

# Power Shift: The End of Gasoline Cars?

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Announcer: This is Climate One, changing the conversation about energy, economy and the environment.

On today's program - flipping the switch on America's road trip.

Caroline Choi: I mean, once you get into an electrical vehicle and it's smooth and it's quiet and it's fast, you don't want to actually go back into a gasoline vehicle.

Announcer: The future of the planet depends on ending our fossil fuel addiction. And it is happening - sales of electric vehicles are increasing, and self-driving cars are right around the corner. But making a successful transition to plug-ins means getting everybody on board.

Andreas Klugescheid: This is not about finger-pointing. You know, the customer needs to be integrated, the regulator, the policymaker, the industry and also the energy colleagues let it be utilities or let it be fossil.

Announcer: Power shift: The end of gasoline cars? Up next on Climate One.

## PROGRAM PART 1

Announcer: Is the age of the gas-guzzler coming to an end?

Welcome to Climate One - changing the conversation about America's energy, economy and environment. Climate One conversations - with oil companies and environmentalists, Republicans and Democrats - are recorded before a live audience, and hosted by Greg Dalton.

After more than a century of ruling the roads, oil is starting to lose its dominance over the auto industry. More and more automakers are introducing electric models, and according to one report, sales of electric cars will surpass those of regular cars within twenty-five years.

On today's program we'll explore the future of the cars we love, the impact of robotic and electric vehicles, and the changing nature of how we get around town.

Our guests represent the electric power industry, fossil fuel producers and a leading automaker that has already made the leap into electric cars.

Caroline Choi is Senior Vice President of Regulatory Affairs at Southern California Edison. Cathy Reheis-Boyd is President of the Western States Petroleum Association, and Andreas Klugescheid is Head of External Affairs for the BMW Group.

Now, our conversation about the future of personal mobility. Here's Greg Dalton.

Greg Dalton: Cathy Reheis-Boyd, let's start with China. Fortune reported recently that China has a timetable for ending production and sale of cars running on fossil fuels the next couple of decades. That could reshape the global auto industry. How do you think that's gonna shake out?

Catherine Reheis-Boyd: Thank you Greg and thank you for having us all here at the Commonwealth Club. So when we think about this issue as the oil and gas industry, we really wanna understand how these conversations impact some really important things. Because I think it will drive sort of a shared vision that we have for the sustainable energy future if you might in this kind of low carbon economy. And one of the things we ask ourselves is what is the type of energy mix that will give us the most affordable energy to the most people. What is the type of energy mix that will deliver the best air quality improvements or climate change reductions of greenhouse gases. What are the best energy mix that will really talk about the economic side of the equation for upward mobility of people who certainly work in our industry and many who engage obviously in the issue of transportation fuels. And then lastly how do those three things mix together as we really plan for the future. How do they interact with one another, what is the right combination.

I was speaking at the VerdeXchange and one of the issues was natural gas, and the only comment I made relative to your question Greg is, you know, we're in each other swimlanes now. I know Caroline, I know Andreas we've interacted for many, many years. In the past, we did transportation fuels. Edison did electricity. Autos kind of mixed with the two of us so how we're gonna have a car and a fuel that like works together. And so now, we're all over each other's swimlanes. You know, I have companies who invest in electric charging stations. I have companies who are trying to make the cleanest biodiesel or renewable diesel or renewable natural gas. I have companies who are trying to make, you know, the best low carbon ethanol for liquid fuels. So it's just we use electricity, we produce electricity because we provide natural gas. We're all over each other's swimlanes. And I personally think that's exciting. I think that's gonna deliver really the best answer to our shared vision of where we all go.

Greg Dalton: Yeah, entrance, electricity coming into oil, oil and electricity mixing in ways they didn't in the past. But on China saying they want to end the age of gasoline cars. China is, you know, certainly rising in the global economy in terms of auto industry, manufacturing, and they have the ability to do things little more simply and cleanly than the U.S. Federal government does. So when China says they want to end the age of oil, what does that mean for oil companies?

Catherine Reheis-Boyd: Well, put it in context to California's aggressive environmental leadership in this area. Certainly the state of California has made it very clear on what their goals are for electric vehicles and for the transition. But when you step back and say okay what does that actually mean to all of us in sort of an inclusive conversation about this. We've got 26 million vehicles, internal combustion engines, in the state of California. We have 340,000 electric vehicles. I could say the last time I spoke here we had 200,000 electric vehicles. So electric vehicle penetration is increasing and that's, you know, that mix in that conversation is exciting.

But in the context of how long, and to China making that statement, when you put it in the context of like a place like California, we're the third largest consumer of transportation fuels in the world as a state. And the only two that are in front of us is China and the United States of America. So the challenge of what goes behind that statement from China is huge when you just bring it back and

put it in the context of California, and what that's gonna look like and the time of the transition and the conversation about what that really means.

