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PANEL 1: IMAGINING THE PLUG-IN FUTURE

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PANEL 1: IMAGINING THE PLUG-IN FUTURE

MR. SANDALOW: Our panel is coming on the stage, as you can see. I'm only going to introduce one of them, the Moderator of our program, our friend, Vijay Vaitheeswaran. And I want to tell you two things about him. First, as I think everybody knows, he's the Economist Correspondent, award winning in that respect.

Second, he is the co-author of a fabulous book called Zoom, which is for sale out in the lobby. Everybody should buy one. I'm sure Vijay would be delighted to sign it. We will start this panel with a video, as well. Thank you.

MR. VAITHEESWARAN: Ladies and gentleman, I'm Vijay Vaitheeswaran, as David mentioned, I'm a Correspondent for the Economist, and it's my tremendous honor and pleasure to be here with you today, and with such an extraordinary panel, our kick off panel, where we will be imagining the plug-in future, and the context of what I think is one of the most exciting times, which is, we're really at the cusp of a new golden age of innovation and cars and energy, of the sort we haven't seen in a century.

When I talk about innovation to people who are not involved with cars or energy, indeed, often to people

who are involved with cars and energy, sometimes, until very recently, they're stunned.

When you think about the internal combustion engine and gasoline, the sort of iron nexus that's powered the 20th century economy, essentially unchanged for 100 years. And I know there have been lots of incremental technology changes, but we're talking about one combination of fuel and engine technology that has been dominant to the point of near monopoly, as Jim Woolsey pointed out. It seems odd to talk about innovation. But there was an era a century ago when there was a real rivalry between fuels. In 1900, there were more electric cars on the roads of New York than there were gasoline powered cars. Henry Ford's Model T was a flex fuel vehicle that ran on corn ethanol or on gasoline.

And so what happened? We entered a century in which one fuel became dominant. And we have come to see the geopolitical, the economic, and ultimately environmental consequences of that addiction to oil.

I'm happy to report that, thanks to a real confluence of forces, technological, economic, political, and environmental, we're really at a tipping point. And to

help us think through what this means, this new race to fuel the car of the future, we have a wonderful panel.

Just a word to my panelists, and also to the questioners, because we're going to leave a lot of time for your questions, as well, we have other panels looking at where we are today with the specifics of the technology, we'll be talking tomorrow about the role of that federal policy and local policy can play. I ask that we lift our gauge to the horizon for a moment during our initial panel and really imagine the future very much as one that might be different from the immediate past, and look at the sense of possibilities. What's possible with the technologies we're talking about at this inflexion point, this moment of change? And I would put it, just shamelessly putting in a small plug for Zoom: The Global Race to Fuel the Car of the Future.

The central thesis in the book is that there is not only an extraordinary race going on to find the fuels, but that we've gone beyond just looking for one fuel. The real transformation happening that's helping move us beyond oil is the changes to the vehicle, I would argue, that is, the transformation, the electrification of the car, the advances in battery technologies, on board diagnostics that

we're going to hear much more about, and in a sense, that it's not just the juice, but the jalopy that's changing, and that's really the essence of getting over the old chicken and egg problem.

So with that, let me turn to the first of our panelists. They'll all give brief overview remarks, just to get the conversation going, and we'll continue in spirited debate, I promise you. Shai Agassi won't need an introduction to many of you, but he's, of course, a legendary entrepreneur, founder of Project Better Place. a few opening comments from you, Shai.

MR. AGASSI: Thanks, Vijay. If I tell everybody to go buy Zoom, can I get an extra minute?

MR. VAITHEESWARAN: He knows how to work the Moderator, doesn't he? Yeah, let's see what you've got to say.

MR. AGASSI: So we started with a bit of a different question in Project Better Place. Our founding question was how do you run an entire country without oil? So start from the top down with the following question, how do you run an entire country without oil on the technologies we have today, no new science, without government assistance, so it's not paid by the taxpayer,

with a time frame that is actually fast enough to get off oil before we run out of the planet, so a framing question for everybody.

I'll fast forward you to the end of the first chapter, which happened on January 21 of this year, 2008. For the first time, all four elements actually get that done. It happened in one place, which was Jerusalem. Israel announced that it's going to get off oil within a decade. Now, what are the four elements? We had a government that stood up and said, vision-wise, we get off oil within the next decade. We drive the entire transportation sector in the country not on gasoline. We're going to go electric. They put a policy in place that was extremely simple to understand, created tax differential between gasoline based cars and zero emission cars, zero oil cars, and they didn't even specify what zero oil car, just zero oil.

And the tax differential is 60 percent. So it's 72 percent for gasoline cars, ten percent for electric cars. And what they said now is, this is going to be in place until 2019, and if more people are going to buy the ten percent tax cars, we're going to start raising both prices up. So at the end, we want to be at at least 50

percent. So they said at 51.10, we're going to stop. So that gives us the tax we want.

Then we had a car maker, we actually had the only CEO in the car industry that actually is a CEO of two car companies, Carlos Ghosn, he's the CEO of Renault and Nissan, two different continents, stood up and said, we're committing to building these cars, electric cars, fully electric, zero oil, not even a place to put oil, and we're going to make them fast, we're going to make them fun to drive, they're going to be full sized, we're going to make many of them, different sizes, different cars, they're going to go 100 plus miles on a single charge on a battery, and they're going to have a feature which is a replaceable battery. So you can actually exchange the battery if you want to go beyond the distance of a single battery.

So these cars have two conduits of energy into them. The first one, which is used normally most of the time, is you park your car, you plug it in, you walk away. By the time you come back, the car is full. The second way is, if you want to drive a long distance, instead of activating a power plant in the back of your car, you go into a car park, into a device that looks like a car wash,

and as you go into a gas station, your depleted battery goes out, a full battery comes in, and you keep driving.

