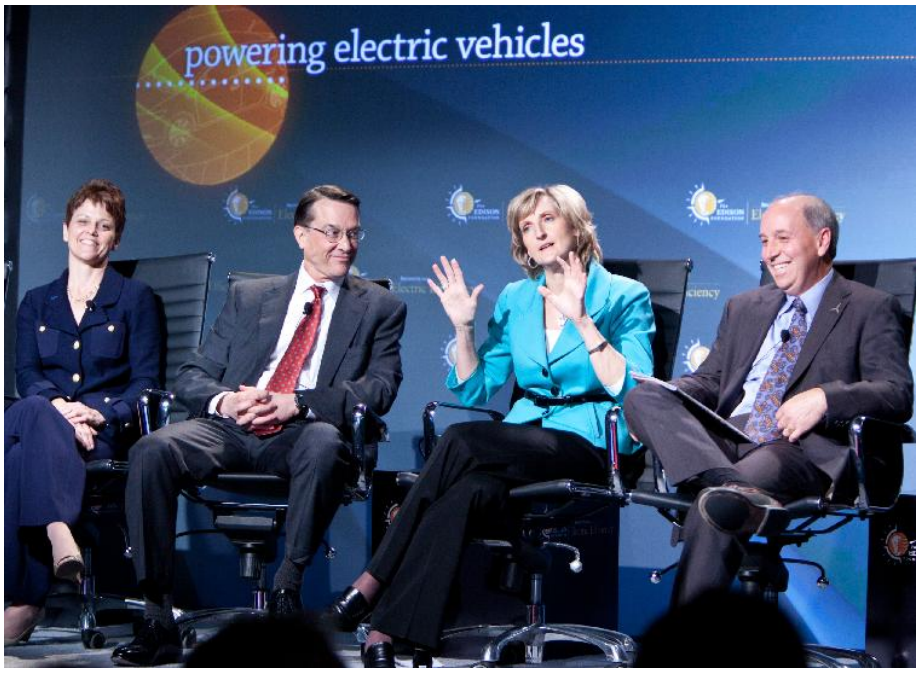
With the battery centered down the middle of the car, it has great handling. No one is going to mistake these cars for golf carts. The fact that they get great mileage and are emission-free is just a bonus. Obviously I have a bias here, being from Detroit. But you don't need to take my word for it. In January, 50 automotive journalists in the US and Canada named the Chevy Volt "North American Car of the Year" at the 2011 Detroit Auto Show. *Motor Trend* and other magazines have given the Volt their 2011 Car of the Year award. A January cover story in *Bloomberg BusinessWeek* focused on the LEAF and the Volt and their potential impact as the first serious contenders for mass-scale electric cars.

Utilities are committed to making electric transportation a success. Electrifying transportation will create new high-quality jobs and help reduce our country's dependence on oil imports. And it will be good for the environment.
But what's different about electric vehicles today? Will these vehicles make a real difference? Or will this just amount to another fad?

Jim Piro: I'll start with just one thing: battery life. Lithium ion batteries have a ten-year life. They'll give us the range we need and their cost is coming down. With economies of scale, we'll see prices come down even more, making it much more affordable. That's key.

Britta Gross: Right. Lithium ion battery capability has improved stunningly in the last few years, and it's going to get better and

better. We've learned so much from previous efforts – from the EV1 for example. And times are different today. Today there's so much awareness about energy security, the environment, needing sustainable energy here in the US, solving our economic problems. Just in job-creation – so many things are so different from 10 years ago. The moment is now.



L to R: Panelists Gioia, Craver, Gross, and Piro

Ted Craver: We're celebrating the 125th anniversary of Edison International this year. Right behind my desk, I have a picture of our 1915 "electric wagon," as it was called then. It was for our utility crew. Actually, one-third of our vehicle fleet at that time was electric, so we're really going "back to the future." The big difference today is the cost factor. With the simpler drive train, and electricity so much cheaper in real terms than it was in 1915, the operating cost of EVs is about one-third to one-quarter of the cost for internal combustion engines. You have to get past the initial capital cost. That's going to be huge as gasoline prices continue to rise. I believe the economic proposition is the big game-changer.