Greg Dalton: Andreas Klugescheid, with BMW when you look at China making a statement like that, also Britain, U.K., India and France have done similar things, do you say, oh those are politicians making promises they won't be around to keep, or does that make you sit up and think oh something's going on?

Andreas Klugescheid: Well, in case of China I'm not even sure if they're actually out there long enough to see the fulfillment of whatever plans they have for the next decades to come because they tend to stay a little bit longer, China's politicians. But anyway, you know, and car business being a global business you cannot ignore nor can you just don't care about what politicians actually do and say. It is framing to a larger degree and of a larger degree our products and with that our strategies. So in other words, yes we are aware obviously of what the politicians say and then what plans they have, but for the time being I share Cathy's view that the internal combustion engine and with that to some degree also the fossil fuel portion of the fuel equation is going to be out there for a long while. And the question is how to, you know, how to shape the transformation to a decarbonized transportation system in parallel. So you will have to do both. And we do both actually, you know, we are for example, in Europe, by far the market leader in selling electrified vehicles with BMW. Nobody is selling more electrified vehicles than we do. But on the other hand, if you look into the numbers we are probably selling around 2-1/2 million cars per year roughly.

And, you know, our next target for 2019 is to do around 140,000 electrics so that is still a smaller portion by far actually a smaller portion compared to the internal combustion engine car. And what we see is yes there are more cars coming to the roads and it's actually accelerating rapidly when it comes to electric vehicles. But there is still the task to make conventional cars more and more efficient and that also absorbs obviously money, investments and energy.

Greg Dalton: Caroline Choi, we had on this stage the mayors of Houston and Miami who suffered tremendous pain in their cities and talking about a faster transition away from fossil fuels because they're paying the very real price. Tens of billions of dollars of storms that were amplified, not caused by, and we all saw the devastation that Harvey and Irma caused. So I think you all agree on the direction. Let's talk about the pace. Is this happening fast enough to decarbonize the transportation sector? The scientists would say it's gotta happen faster.

Caroline Choi: Yeah, I think that's true and we certainly agree that it has to happen. We have very ambitious goals here in California, right, so the 2030 carbon goal to get the 40% below 1999 levels by 2030. The pathway that we put forward in October talks about seven million electric vehicles in California by that date. So 12 years to get to seven million, when we're at 340,000. So it's a very ambitious climb to get to that number. The governor just put out five million, you know, in his state to state, an executive order. And that only represents about 24% of passenger vehicles at that time, projected at that time. So still a lot of headroom in the internal combustion engine space even with seven million vehicles in California at that time.

So a lot of room to go but I think we have to get started and there has to be more activity and momentum behind getting there. And I think it is doable we talked about this, you know, in the backroom there about how quickly the internal combustion engine took over horse-drawn carriages. And so I think with more models coming, with affordability, the pricing coming down to a degree that more people can get into those cars, more used vehicles in the marketplace for people to try them out and test, awareness growing and then the accessibility of charging increasing with various programs, I think we'll see adoption hopefully leaping forward.

Greg Dalton: Well tell us about, you went to I think it's a car show or convention recently. You went around and you talked to different carmakers, Caroline Choi. And General Motors was talking about having electric options for all their models by 2022. All the others were saying that by 2025 which is a curious timeframe. So tell us about that experience about the different aggression you see on going electric.

Caroline Choi: Yeah, well I think that timing was somewhat interesting only in that the federal government is looking right now at the standards that it has in place for the model 2022 to '25 vehicles. The fleet and the emission standards that are appropriate for those vehicles and in time to give the automakers time to plan and design and build those cars. So it was just interesting that GM was on the early side of that timeframe and all the other automakers seemed to be on the later side of that timeframe. But I do think it will be happening and what I do see is the acceleration of announcements by automakers to move into more electrified vehicles, to either transition to have an electrified version of every passenger vehicle that they sell or a significant portion of their offering to have an electrified version which I think is great.

Greg Dalton: Andreas Klugescheid, tell us about, there's so much hype and excitement and a little bit of fear about robotic, autonomous. We're not even sure what labels for these cars. Lots of acronyms out there. We see them daily here in San Francisco, Pittsburgh and other cities. What's the connection between robotic cars and electrification? Do they have to go hand-in-hand, what's the relationship?

Andreas Klugescheid: Well, you know, we put what will happen in the next few years in an acronym that is called ACES and that stands for Autonomous Connected Electrified and Shared. So these four elements will be an integral part of what our future products will encompass. And when you think about autonomous driving everybody assumes that this will be to a large degree electrified. Because, you know, when you think about the potential of a very convenient mobility, then with that goes the necessity to decarbonize that mobility to a larger degree. And, you know, what we also see to some degree is a parallel development. The autonomous vehicle and the electric vehicle will, you know, see larger portions of market penetrations probably around the mid 20s, so 2025 you mentioned that. And so it's a no-brainer to some degree to think about these developments in combination.