In a sense, the range extension is not inside the car, it's in the infrastructure. Just like it is today with gasoline, we don't drive with a second gas tank to extend the range of our cars, we use the gas stations to do it.

Now, that led to a - and by the way, it said we're running this through the normal programs in Renault and Nissan. This is now about a billion dollar of investment in Renault and Nissan, not to make 1,000 of these, but to build a car that goes through the entire production cycle, so we can make 100,000, a million, or ten million of them, depending on demand, and those will be in the market, by 2011, it will be mass production, 2010, production, 2011, mass production, mass production being supply meets demand.

The third element was what Better Place does. We actually build the network. If you want to think of Renault Nissan as Nokia, we're AT&T. So what we said is you can't get these cars to be convenient until you have electricity in every parking spot.

So we put parking spots, electric parking spots, everywhere you have a parking spot. Across Israel, we'll put 500,000 spots of electricity in parking lots, mostly at work, at home, downtown, and retail. So when you park your car, you walk away, you come back, it's full. No credit card passing. If you want, you have a Sims inside your car.

And we buy the batteries, so you don't have the risk of the battery. We buy a lot of batteries, as some of the battery makers here will tell you. And what we do is we price it for the consumer in a way that is more affordable. We introduce a new business model, just like the cell phone companies. You can today buy your cell phone, own your cell phone, and not commit to a plan. Then you pay the full price. But if you commit to a plan, you get a very interesting discount model. So with our cars in Israel, if you're willing to pay what you pay for the drive on gasoline today at the price at the pump today, not even with price rises in the future, what you pay today, and you sign up for a four year plan, you get a full blown electric car, sedan, for free to drive.

If you want to drive it as much as you want, we have a plan that is sort of metro PCS. You pay an extra

\$50 a month, drive all you want. And with that plan in place, we created a new segment in the car industry called Zero Zero, zero emission, zero dollars to drive.

Zero Zero actually changes the dynamics of the market, because if you have the option of going in and picking up a used car and paying gasoline or paying - or buying a new car, paying nothing for it, and paying the same amount of money to drive, you don't want a used car. If nobody wants a used car, nobody wants a new car.

So, in effect, we created a new segment that changes the dynamics of the market. Now, all this are the three elements that happen. We're putting the infrastructure in the ground, we're putting the swap stations in the ground, we're buying the batteries, and this story is interesting because of the fourth element. If there was no fourth element, this would be an interesting plan. The fourth element is we raised \$200 million in seed capital from private sector to go put that infrastructure in the ground in two countries already, Israel and Denmark.

These are investors like Morgan Stanley. These are - it's Israel Corporation, it's the largest holding company in Israel. It's Vantage Point investors and a

number of businesses around this. It's a bunch of individual investors who are here.

So when you looking at this for the first time, we've got cars, policy, network, and money all coming in in one place. Two months later, Denmark said, we'll do the same thing, by the way. We want to get off oil more than Israel, so we'll do 180 percent tax to zero, okay. The cheapest sedan you can buy on gasoline is \$60,000; the cheapest on electric is zero. And sort of - if you fail the test, they send you over to another country. And when you look at that model, you actually start to see a model that can deploy everywhere in the world. To put the numbers in some sort of framework, at \$500 per car in the country, \$500 per car in the country, you can get off oil. In the U.S., that's \$100 billion, that's two months of oil, two months of oil we can get off oil. Not a single bit of new science required. No research, nothing.

MR. VAITHEESWARAN: Let me stop you there, Shai. That's a stunning fact. You mentioned the two zero of your business model, if we don't move on, we're going to have zero time, as well, so we -

MR. AGASSI: Buy his book.

MR. VAITHEESWARAN: Thank you. He's good, isn't he? This is why this man is successful. Let me turn to our second speaker, Mark Duvall, who's the expert on electric vehicles at EPRI, the Electric Power Research Institute. Mark, tell us about the utility perspective. I know that an important study that your organization has done in cooperation with NRDC will -

MR. DUVALL: Widely quoted today.

MR. VAITHEESWARAN: -- and widely quoted today, much invoked. I remember when it was just a glint in your eye many years ago when we talked about this out in Palo Alto. Now it has been done, it's been cited a couple of times. Maybe you could take the opportunity to give us a little bit of the backdrop and the main takeaway. And if I'm not mistaken, I think the question that was - one of the questions it was meant to answer is, the common jibe I heard many times from conventional Detroit and other car makers that, oh, electric cars, come on, that's just a pollute somewhere else vehicle, right, you know, you're hiding the problem because you plug into a coal grid, it's obviously worse than gasoline, and that was a common jibe, your study debunked that, and so give us a quick overview as to how and why.

MR. DUVAL: Thank you. EPRI is - the Electric Power Research Institute is a non-profit scientific R&D organization dedicated to research focused on electricity and the electric utility industry. Fortunately, our august speakers took most of my opening comments. I will sell Shai some time after this is all over.

But what our study showed, and our study partner was the Natural Resources Defense Council, Google.org was a participant, what it did is, it took the two main components of this, the electric sector and the transportation sector, showed how they would evolve dynamically in time with new technology and with the constraints of a future, of an electricity and a gasoline future, and looked at the intersection, looked at how electricity is served to those vehicles, how they're charged, what kind of plants are charged, how the electric sector builds new plants, retires old ones, and ultimately what we see is that the intersection of that sector, the existing constraints on it for emissions, for possibly in the future, greenhouse gas emissions, show that, in general, you have very wide ranging air quality benefits. There is no such thing as a coal powered hybrid. There is also no such thing as a wind powered hybrid.