Nancy Gioia: One of the reasons electric cars practically disappeared by 1930 is that they didn't meet customer needs. In 1915 the electric starter came out for gasoline-fueled vehicles. That made them much more convenient to use, and they were half the cost of electric vehicles. In addition to the battery technology, two other big elements are the computing power we now have on board – the technology is much more than the battery – and the systems engineering. It's a complex integrated system, so now we can deliver durability, reliability, and safety. With all of that – as well as a driving experience that's fun and engaging –we have something that allows the industry to grow. We're just at the beginning of that!

Don Karner: I think the key is information technology. There's obviously not just one thing that makes a difference, but availability of information technology that can integrate the vehicle with the outside world makes a huge difference. There are a number of different value chains that information technology brings to these grid-connected vehicles that will help drive costs down. We'll be able to exceed customer expectations in ways we haven't even imagined yet.

Earley: Britta, General Motors has the Volt in the market. Is the customer's experience different buying an electric vehicle?

Britta Gross: It is a bit different, yes. The Volt comes with a cord set – a 120v cord set that plugs into any three-prong home outlet. When we did the EV1, we learned that you don't want to depend on a special infrastructure system being developed. We wanted to make this vehicle as easy as plugging in to your home outlet, so outside of your house, or a hotel, or wherever you can find a three-prong outlet, you can charge this vehicle. It charges in about 10 hours. You can also charge the vehicle at 240 volts, more like a clothes dryer experience. That shortens the charge time to about four hours.

We have contracted with SPX, a service installer, to organize for the customer all the options for these 240 volt chargers because there are many options. We are involved in a DOE grant program that we are partners in with ECOtality. We're offering Coulomb chargers, as well as our own Voltec charger. SPX provides their own hardware, so we are agnostic about what kind of 240v charger the customer wants. We just want the experience to be smooth and affordable and familiar – as automotive-like as possible. We can easily scale this effort up to millions of vehicles quite soon.

Earley: Nancy, I know [Ford CEO] Alan Mulally would kick me if I didn't give you a chance to talk about what Ford's plans are to bring electric vehicles to market.

Gioia: Well, first there's the 2011 Ford Transit Connect, a van that's been on the road since last year. At the end of this year the Focus Electric launches. We're focused not just on the vehicle but the whole electric vehicle experience, so we have an arrangement with Best Buy. When a customer comes into a Ford dealer and wants to buy the car, the dealer will ask, "Would you like us to set up a charger appointment for you?" If the customer says yes, the Best Buy Geek Squad will come out with a certified electrician to determine if the residence needs any additional wiring. If you're getting the Focus Electric, we recommend a 240 volt charger. Just like the [Chevy] Volt, a 110 cord comes with the car. Either way, you can easily recharge your car overnight.

In addition to that, we are breaking from the paradigms of how we've done things in the past. We also offer "Value Charging by Microsoft," which gives customers the ability to have their car charged at the lowest possible rate. Let's say Value Charging monitors Southern Cal Edison's rates. It can tell the customer, "Charging cost is lower between 1 o'clock and 3 o'clock, but it's *really* low between 1:30 and 2:30." The system can charge and adjust charging within very short time periods to give the lowest electricity rate. In the future a customer may say, I only want to charge on solar, or I only want to charge on wind. Those energy management choices are put in the hands of the customer.

We also have a new app called MyFord Mobile for smart phones which links SYNC technology and the technologies in the car and it puts it on your mobile phone as an application. With that you can set your car to charge remotely, and you can tell if you can get to your next location on the charge. The app on your phone will tell you, "You are getting a little short on range, so why not charge your vehicle now?" It will also tell you, "Here are two or three charge points on

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