Greg Dalton: Though a lot of the cars so far, a lot of them, the pilots out there are still running around on gasoline. Cathy Reheis-Boyd, how do you see that, that the robots out there and the auto companies are saying, well it makes more sense to have them be electric for many reasons. How does that sit for you in terms of looking at the future demand for oil?

Catherine Reheis-Boyd: I'm still trying to get my mind around a car without a driver. But I would say and I just want to mention too on the liquid fuel side. Because as Andreas said, we will have the internal combustion engine for quite some time. And not to say there's so much we can do on the liquid fuel side. And I reflect back to where we've come, you know, in many conversations we've had Greg, where we used to have leaded gasoline, right. We took that out. We used to have -- I remember the days when EPA launched the ultra low sulfur diesel. Where, you know, we went throughout the state and we held the hanky at the backend of the bus just, you know, to show that, you know, wow this is such a cleaner technology.

So now we're in the space of what do you do with liquid fuels to make them less carbon intensive? And on the diesel side, there's a lot that can be done on biodiesel and renewable. On the gasoline side it's a little tougher because many people probably have a comprehension of what's known as the blend wall. You can only put 10% of ethanol into gasoline. So the type of ethanol, whether it's corn or sugarcane or what have you is really important because you can't go above 10. So it's a harder

nut to crack as we're in this transition period of what does that look like.

Greg Dalton: Let me ask you about that because there is a law in California and other states, the low carbon fuel standard, which says you've got to reduce the carbon intensity of fuels 10% and figure out however you want to do it. And oil companies have litigated against that law at a 10% reduction. Meanwhile, Andreas and BMW and other carmakers have committed to hundred percent increase in efficiency of the vehicles. They make over a period of 15 years or so. So if auto companies can do a hundred, why is it so hard for oil to do 10?

Catherine Reheis-Boyd: And part of it, you know, and we're very supportive of the CAFE standards, I mean, as an industry. We understand efficiencies of cars are a very good thing for us, one of the most cost effective thing that can be done. But on the gasoline side, it's a technology issue. So even though we've made strides on the gasoline side with ethanol, we all hoped that cellulosic ethanol would be the big breakthrough because it's a lower carbon intensity, nobody's been able to quite crack that nut yet. And so it makes gasoline a little more challenging when you have this 10%. Why is there a 10% blend wall? As Andreas could talk about, if you go above that there's some damage to the engine. So you can't, the relationship of that in an engine you can't really have any more than 10%. And so is the type in a low carbon fuel standard to your question Greg, it's the type of ethanol you put in there. So when you think about well why don't we just put sugarcane ethanol in all of it. Well, then it's --

Greg Dalton: That's what happens in Brazil, right.

Catherine Reheis-Boyd: But the volume side is an interesting equation. Is there enough sugarcane ethanol to blend in every gallon of gasoline in the state of California when it's 2 million gallons of gasoline and diesel every hour of every day. That's a lot of ship transportation of corn-based ethanol and emissions associated with it.

Greg Dalton: So let's ask Andreas. I thought there's E85 that, you know, \$100 cars can be retrofitted or changed so the engines can run on high percentages of biofuels, is that correct Andreas?

Andreas Klugescheid: Well, you know, the typical answer of a car manufacturer to that is it depends, right. And I'm probably not engineer enough to actually dig into the details of that conversation. But what I can tell you and I think that is important bit here, we need to think about a variety of solutions when it comes to that point. And Cathy knows very well that we at BMW we are pretty supportive of the low carbon fuel standard because we think it is necessary that, you know, all stakeholders in that equation do their bits in order to come to the ultimate goal of decarbonization.

But as we car manufacturers can actually vouch for it, it's not only the low carbon fuel standard. It's also about hydrogen as a fuel that again and, you know, hydrogen not being a fuel technically but an energy carrier. So it depends on how you do that, right? It is about electricity and again here, you know, the question of what is behind the plaque really, you know, the upstream is a decisive question and so on and so on. And, you know, it means that car manufacturers currently are putting their money on several bets, you know, it's a period of time that we witness right now where we actually have to distribute our investments to many, many technologies. And on the other hand, the good news is really that many options are out there to actually contribute to that goal. And we need to take whatever we can get in order to bring the carbon emissions down.

Announcer: You're listening to a Climate One conversation about making the switch to electric cars. Coming up, what becomes of Big Oil?

Catherine Reheis-Boyd: I think it's very important in any conversation about the energy mix that we are inclusive in that conversation. And I think we will be in an important part of that conversation not only in the past but going forward.

Announcer: That's up next, when Climate One continues.

## PROGRAM PART 2

Announcer: We continue now with Climate One. Greg Dalton is talking about the end of oil and the electrification of transportation. His guests are Andreas Klugescheid of BMW, Catherine Reheis-Boyd of the Western States Petroleum Association, and Caroline Choi, of Southern California Edison.

Greg Dalton: Caroline Choi, some people think that, concerned that when they buy an electric car, depending on where they live in the world and in the United States it runs on coal and coal is dirty. So tell us about coal connection in electric cars because where you live matters a lot and how clean your electric car is gonna be.