The electric sector is a system, it acts as - it is driven by its constraints and by its opportunities, very much driven by economics, and ultimately, plug-in hybrids, 40 to 50 percent reduction in CO₂ emissions into the future. It was mentioned earlier three to four million barrels per day, and potentially 500 million tons of greenhouse gas reductions, that's with electrification about 30 percent of total VMT, up through vehicles of about 20,000 pounds in total weight, gross weight.

So the potential is definitely there. There is potentially a billion dollar annual reductions if you look at all applications of electric transportation, or look at more aggressive implementation of vehicles like the Chevrolet Volt or pure electric vehicles, which definitely do a little bit more than we considered in our study. So the benefits are clear. One of the things that is a key component, there's two components of this, one on each side of the aisle. Automakers have to build the vehicles. And it will be tough in the beginning. Cars are not iPhones no matter what - how much we want them to be, and we will have to deal with the auto industry, which is very large, has a lot of inertia, and we can help them, and there's a number of ways we can help them.

But it is - an automobile is a collection of a vast number of very sophisticated technologies. And this will help the process of developing very good plug-in vehicles.

On the utility side, the smart grid is key. We have to accomplish this transition from gasoline to electricity or from petroleum to electricity with a minimum of cost. Economics will say if you want everyone in America to own one of these things, then the cost has to be as little as possible relative to the value.

We have \$10,000 to \$15,000 in net present value of savings in a plug-in hybrid with about 20 miles of electric range over the life of a vehicle, and that's at 4 to 4.50 a gallon, so there's a lot here to play with, there's a lot of value in the energy sector in this and the value they bring to the grid. Capturing those at the lowest possible cost is definitely how you make this work for both the automotive industry, the utility industry, and most importantly, the vehicle owners and operators.

MR. VAITHEESWARAN: So what I'm hearing is that your analysis shows it is worth doing, though -

MR. DUVALL: Absolutely.

MR. VAITHEESWARAN: -- there will be, of course, technological challenges along the way, enabling technologies, infrastructure particularly of the sort that Shai is working on in Israel and Denmark need to be put in place. But particularly as the grid itself decarbonizes over time, we'll see ever increasing benefits from electrification of the fleet.

MR. DUVALL: That's absolutely the case.

MR. VAITHEESWARAN: Great; to push a little bit further on the environmental question, let me turn to our next speaker, but with a quick comment first to our - the people logging in online. This is also being webcast, by the way, folks. And if I could ask them, for those of you who are interested in our online audience to send questions for this panel, you can email questions to electricvehicle2008, that's all one word, no punctuation, electricvehicle2008@atlanticvideo.com. Great! Let me now turn to Deron Lovaas, who is a Vehicle Campaign Director at NRDC, the Natural Resources Defense Council. Give us your perspective. We've heard a little bit about the infrastructure and some of the perspective from the utility side of things. Your organization was, of course, involved in this study that was mentioned. Can you tell us, from

the environmental perspective, where do you see plug-in technology and the broader electrification transport fitting in?

MR. LOVAAS: Sure; and we're proud to have collaborated with EPRI and look forward to more of the same in the future. For us, what needs to happen, particularly with the light duty vehicle portion of the transportation sector is a flip. And actually on that note, in this week's Automotive News, the headline is "A Wild Ride as Market Flips to Small Cars."

We live in incredible times, and we need to flip the whole light duty vehicle sub sector so that it is, as opposed to 96 percent dependent on oil derived fuels, it only uses ten percent of such fuels by 2050. So that's a huge delta that we need to fill between here and 2050. What goes into that delta, the - line that we see emerging over the past few years is a moderation in vehicle miles traveled. So that's what we need to do. It is a huge change by 2050 to decarbonize this portion of the transportation sector. The good news is that we're taking big steps in terms of policy. We took two very big ones in last year's energy bill, putting into place higher fuel economy standards for light duty vehicles. And for the

first time ever, and this is a little known fact, we require fuel economy standards to be set for heavy duty vehicles, as well. So that's what we did last year.

Something that's overlooked is that the next biggest step that we could take to decarbonize the sector is to put in place an economy-wide cap and trade system. We actually analyzed the potential effects of the Lieberman-Warner Bill on light duty vehicles and found that by 2050 more than 60 percent of the fleet would be plug-in hybrids in the most aggressive scenario that we analyzed.

And that's just with cap and trade, along with the complimentary policy of a low carbon fuel standard, which was also in the bill. And that may be a little known fact. So what people may not realize is that there would be a huge squeeze put on oil and oil imports when we put a cap and trade system into place with a declining cap over time. A climate bill really is also an anti-oil addiction bill, so that's something that we need to make sure that people know about, because unfortunately, the debate last week was very truncated and very political, and we need to make sure that there's more light than heat around this topic when Congress and the new administration take it up next year.

MR. VAITHEESWARAN: Good; I know our panel on federal policies will pick up on this in much more detail tomorrow. But it does sound like you see plug-in hybrids as one of the important parts of this portfolio of technologies that you see cleaning up the transportation.

MR. LOVAAS: They're a big part of the future. By 2050, we see all vehicles being flex fuel vehicles, and nearly all vehicles being plug-in vehicles, so they're a very big part of the future.

MR. VAITHEESWARAN: Great; let me turn to Chelsea Sexton, Executive Director of Plug-In America. And for the cognoscenti in the room, you'll know she's also one of the stars of *Who Killed the Electric Car*. So we have a real celebrity in our midst. Tell us a little bit, Chelsea. When you're not hobnobbing with the George Clooneys and Ed Bagleys, I know that you're also known as someone who hobnobs with the grass roots, playing an important role in organizing the grass roots movement for plug-ins. Can you tell us a little bit about what you're hearing and how that movement has evolved? We talked about, of course, the policy, and the economic, and technical issues, but doesn't the heart of this movement have to depend upon people actually wanting to drive these cars?

MS. SEXTON: Very much so; she blushes really easily, too. So Plug-In America is an organization that is composed primarily of former or current EV drivers or plug-in hybrids, or those who wish they had them. It's a consumer very grass roots organization. It's one that grew very organically out of ashes. When vehicles are being crushed, and this was when people said, you know, we kind of just can't stand by and let this happen without being noticed.

And so it grew from a series of campaigns of said cars into an effort to get more cars built, and to work in three primary areas. And we do some work with the industry. We work directly with automakers, big and small, helping them understand the market, doing a lot of interpreting between sort of the industry usually sequestered back in, you know, the middle of the country somewhere and the consumers. We work with the policy makers, folks who create new policy, as well as rehab old policy. So, you know, state level in California with folks like CARB, and we work on a federal level, and also some local level stuff.

And we do a lot of work directly with consumers, you know, consumer education, teaching people it's

possible, getting the mass for it. And we find that those three elements really do push against each other a lot, but they're very mired in kind of a chicken and egg dilemma.

You know, policy makers don't want to make policies and create incentives for vehicles they don't know are coming. Automakers stand on this premise, we want to build cars that people are requesting by the millions, and people aren't requesting plug-in cars in that sort of volume, ergo, they must not want them. And we kind of stand back going, you know, we went around the country and most people don't even know that electric cars or plug-in hybrids are possible.

So we face this challenge, you know, I use this iPod analogy lately that, how many of us looked at our walkmans about 15 years ago and said, gosh, I wish this were the size of a deck of cards and I could watch t.v. on the thing, you know. We didn't know we wanted iPods until they were here. So we spend a lot of time, you know, working with a bunch of other organizations, kind of the grout between the tiles, as it were, but running around showing people the iPod and getting them to ask for it, and we are known to do it sometimes in non-traditional ways.

It was actually pointed out right before the panel by David Sandalow that this is the most obedient he's ever seen me, as they were lining us up for the panel, and I think that's got to stop right now actually.

So we're known to do it very traditionally sometimes, we're also known to do it a little bit more feisty. We did put Bob Lutz's email address on the internet, you know. But at the same time, GM's doing the Volt, so you know. I certainly won't take credit for it, but I don't mind whatever little part that played.

And we also have done some lesser traditional communication devices. A few years ago we decided there was not nearly enough conversation about the subject, and so a few people got together and did what you do when you're from LA and no one will tell your story, and we made a movie. And there are at least four of my co-stars in this audience, and I'm not above outing them, there might be more. And we are working on a sequel, and the premise of it is sort of who's resurrecting, who's saving the electric car. So, you know, we're an organization that grew out of actions, we believe in giving tools of action to other people, so you guys all have homework to resurrect the electric car so we can make a movie about it.

MR. VAITHEESWARAN: Well, fantastic. So you heard it here first, folks. Who Saved The Electric Car, starting in this room, a curtain call, and casting next door followed during the break. Our final speaker, Dave Vieau, is from A123, which is a pioneering company in what is probably the most exciting space in technologies today, and that is energy storage and batteries. They're working on some real path breaking technologies for energy storage on board.

And I actually had the privilege of being in the same material science laboratory back at MIT 20 years ago as the founder of A123. And you'll know, of course, that Yet Ming Chang has gone on to great fame and fortune and may have, you know, created a company and the technology that's going to save the world. I ended up as a journalist. So you can kind of work out which of the two of us was the clever of the two in the lab. In any case, I'm delighted to have Dave on our panel. If you can give us an overview of, again, what in many ways is a lynchpin technology that could well prove a snag, or could be a great obstacle, or one of the wonderful enabling technologies.

MR. VIEAU: Thank you. Well, being a battery guy, when we look at the plug-in hybrid revolution, we think it's all about the battery. But truthfully, when you listen to the transmission issues and all of the other infrastructure issues and the vehicle issues and so forth, it's a pretty big problem that we've got.

But unlike Shai's business, we can start with existing technologies. When we came out six years ago, what we had to do is, you want to start an American battery company, we went over to MIT and licensed some new lithium ion chemistry that had some great promise for changing the way we would perceive performance of battery technology for transportation.

And you throw in a Department of Energy 100,000 SPIR grant to get yourself going, you want to raise some money, hire some bright scientists, and then go about the process of trying to build batteries that actually take advantage of the new chemistry and prove that it will work. So from that start, of course, we're looking at the automotive business as a great opportunity for this technology. If you look at the hybrid vehicles that we drive today, that we enjoy today, that have changed the landscape for us, the batteries in those vehicles are I

would call five or ten year old technology, effectively. And although they're very, very good performers, they are relatively heavy and large for the amount of mileage that you get from them.

In the typical hybrid today, if you just drove pure electric on it, you'd get maybe a mile or two out of that and it would give it up.

And the barrier that's kept the industry from going forward is having both cost effective and performance effective batteries that could fit in the vehicle and provide the long term performance that you really have to have.

So we started out with what we call Nan phosphate technology, it provided an advancement in the size and the weight, the overall power we could deliver, and certainly some improvements in safety over other lithium ion technologies that had been on the market at the time. So a significant technology break through, to say the least. But we really didn't have a big demand for batteries for automobiles at that time. If you went around the industry, which we did, there wasn't an opportunity really for big improvement or big access to the market, and batteries, certainly in North America.

So while we were waiting for \$130 a barrel for oil, we hooked up with Black and Decker, who makes a lot of cordless power tools, and we developed systems that would allow them to advance the power tool industry by building batteries. And so we built and have built millions and millions of batteries now and proven that we can make this technology scale that we had while we were waiting for this PHEV revolution.

Then we came across a little company in Canada called Hymotion, and they had what we think was a really cool idea for how you could take an existing hybrid vehicle and you could advance it into the plug-in hybrid world.