Caroline Choi: It does. It does matter. But it was interesting I just was at BNEF, their mobility summit last week and they were talking about this exact subject and then also what they've done shows that it doesn't matter even if it's coal power; that you do still see a cleaner vehicle from a non-emission vehicle because on the coal side you have controls to try and minimize the emissions coming out of the coal fleet. In California, that's not as much of an issue, we don't have coal in our generation mix and neither does PG&E and a number of other utilities and coal is getting faded out of the California generation mix. So I do think it does matter as Andreas said what is behind the plug and what is powering electricity.

Here in California we already have a 50% renewable portfolio standard that I think we're going to easily achieve and we do anticipate legislation that is going to increase that standard. So the grid is going to get increasingly cleaner and cleaner and so we should leverage that grid, that's ubiquitous everywhere for more aspects with economy like vehicles. So plugging in should be fairly easy because the grid is there. We just have to add charging stations in more places that people have that availability whether they're in an apartment building or a condo or a home or a business, that charging is available for people so they can feel comfortable getting into an electric vehicle and not feeling that they may be stranded without access to a plug.

Catherine Reheis-Boyd: Greg, I think one of the other issues just to touch on is the role the consumer plays in all of this because as we're talking about what that right energy mix, one of the things I talked about at the beginning was the economic side of that equation. Because the policies that we are adopting in California, you know, certainly have an impact on the cost of a gallon of gasoline or a gallon of diesel, whether it's the, you know, the infrastructure bill which, you know, was 12 cents a gallon. Whether it's fuels under the cap and trade program. The energy commission's estimate is about 10 cents a gallon. The low carbon fuel standards another, I don't know, maybe 5 cents a gallon. So as these policies get adopted, we also have to keep in mind what impact does that have on communities and in some cases disadvantaged communities where their proportional income is difficult to invest in transportation fuels. Meritorious as they are the cost side has to be in that equation also.

Greg Dalton: John Hofmeister is the former president of Shell Oil. He had something surprising to say recently when he was at Climate One about fossil fuel reserves that are on the books and reflected in the stock price of major oil companies.

[Start Clip]

John Hofmeister: I don't think they'll be burned. You know, there's too much going on.

Greg Dalton: What happens to the share prices of some of those companies that are --

John Hofmeister: They'll be flat. They'll be flat to down. But these companies won't go out of business. They'll change, they'll adapt. They're full of smart people. There are more PhDs, more scientists in these companies working on -- even Exxon Mobil, formidable competitor of my former company, is putting half a billion dollars into biofuel algae research.

Greg Dalton: While all the time they were denying climate science, they were looking at ways they could benefit from a warming world by looking into the Arctic.

[End Clip]

[Laughter]

Greg Dalton: I slipped that in there. But he agreed, you saw him. So there's the Exxon piece of that, what Exxon knew. But the first piece that, Cathy Reheis-Boyd, was that's the former head of a major oil company saying that the assets already on the books reflected in the stock price of major oil companies will not be burned. Their stock prices will be flat to down.

Catherine Reheis-Boyd: First one of things that John said and I know John well, one of things that I really liked he said was the creativeness and the innovation of this industry. I've been with the industry for close to 30 years now and they are some of the most creative, innovative people I've ever seen. The amount of research by these companies going into not only their liquid fuel side, but the future of alternative vision and renewables is huge. It's actually more than the federal government or any other private entity. So they are thinking about the future and what that means to them as a company. And I can tell you as a trade association they're very different. They all have different views of how they look at that.

Greg Dalton: But they are also trying to slow down that future with their lobbyists in Washington and Sacramento.

Catherine Reheis-Boyd: Well, I mean, I think it's very important in any conversation about the energy mix that we are inclusive in that conversation. And I think we will be in an important part of that conversation not only in the past but going forward.

I mean, we were very supportive of the cap and trade extension. We were very involved in those conversations. So there is a desire to look at a shared vision for our sustainable energy future together and I'm very proud that they're at the table in that conversation. And I think they want to be and they've invested a lot of time and energy in it.

Greg Dalton: There's a lot of technology and talent in those companies, the question of how it's used.

Caroline Choi: I think just to build on that. I think it's that transition to that clean energy economy, right, so planning for that, giving the companies the time to think about how they can stay within energy business but in a different way and train their employees to do different things than they have in the past. The utility industries had to do that moving away from coal to natural gas to renewables and it's a completely different mix of employees that you may need to run those types of facilities, giving them adequate time to train employees and have other employees that are gonna

retire. I mean, I think that's what we as a state have been able to do pretty effectively in sending long-term goals and then putting forth a path to try and achieve those.

Greg Dalton: Chief scientist of the Rocky Mountain Institute, Amory Lovins, was here. He described how quickly things can change when it comes to transportation.