And at first, from our view, it was a demonstration. And the importance of the demonstration was that the industry, by and large, didn't get the idea, and maybe still to a great degree today, that a plug-in hybrid really made any sense at all. And the only way you do it is you've got to build some. And short of building a new car and starting from scratch, you start out with existing cars. And this idea was basically, leave the car basically alone, but add a reservoir of energy to the back of that car, add energy to it so you can increase the electrification of the vehicle. Don't change the vehicle

in any significant way other than adding this amount of energy. And if you could do that, and you could get 100 miles per gallon, you're going to get the attention of people.

And so what we did is we acquired that little company. We put it together with our people. We added the financial resources and the technical resources to provide safety testing and durability testing and crash testing and the things that you need to do if you're going to employ in this particular arena, and today we've got that Hymotion product ready for launch for public consumption and for fleets around the country.

Then we got together with BAE Systems. That's a maker of hybrid drive systems for buses, and they supply the Daimler bus system that drives to New York, and we helped them develop a system using our new technology that allowed them to save 3,600 pounds per bus in weight of battery systems by using this new technology, and more than double the fuel mileage, and those are running in commercial service in New York City today. And we've engaged with a number, a large number of automakers and new car companies with new models in which to create the

batteries for the volume population which we're all looking for.

So over the next two to three years, we expect to see a number of hybrid vehicles, a number of plug-in hybrid vehicles, and certainly a number of electric vehicles, pure electric vehicles, that will be out driving around our streets, and we're very proud to be a part of it.

MR. VAITHEESWARAN: Very good; so we've heard from our - a range of experts on the topic. I'm going to take the Chairman's prerogative to ask them some questions of my own. But I encourage those of you with questions to start forming a line here at the microphone. We are webcasting this, so we do want you on the mike for the questions, please. So I'll turn to those questions in a moment.

But first, let me turn to my panelists. Shai, the two countries you're working in first, Israel and Denmark, present interesting - two questions in my mind; first of all, these are both, obviously, small countries, right, relative to say the United States, a continental economy like the United States; is this an infrastructure play of the sort you're working on that is amenable to small countries, but might be quite difficult on a

continental scale, and that something may be marking way from the grid perspective, as well? Are the challenges - and does that perhaps suggest that we might have multiple solutions in different parts of the world?

MR. AGASSI: I think there are multiple solutions for different time frames in the world. If you have zero infrastructure, obviously a plug-in hybrid vehicle makes more sense than a swappable battery until you got a swap station. Now, the question is, when do you get the infrastructure in place, not do you get the infrastructure in place, because when you look at the cost, the cost of putting infrastructure in place is much cheaper than carrying your own power plant with you in the car.

So when you're looking at it from a global market perspective, you would rather do something in infrastructure if people share in it, just like we do the grid, nobody has - we have a few people with generators at home, but not most people have generators at home. Now, could you do the U.S., let's start with that question. I think if we look at the mobile phone metaphor for a second, when we bought phones, you know, 15, 20 years ago in the states, we used to get coverage maps, right, and it would say, you know, here's the coverage map for this region this

year, six months from now, a year from now, a year and a half from now, now we know there's terrible coverage everywhere you go, but you sort of have the same coverage everywhere.

What we're doing is basically looking at it from the same kind of perspective. Draw a 120 mile circle around every city in the west side of the United States and you'll get these transportation island, LA is one. Most Angelinos don't know there's anything outside of LA, and you just go in the circle.

But then you go on one artery and it connects to the next island. It's Vegas, where most people go in and out of the strip. You could create these circles of coverage, and when you created coverage, you're free to go.

On the east side, these circles actually overlap with each other. So the New York circle takes you all the way to the edge of Long Island, takes you all the way to Philly.

MR. VAITHEESWARAN: Does this make sense, Mark, the cell phone model of -

MR. DUVALL: -- are very well known in the industry, where they run electric forklifts and ground support equipment at airports and all these things, and

they do it because it's more cost effective. They win, not because of minor reductions, they win because of cost, and maintenance, and fueling, and especially now. They did this back in \$2 land, so - however, each event, whether you swap out a battery, you fast charge someone, or you put in a street side charger that charges people overnight who don't have garages, you're talking very, very low cents per hour opportunities for revenue.

So whatever you do, you have to do it on a very cost effective basis if you're going to make it work, because you have a huge capital investment and you've got to recover that investment.

So without getting into the details of any one plan, public infrastructure is, or multi user infrastructure is definitely a challenge that has to be addressed, more so for electric vehicles and plug-in hybrids. But the City of San Francisco said the other day that only - they think only maybe a small fraction of their vehicle owners have garages to park them in, to access infrastructure. So they have a high median income, they're going to be early adopters, they have the highest density of Primus's I think in the country, and that problem will have to be addressed, but it has to be addressed very cost

effectively, because I'll say this, vehicles are expensive, batteries are expensive, and in the future, in this rosy future, I believe that we'll have a vehicle that has a lifetime battery, and we'll be very well aware of that, that plug-in hybrid vehicle batteries will ultimately last a lifetime, and we'll get to that point before we get to a truly cost competitive. We will always have to pay a little more up front for the savings down the road.

MR. VAITHEESWARAN: Thirty second rebuttal.

MR. AGASSI: I actually don't believe we have to pay more up front. I think that - we have to pay more up front, we tried that, it didn't work. I think -

MS. SEXTON: We can talk about that.

MR. AGASSI: No, but I think the situation is such that if we have - if we go to consumers and we say every electric charge you pay for in a transaction, you need to pass your credit card and it's a hassle, is a problem. If we put a network and an operator in place, where your contract is a one time contract, where interaction is everywhere you go, you can charge, it's not just your home meter, where you're not limited by infrastructure, and the car price is cheaper, it's not more

expensive, then you don't see small fraction, then you see a tipping.

MR. VAITHEESWARAN: Hold that thought. I'm delighted to see there's a robust interplay of market forces pushing different business models. This is a sign that there might actually be profits to be made in doing this, and not only, you know, addressing the public goods problem, so this, to me, is actually a very good sign.

We have a long queue of people waiting, so let me start taking questions. I might take a couple of questions at once and then put them to my panelists. Just a couple of ground rules, please. I'd be very grateful if you could identify yourself, and if you could make your question short, direct, and preferably witty, as opposed to a long gas bag comment, I mean nobody wants any of those, that's the Chairman's prerogative. Go on, sir.

MR. KLINE: I'm Stan Kline, my company is Open Secure Energy Control Systems, and I have two comments that I want to -

MR. VAITHEESWARAN: Please, a question, there's a lot of people behind you.

MR. KLINE: It's real quick. Well, I want to get your reaction to both of these. First, I did a back of the

envelope calculation, and I calculated that if every car in the United States had the specs of a Chevy Volt, a 30 percent penetration of wind power would take care of all of the battery charging, and by comparison, Denmark is at 25 percent wind power, headed to 50 percent. And I'm glad you mentioned Denmark.

The second point is that the information infrastructure of the electric grid is just as important as the electric infrastructure and the market infrastructure, and I'd like your reaction to those two comments.

MR. VAITHEESWARAN: Very good; so we'll take - sir, right behind you, let me take another gentleman.

MR. STRAUSS: Yes, my name is Carlos Strauss from Cortona Academy. My family owns a school in Northern Virginia --

MR. VAITHEESWARAN: Into the microphone.

MR. STRAUSS: -- in Northern Virginia, and two years ago I got a bumper sticker from CalCars that said 100 miles per gallon on my car. I put it on my car and was amazed at how many people would stop and say, wow, this car gets 100 miles per hour. It's a PT Cruiser, it didn't, but people would see that. Then I bought a bumper sticker a few weeks ago from GMVolt.com that sponsors the Volt car,

it says electric on it, and I swear that angry men in pick-up trucks have been threatening to ram my car because they do not like the word electric.

I notice that every one of the panelists that keep saying electric cars, electric cars, electric cars, and so I did a personal study, and I talked to 70 people, and I said, would you rather buy a plug-in electric car or a car that gets 200 miles per gallon commuting to work, and almost 95 percent of them said, I want a car that gets 200 miles per gallon commuting to work. I'm talking about the General Motors Volt car.

So I think it's a big mistake not advertising that these cars get 200 miles per gallon and advertising that they're electric. Electric, I think people don't want, 200 miles per gallon, everyone understand that.

MR. VAITHEESWARAN: I think that's actually a very powerful point, the gentleman makes more of a comment than a question. What ordinary people want, of course, are energy services, what my good friend, Emory Lovins likes to call the cold beer and hot showers, right. Nobody cares about electrons, and similarly, what people want from cars are reliable, fun, safe mobility, personal mobility, and

electric, nobody actually cares about the benefit, other than maybe the people in this room.

MR. STRAUSS: They don't understand it, that's what I'm saying.

MR. VAITHEESWARAN: Right.

MR. STRAUSS: They don't understand electric car; 200 miles per gallon, you don't have to explain it, just put an asterisk by it -

MR. VAITHEESWARAN: Let me - and go to Chelsea. You've dealt with the grass roots; how do you deal with the question of how you ask the question and what do people respond to, because again, you've got a lot of experience canvassing more than 70 people?

MS. SEXTON: Actually what jumped out at me the most was sort of the speculation that maybe GM might have made a mistake in marketing, and God knows they've never done that before. You know, just as there are a number of different issues that bring people to the table, climate change, economics, national security, there are a number of different messaging things that they'd like to hear. So, you know, really what it comes down to for the consumer is "What does this mean for me?" And one of the things that we've learned is that people like to conspicuously non-

consume. Part of the reason, the Prius is more successful than the Honda Civic hybrid, it looks like a Prius. And we have the same experience on the EV program, the more distinctive ones got more attention.

So that's really what it comes down to. People want to know what it means to me, they understand 100 miles per gallon, some of them understand electric, but as we've covered, some of them don't know what electric is, or it means a golf cart. So that's the issue, but it's real world economic terms for the consumer.

MR. VAITHEESWARAN: You wanted to jump in?

MR. LOVAAS: All I was going to say is that I think you hit the nail on the head. I mean all you have to do is look at the automakers, a very expensive television advertising in recent years, right up front, for a change, because of the remarkable occurrences in the oil and gas price markets, MPG, MPG, MPG, it is what people care about, I agree.

MR. VAITHEESWARAN: The first gentleman asked a couple of questions. Mark, do you want to take the question about electricity infrastructure?

MR. DUVALL: Yeah, absolutely. I believe that that much wind could charge every vehicle in the United

States. A single large power plant can probably charge two million plug-in hybrid electric vehicles. So the kind of wind he's talking about, remember, this is a huge system, 900,000 megawatts, growing at one to two percent a year, depending on the region of the country, so it can definitely handle it, it can definitely handle it.

MR. VAITHEESWARAN: I mean the Great Plains have been called the Saudi Arabia of wind. But don't we need significant improvements in grid infrastructure, whether it's DC lines or, you know, better means of both storing and transmitting?

MR. DUVALL: I think it's important to state that the utility industry is doing hundreds of billions of dollars in investment in new generation technology renewables, smart grid, and if you're into disruptive technologies and you like new innovation and new ideas, that's where a lot of that is going to hit. These - they have to do this anyway. The key is that when the plug-in hybrid comes to market or electric vehicles come to market, the grid integration piece is already done, so that these vehicles slide in, we use the onboard intelligence that every car has a surplus of, and we use it to have these vehicles act as intelligent great agents right off the bat.