[Start Clip]

Amory Lovins: There are two pictures looking down Fifth Avenue in Manhattan. In 1900, you have to look really hard to find the first car. In 1913, you have to look even harder to find what might be the last horse. It is not at all clear that there is any horse left in that picture. Thirteen years to go from first car to last horse. And, of course, the horse and buggy people thought they would have decades to adapt. You'd have to put in gas stations and traffic lights and all this infrastructure to replace their stables and such.

But Henry Ford simply made the model T 62% cheaper in 13 years. Not quite the same period. And then it was all over when GM and DuPont invented something called car loans which were used in three quarters of the purchases that made U.S. household car ownership go from 8% to 80% in 10 years.

[End Clip]

Greg Dalton: That's Amory Lovins from the Rocky Mountain Institute. Andreas Klugescheid, with BMW, you know, smaller population, things are moving very fast these days. What do you think about the potential for a really quick transformation, quicker than even big smart companies like BMW might anticipate?

Andreas Klugescheid: Well, you know, if you look into the things that are happening right now and you think about the pace of change that we are already realizing here, you know, so it took us three years to sell the first 100,000 electric vehicles between 2013 and the end of 2016. Last year, we did another 100,000 within one year. And as I mentioned early on in 2018 you will see probably around 140,000 electric and electrified that is plug in hybrids also vehicles from BMW. So, you see, there is an acceleration on that topic. But the truth is also that, you know, it's not only about the car or the vehicle itself, but as you mentioned early on, it's the infrastructure side, and yes, the Amory Lovins was referring to the fact and you are referring to the fact that also for cars, you know, the filling stations, the traffic lights and so on and so on.

But, you know, you need to think, when you think about the electric vehicle you need to also think about the availability of infrastructure, you need to think the customer perspective, that Cathy also mentioned. And so this topic is a little bit more complex than just about what used to be the horse and then became the internal combustion engine car, now being the electric vehicle.

Greg Dalton: So huge systems, hundred years we got a lot invested in these systems. I'm Greg Dalton. We're gonna go to our lightning round, a series of quick questions and quick answers for our guests starting with association. I will mention a person, place or thing and our guests will say the first thing that pops into their head unfiltered regardless of what their mother or teacher might think of that. So first with Andreas Klugescheid, what comes to mind when I say Tesla.

Andreas Klugescheid: Good to have them as competitor.

Greg Dalton: Cathy Reheis-Boyd, EPA Administrator Scott Pruitt.

Catherine Reheis-Boyd: Interesting.



[Laughter]

Greg Dalton: Caroline Choi, beautiful, clean coal.

Caroline Choi: No such thing.

[Laughter]

Greg Dalton: That's from the State of the Union speech. Cathy Reheis-Boyd, California Governor Jerry Brown.

Catherine Reheis-Boyd: Pragmatic.

Greg Dalton: Andreas Klugescheid, VW.

[Laughter]

Greg Dalton: I can't hear, your eyes on radio.

Andreas Klugescheid: Did I say beep?

Greg Dalton: Caroline Choi, peak oil.

Caroline Choi: When's it going to happen?

Greg Dalton: Yeah. True or false. Cathy Reheis-Boyd, burning fossil fuel is a major cause of climate disruption.

Catherine Reheis-Boyd: A contributor.

Greg Dalton: True or false. Andreas Klugescheid, the notion of capturing carbon pollution from smokestacks and cramming it down a hole in the ground is totally bogus.

Andreas Klugescheid: I would say that.

Greg Dalton: Okay. Also for Andreas Klugescheid, diesel cars produce less carbon pollution than gasoline cars.

Andreas Klugescheid: That's true.

Greg Dalton: But they also produce more local pollutants that cause cancer.

Andreas Klugescheid: Not necessarily.

Greg Dalton: It depends on the diesel.

Greg Dalton: Catherine Reheis-Boyd, the last question, well, the last two. When your husband was CEO of the California Air Board, he directed the country's largest air pollution control program run by a state?

Catherine Reheis-Boyd: True.

Greg Dalton: So that means that your marriage is an example of an industry capturing its regulator.

[Laughter]

Catherine Reheis-Boyd: He actually captured my heart but, you know.

Greg Dalton: Oh, good comeback. Her husband is a great guy who did run the Air Board in the state for a long time. Good comeback. That ends our lightning round. Let's give them a round for getting through the gauntlet.

[Applause]

Announcer: You're listening to a conversation about getting around without gasoline. Coming up, the promise of self-driving cars.

Andreas Klugescheid: The potentials that are out there is autonomous driving actually will, to a large degree, bring down the issue of casualties in traffic.

Announcer: That's up next, when Climate One continues.

### PROGRAM PART 3

Announcer: You're listening to Climate One. We're talking about how technology is driving the movement towards cleaner cars and a cleaner planet. Our guests are Catherine Reheis-Boyd of the Western States Petroleum Association, Andreas Klugescheid of BMW, and Caroline Choi, of Southern California Edison.

Here's Greg Dalton.