If we do that simply for charging, we'll get the lowest possible cost, consumers will get the cheapest electricity, and everyone will go away happy.

MR. VAITHEESWARAN: We have a question from the internet, from our webcast. And this very beautifully named gentleman, Vijay Tulsiani asks "Do solar powered cars have a place in the plug-in future?" Anyone feel like handling that question?

MS. SEXTON: Sure.

MR. VAITHEESWARAN: Well, Chelsea, I mean the EV-1 was a natural successor to a solar car, wasn't it, if I recall my history?

MS. SEXTON: It was a natural successor from a solar car. I'm not sure that it would have worked the other way around.

MR. VAITHEESWARAN: Right.

MS. SEXTON: You know, but we heard it a lot, just put solar panels on your car, put sails on your car, put wind turbines on your car, I mean everyone had the improvement, and you know, if they were rude, I'd hand out job apps. You know, I think right now the best thing to do, by far, given the state of solar, is to put it on your house and let it run that house when you're not, you know,

charging your vehicle with it. So that's still the best marriage between renewables in general and vehicles. Will we maybe get to solar panels on cars one day, yes, but we're not there yet.

MR. VAITHEESWARAN: Very good; let's have a couple more questions. Sir, please identify yourself, and a short, sharp question, a little better than my earlier questioners, please. I think my patience is running short.

MR. KATZ: Hi, my name is Seth Katz, and I have two questions about the Project Better Place initiative. The first is, particularly in the European Union, I know that there's a lot of privacy concerns with billing, and in particular, it seems like there could be some potential here for either a company or a government to track people's movement. What are the issues that you've confronted with that?

And the second question is just, if you have a city, let's say like New York, where the population all goes to the city during the day, and then leaves the city at night, do you have a problem where all the batteries accumulate in one place and there aren't enough batteries in the initial place during the day, and then at night you

have the reverse problem, you know, because everyone is moving their battery in the same direction?

MR. VAITHEESWARAN: Great questions; sir, the next gentleman, we'll take your question, as well. And please identify yourself.

MR. FRANK: Well, let's see, I'm Professor Andy Frank, and -

MR. VAITHEESWARAN: Professor Frank, if you could speak into the microphone. It's great to see you, sir.

MR. FRANK: Yeah; I'm Professor Andy Frank, and I may have, I don't know whether I started this or whatever, but I've been working on plug-in hybrids for 30 years, and I have a couple questions. One of the things we're supposed to do is talk about how this is - plug-in hybrids may affect the world as we move forward.

Now, Shai has some very nice ideas about getting Israel involved and stop using the oil and all that. But your neighbors right across the border, five miles away, aren't going to like that very much, because they sell oil, oil is their commodity, oil is what makes them go. So my main question is, what do you do about the oil companies? Oil companies have enough profits now to buy the world, and so the \$200 million that you're raising isn't going to do

much. So the question is, shouldn't we be considering the entire world, including the oil companies, including the coal companies, in our policies to move forward? That's the first question.

I think that's an extremely important question, because if we don't make the oil companies our friends, they will be our enemies, and that's worse. And, you know, I'm a technologist, and somehow or another I'm getting into geopolitics, but nevertheless, in order to make this kind of technology move forward, we have to consider that.

The second thing is, the use of, or the shift of oil into the use of electricity I think should be starting right from the starting gate, including renewable energy. Renewable energy and V2H, as mentioned by PG&E, all those things must occur simultaneously with the introduction of the car. And this business of waiting five years or ten years into the future, we can't do that. I think, this is a statement and not a question, I think the panel - I would like to hear the panel consider how we would introduce all these technologies simultaneously so we can get this thing moving faster than later.

MR. VAITHEESWARAN: Very good; thank you, Professor Frank, of course, a godfather of plug-in hybrids.

And, of course, he has worked for many decades on this technology. And I know from having spoken with him over the years and visited with him, that he has fought many bitter battles, difficult battles with car companies and oil companies.

I wonder - let me turn to my panelists. Based on that experience, he asked sort of two interrelated questions, one is, what about the power of oil companies and other folks who have a strong interest in the status quo, and a related sort of solution he offers, rather than incrementalism, to go for a big bang, that you need to do multiple things at once.

We did see sort of big banks with cellular telephony, with PC's in some ways, how they challenge the main frame paradigm. Does it work when we talk about energy automotive infrastructure? Yes, go ahead.

MR. LOVAAS: Well, I think, unfortunately, you have, with the oil industry, your wonderful work, by the way, is about these two industries and how they're headed to a split, right, a divorce. The auto industry is being pushed by prices and new fuel economy standards to turn out more efficient products and to turn to hybrid electric vehicles, et cetera, et cetera. Unfortunately, the prices

that we've seen recently seem to be having an opposite effect on the oil industry. They're buying back stock, they're turning to traditional exploration production activities, turning away, in some cases, from renewable alternatives, and it kind of makes sense.

If you're a shareholder or if you run one of these companies, and you're getting such an obscene amount per unit of your product, then there's not much incentive to change your way of doing business.

And this is why, you know, I know we're going to talk about federal policy on some later panel, but for us, the solution is to put a price on carbon, put a cap and trade system in place, put coal under that, put the fuels industry upstream under a cap, and push that cap down over time, and require the oil industry to be part of the solution as opposed to what they're entrenching themselves into now, which is becoming a bigger part of the problem, unlike the auto industry.

MR. VAITHEESWARAN: So a public policy as a way of forcing a reluctant industry along in the right direction is what you suggest? Shai, you're in, you know, the business end of this business; have you found

obstructionism, have you found it difficult, and how would you pick up on Professor Frank's comment?

MR. AGASSI: First, on Professor Frank's comments, and then the first question.