Greg Dalton: Let's talk about technology. Cathy, you've talked about some breakthrough potential. There's actually something, you know, the possibility that sunlight, we could combine CO2 and water to make, you know, hydrocarbons. So either that or other things. What are some big tech breakthroughs? We can't solve this carbon equation without some big tech breakthrough.

Catherine Reheis-Boyd: Yeah. And I think really recently one of the things I'm very excited about because I very, very look forward to unique partnerships on innovation. And we've used to work a lot with the national labs, we're blessed in the state with national labs.

Greg Dalton: And that's where this innovation is coming out of.

Catherine Reheis-Boyd: And this innovation comes within whether it's Lawrence Berkeley or Lawrence Livermore National Lab, in this case Lawrence Livermore, reached out and started to talk about some new innovations that they are doing as a national lab to capture carbon and get it out of the atmosphere and then put it to some beneficial use. One of the very innovative things they talked about which I don't know much about, I will more this week, is imagine taking carbon out of the atmosphere and turning it into a hydrocarbon.

Greg Dalton: Methane.

Catherine Reheis-Boyd: Methane or ethylene or some other component. That was just something I had never even envisioned. But is that kind of creative thinking that is going on not only in the automakers or the utilities or in our industry, but that place that academia can actually add so much innovation that they're working on that how can we collaborate on those types of things as we go forward.

Greg Dalton: Andreas Klugescheid, how about in making cars, you know the i3 has carbon fiber. Some people would say there's still a lot of room in the internal combustion engine, you know, 100

years ago. Where are the big innovations, the tech breakthroughs that can get to a new auto industry?

Andreas Klugescheid: Well, as I mentioned before, we are witnessing that right now, you know. I was in California in 2008 sitting in a BMW facility in Oxnard when a guy came around and said, you know, I have this lithium-ion battery and I think it could work well in a vehicle, that is 10 years ago. You know, 10 years is 10 years.

But as I mentioned before, we are doing now 140,000 of these cars per year and obviously numbers are rising. So there is a drastic change in the industry happening and with that in the attached industries, if you like, with the utilities and the fossil fuel producers. You know, that has big repercussions and it means also that this transformation is in need to be managed and that refers to the skills of all associates. That means that the infrastructure needs to grow and come up. That means that the customer needs to understand better what potential these technologies have, you know, one of the big issues actually to make the customer more aware is part of our obligations but also part of everybody's obligations. That, you know, electric vehicles are real alternative, right, for their driving needs.

Greg Dalton: Some people would say that, one little dirty secret of the auto industry is that companies make more money on after sales service, et cetera, than actually the margins are quite thin on selling the car, you know, it's the razor and razor blades. You know, you keep coming back and that companies don't make as much money, Andreas Klugescheid, on electric cars so the dealers don't like to sell them, promote them, because you're not gonna come back for an oil change or transmission or spark plugs or all those things that get you to go back. Is that true?

Andreas Klugescheid: Well, first of all I'm happy to report along that a very well-known U.S. NGO did some mystery shopping and BMW turned out to be one of the few companies actually who made a very good impression in that respect, you know, willingness of dealers to actually sell electric vehicles, you know, consulting their customers and so on and so on.

And I can support your statement that for the time being we are actually having very low margins in specifically selling electric vehicles because the technology is still very expensive but, you know, there is no way around it. And I can also assure you that BMW has clearly understood that the future of automobiles is going to be electric. There is no question about it.

Greg Dalton: You know, every electric car means that people are not filling up at the gasoline station. Caroline Choi, are oil companies trying to slow down you taking some of their revenue?

[Laughter]

Caroline Choi: Well, it is not a significant portion of their revenue to date. We hope to take more and more of it.

Catherine Reheis-Boyd: As I said we're in each other's swim lanes.

Caroline Choi: But they're energy companies and we are an electricity company. I think we are working together right now to advance where the state wants to head. But, you know, over time I do, we hope that electricity does become the dominant fuel of vehicles and other parts of the economy. We want more electricity use in buildings and space and water heating. Again, because we're gonna have so much renewable clean electricity powering the grid that you should plug into the grid for so many aspects of your lives to take advantage of that. And so as long as we can maintain the affordability of electricity, which is going to be critical, Cathy is right that energy is an important component of all of our customers' lives. And it's really important that it stays affordable.

A third of our customers are on an income qualified rate. It's very important that the price of electricity stays at a point where they don't have to make choices that are very difficult for them. But we do see that a cleaner grid the way that California is headed is a great opportunity for customers and for Californians.

Catherine Reheis-Boyd: And, I mean, that's why Greg when we were talking in the earlier session. The cost piece of that to what Caroline is saying is an important piece of this conversation because we do have the highest electricity rates, in California it's very high. And so as we look at that transition going forward or that energy mix going forward, the cost side is really important. And when you sort of peel the onion a little bit and you start looking at some of the projections from the Energy Information Administration which is a federal entity of the Department of Energy, they look out into the future and they give us projections of what they see energy.

And they're still projecting in 2040 80% of energy will come from coal, gas and oil. So when we talk about this time frame, it's really important to put that into perspective of, you know, how do we come together on an inclusive shared conversation with that kind of a statistic out there given the infrastructure that we have and the changes that have to be made and the cost that's associated with it and what the consumers bear. So it is as Andreas said, it's a complex conversation that it's great that all of us are in.

Caroline Choi: Well, and while we have some of the highest electricity rates in the country, we have some of the lowest bills because we do live in a place that doesn't need a lot of energy fortunately. We do have a lot of places that don't have air-conditioning and don't use our heating as the coastal communities. We do have more people moving inland and so that is a concern is how do we keep it affordable and have programs that make it affordable including energy efficiency to try and minimize the use of electricity and those homes and buildings as efficient as possible so they can minimize electricity usage.

I do think that transition is important. California has shown that it is possible to move away from fossil fuels. You see it very aggressively in the policy-making space and in the implementation of these policies at the state level. And so if California can show it can be done, the sixth largest economy in the world, it can be done elsewhere too. It has to be done in a thoughtful way, in a way that does allow for that transition to take place so it's not as disruptive as it could be to the states' economies. But it is possible to do it and I think it can be done faster than what EIA is reporting.

Greg Dalton: We're talking about the future of mobility at Climate one. I'm Greg Dalton. My guests are Caroline Choi with Edison International, Cathy Reheis-Boyd with the Western States Petroleum Association, and Andreas Klugescheid with BMW.

Greg Dalton: Let's go to our audience questions, welcome to Climate One.

Male Participant: Okay. I want to ask you about the agony and the ecstasy which are two possible futures that might come about through this. And the agony is that I send my Beemer out to go get pizza in the evening and it goes out, you know, autonomously collects the pizza comes back, and when I want to go to work I sit in the back of my BMW for two hours working my presentation while my car drives me to work and it takes two hours because there's like twice as many cars in the road. But nobody cares how long it takes, right? And when I get back home, we plug in my Beemer right at 5:00 when the sun is going down and the emissions are going up and it charges then. So that's the agony. And the ecstasy is kind of the opposite, is that you have everything shared and the cars charge according to your power forward algorithm. So when it's the least greenhouse gases and stuff like that. You get the picture. So what do you think the probabilities are of this agony thing and the ecstasy thing? And what can we do to shift the needle so it's more on the ecstatic side?

Greg Dalton: I don't know. I would put the pizza fetching in the ecstasy part.

Catherine Reheis-Boyd: That's pretty good to me.

[Laughter]

Andreas Klugescheid: I'd like to take ecstasy actually with all the connotations that it has.

[Laughter]

But anyway, you know, there's truth in both scenarios to some degree. One is and that is a promise to our customers that there will never be a BMW without a steering wheel, okay? So there's always going to be the option for you to drive your Beemer. But that aside, there's certainly, you know, there might be a future when your car actually does the pizza trip. I'm sure that city regulators and many other people will have issues with that, you know, because it means more vehicle miles travelled and more congestion, you know, more space that you need and so on and so on. That is not a political option and it is really upon us here and also working together with universities like UC Davis and others to figure out how that revolution is going to be managed in a way so that it is, you know, somewhat bearable and acceptable.

The potentials that are out there is autonomous driving actually will, to a large degree, may be down to zero and bring down the issue of casualties and traffic. The last time I admit that is two or three years ago I found for the U.S. like 30,000-plus casualties every year, death of people in traffic. In Germany, it's around 2-1/2 to 3000 so it's way lower, you know, we have only a fourth of your population. But still, every single one is obviously one too many, one too much. And hence that is one of the big promises of autonomous driving that is, you know, on the plus side.

And the charging scenario that you described is actually happening already today. I mentioned early on the managed charging that really is, you know, resulting in you can charge when the energy prices are the lowest, you can charge when the carbon footprint of your electricity is the lowest, you can charge whenever you need your car. So more on the ecstatic side but bear in mind that autonomous driving first and foremost is really about saving human lives.

Greg Dalton: Next question. Welcome to Climate One.

Male Participant: Hi. Global oil prices are notoriously difficult to predict and in fact just a few years ago prognosticators who thought we were entering the era of high global oil prices have shown to be very wrong. However, between OPEC dysfunctions, Saudi political ambitions and U.S. fracking coming online at about \$55 to \$65 a barrel, arguably we're entering an era of low global oil prices.

Any commentary on what the global oil price regime might mean for electric vehicle penetration?

Greg Dalton: Caroline Choi, when oil prices go down people go back to their SUVs that they love.