MR. VAITHEESWARAN: Yes, of course. We haven't forgotten the earlier question.

MR. AGASSI: Unless somebody else wants to answer about Project Better Place. First of all, as usual, Professor Frank's on the money on this thing. Interestingly enough, our largest investor in Israel is Israel Corporation, they own the refineries in Israel. Israel refineries are effectively big oil in Israel, so they import all the oil into Israel, they refine them, they send them to all the gas stations.

Our investor and partner in Denmark is called DONG, Danish Oil and Natural Gas. O stand for oil in that case. And it's interesting that these guys get it first. Because when they look at the equation, they look at the math, if the economics are beyond what we see, they look at the battery, divided by miles, add the electricity, the clean electricity, they get to a price that is roughly in the six to eight cents a mile, and say if you can do six to eight cents a mile, I'm never going to get there with my

oil, so I'd rather move into your business. We're seeing it in all the global oil companies, they're running towards the end of their known reserves, and they're saying, I need to be in business of supplying transportation energy, if that's the next thing, if that's what's beyond petroleum, maybe that's where I need to be.

So we're starting to see a lot of interest at that level, obviously different in the case of national oil companies, but it's coming in there. There's interest also on the generation side. Just a small anecdote, in Israel we said we only want to use clean electrons, so we want to put in, even though it's hard to measure an electron on the grid, but we said we want to add to the grid a clean generation, the same amount as the cars that we're putting in. So for every car, we'd put 1.2 kilowatt solar generation in Israel.

MR. VAITHEESWARAN: Making your cars sort of energy neutral or carbon neutral.

MR. AGASSI: Build a virtual oil field.

MR. VAITHEESWARAN: Right.

MR. AGASSI: Okay. We Tivo it, we sell it in the peak hours to the grid, we buy it back from the grid. But, by and large, we put the same number of electrons as we

use. We went to the Infrastructure Ministry and we said, you know, we need to put an area here of solar because it's a big area, it's not too big, but it's - I said, okay, what if there is oil in there to supply all the cars in Israel, and we want to dig in, and they said, but there is no oil, I said, yeah, but let's say there is, and they said, well, if you can prove it, we can let you build, and we basically said, let's build a solar plant right here, and that - let's put it before the cars come in so we have full coverage.

MR. VAITHEESWARAN: Right.

MR. AGASSI: On the case of New York, I think one of the things you have to remember is that most of the time you will drive and fill and not swap. In the swap station, basically all you need is the number of batteries to cover for practically 30 minutes worth of swaps, because 30 minutes later, the battery that you put out 30 minutes ago is already full, and you put it back into the next car.

So we always think of who fills up the gas station with gasoline. In this case, the electrons keep on coming, the grid knows that it's sending electrons. It's just the last ten inches that you pour in with a mechanical device. Everything else comes in through the grid.

MR. VAITHEESWARAN: Dave, a last quick point before we wrap up our session.

MR. VIEAU: Just a quick point on the issue about the oil company. I think, from a technologist perspective in looking at technology adoption over the last 35 - 40 years of my career, we can't sit there and say we're going to depend on the government making this happen, although I mean I hope that the government does take the initiative and does step up, and we looked at it and said, that's not going to do it.

And we certainly are not living in fear of the oil companies and the position that they've got. Our position has been, if we can drive cost out of the solution, if we can make the economics of it work, then fundamentally the batteries last for ten years, and the cost per unit of energy stored gets a reasonable space.

And we have a line of sight to that as an industry, not just as a company, but there's a line of sight to that point. Now, we're void by the fact that oil is at \$130 a barrel. Unless we're talking \$20, we probably wouldn't be having this conversation here today, frankly. But the fact that it's there and it's not likely to go back, I think we're heading in the right track in that

regard. And the other thing I want to say is that I think Shai is on the right track with his thinking about this stuff, and I'm hoping what he does, he's able to change MPG to DPM, which is dollars per month.

MR. VAITHEESWARAN: That's a great note to end on. We have run out of time. My great apologies to the people standing there. I think we have - the real lesson, to quote Edwin Land, the Founder of Polaroid, sometimes coming up with a new idea means stop having an old idea. We've certainly seen a lot of that from our panel today. Let me bring back Dan Reicher again, he's going to tell us about what will happen during the break.

MR. REICHER: Thank you, Vijay. What a great line, not just the juice, but the jalopy, I love it. Thank you to our panelists. Chelsea, I love it, as well. We are the grout between the tiles, that's a new one. And thank you to our speakers, Peter Darbee, thank you, Jim Woolsey. This has been a great set of talks, punctuated by some wonderful YouTube videos and this great webcast. We now have a real treat, and that is three technology talks out here in the lobby. You'll get to hear from some real engineers talking about their cars and their excitement about those cars. Alec Proudfoot and Rolf Schreiber of

Google will give you an overview of a car in our fleet, the Google fleet, this is a plug-in Prius that was converted by A123, and they'll also talk about our broader recharged initiative.

Will Kempton, a real leader in this industry from the University of Delaware, will give you a live demonstration of vehicle to grid. He will show you how electricity can, indeed, go from a car back to the grid. And we're confident, Will, that that will actually work here today. And Diarmuid O'Connell from Tesla will talk about the all electric Tesla sports cars.

These talks are going to start in ten minutes out in the lobby. The break will go until 3:45 rather than 3:30. I only want to add one more thing, which is that we have a number of cars here for people to see. Upstairs in the hotel, in the front of the hotel, you'll see a GM Volt, we have our Google Recharge It car here, we have an Ebox, we have a Toyota Prius plug-in demo, we have a Tesla, as you've already heard, and last, but certainly not least, we have the Zero X electric motorcycle. Enjoy, and see you at 3:45. Thank you very much.