Caroline Choi: They do. It's unfortunate. I do think it takes a lot of effort to get people to switch to an electrical vehicle and one of the things that the state has done most certainly is create a new nonprofit called Veloz. You have a number of automakers, utilities and other companies who are contributing to that to have a statewide marketing education campaign for people to be aware of the fact that there are all these electric vehicles. And once you get into an electrical vehicle, I mean, how many people have an electric vehicle, I mean, once you get into an electrical vehicle and it's smooth and it's quiet and it's fast, I mean, you don't want to actually go back into a gasoline vehicle. So it's just getting that awareness, getting people into those cars, ride and drive those kinds of experiences, to have people make that switch.

But when gas prices are low, it is very difficult. And if there aren't enough options for people who like their SUVs, who need a big car, who have families, you know, trucking stuff around, you've gotta have the models available for those people to switch into the kinds of cars that they currently drive and that meets their needs. Those models are coming. I was at the LA Auto Show last year and every year you see more vehicles, more model types coming out by automakers to meet the demands of customers because they do see that the future is electric and they're bringing models that have electrification as part of their fleets.

Greg Dalton: Let's go to our last question. Welcome.

Female Participant: So I'm gonna go back to the first speaker who talked about the agony and the ecstasy and the ecstasy seems to be this discussion of the transformation and California's lead on that transformation away from fossil fuels. But the agony for me has been one of the things in the news lately that Donald Trump has opened up offshore oil drilling and that seems to be quite a contradiction. I would suggest that if the petroleum industry did not drill in the offshore openings of that, it would be irrelevant. I'm wondering if you can respond to what the lobbyists in regards to the petroleum industry have been involved with and what your position is on that offshore oil drilling.

Catherine Reheis-Boyd: Thank you for the question. And I would say for California and really the Pacific West, you know, Oregon, Washington, California, we're probably under the, I think everyone knows, the most stringent environmental regulations probably in the world. And the only thing I'll ask you in that question to think about is when we have to supply the amount of transportation fuels every day that requires people to move from A to B and cool their homes or turn their lights on, that it takes crude oil to do that and to turn it into those valuable products.

And so it has to come from somewhere to make 38 million, 39 million people in California able to move tomorrow or move goods and services out of the ports; that still has to happen and if it's not gonna be offshore and it's not going to be in our own backyard and it's not gonna be crude by rail, it means we're gonna transport it in on marine tankers from parts of the world that don't particularly appreciate our desire to be energy independent.

Greg Dalton: We have to wrap it up. I'm gonna ask each guest, you know, your vision or hope for the future. What gives you hope Andreas that we're gonna meet this mathematical challenge to make this major transformation in time before there's more Houstons and Miamis.

Andreas Klugescheid: Well, you know what gives me hope and to some degree also ecstasy is really that there's so much potential in there, you know, I'll stick to that idea of convergence of the energy transition of the transport system transitions. This is really where the fun starts where there are new business cases. And new business cases mean that, you know, we will have a rapid development in the right direction, but we need to do it together. That is super important. This is not about finger-pointing. You know, the customer needs to be integrated, the regulator, the policymaker, the industry and also the energy colleagues let it be utilities or let it be fossil.

Greg Dalton: Caroline Choi, your pep ending for how are we gonna get it done.

Caroline Choi: You know, I think this transformation is already underway. An innovation that's coming, that's out there and that's coming is really fantastic. So I'm not worried about that we can't do it, it's just a matter of getting more people to know about the options and adopt those vehicles. And the financial innovation that's happening, the technological innovation that's happening both at private companies as well as in academia and in industry, it's really fascinating. I do agree with Andreas it's working together because the policies really have to come together and be integrated both at the state and local level, and at the federal level if possible. But California can do it on its

own in many, many ways and it's doing that, it's demonstrating that. And so it's just getting out there all you people with electric vehicles and preaching to the choir of getting more people in those vehicles because it's really a tremendous opportunity. I don't think we should let it go by.

Greg Dalton: So Cathy Boyd, tells us how we're gonna get it done and how your members are gonna make tons of money on clean energy.

[Laughter]

Catherine Reheis-Boyd: I really think it's a transition of our mindset because I do believe that if we answer those core questions together we will get to the right shared energy future. And that is, affordable reliable energy to the most people possible. It is making sure we meet our environmental goals whether they're air quality or climate change. And it is the economic side of that equation so there's upward mobility for communities and people that rely on this energy mix. And then in the end that we've all talked together about how are we gonna balance those so we can go forward. So I think it's a transition of all of our mindsets together.

Announcer: You've been listening to a Climate One conversation on the future of the automobile, with Greg Dalton.

Greg's guests were Caroline Choi, Senior Vice President of Regulatory Affairs at Southern California Edison, Cathy Reheis-Boyd, President of the Western States Petroleum Association, and Andreas Klugescheid, Head of External Affairs for the BMW Group.

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Greg Dalton: Climate One is a special project of The Commonwealth Club of California. Kelli Pennington directs our audience engagement. Carlos Manuel and Tyler Reed are the producers. The audio engineer is Mark Kirschner. Anny Celsi and Devon Strolovitch edit the show. The Commonwealth Club CEO is Dr. Gloria Duffy.

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