

Nicholas Stern and Steve Westly

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Greg Dalton: This is Climate One and I'm Greg Dalton. The numbers for moving the economy from fossil fuels are big, really big. It'll cost \$44 trillion to get the carbon out of the US economy, according to federal experts. But spread that out over many years, the tab may not be as high as it sounds. And Citibank says that failing to act on climate disruption could hit companies and governments with 44 trillion in losses, give or take over the next 25 years. Economic stakes are huge and on the show today, we'll explore the downside and upside of getting off fossil fuels and plugging into the sun, wind and other sources of renewable energy.

Our guests are leading economists and a Silicon Valley investor. Lord Nicholas Stern is a former chief economist of the World Bank and one of the foremost global experts on moving the economy from fossil fuels to cleaner energy. When world leaders signed the historic Paris climate accord last year, Lord Stern was cheering in the front row right alongside Al Gore. Steve Westly leads a venture capital firm that made early investments in Tesla, where he served on the board and the biofuel company Anyris. He currently holds positions in Good Eggs, Planet Labs, Revolution Foods and other companies pursuing more sustainable capitalism. Steve Westly was an early executive at eBay and is a former controller of the state of California. Please welcome them to Climate One.

[Applause]

Welcome both of you. Nick Stern, take us back to Paris. You were there, had a ringside seat at a one of the most historic agreements ever where countries came together, companies were present. What was - just give us a peek inside Paris how it came together.

Nicholas Stern: Well, it felt like being in the ring as well as having a ringside seat.

This was a few years in the making. The diplomacy from France was very good. The preparation the year before in COP 20 in Lima was very good. But it was founded on a deepening understanding of actually the issue we're going to discuss today. Which is the attraction of moving to the low carbon economy. The risks I think had been gradually understood over time. Just how devastating it could be to move to three or four degrees, I'm talking about centigrade now.

Greg Dalton: Warming as opposed to industrial times.

Nicholas Stern: Yeah, that's average global surface temperature relative to placing half 19th century. It is okay to use centigrade on NPR?

[Laughter]

Greg Dalton: Americans have a little difficulty but they'll deal with it.

Nicholas Stern: Anyway, what I'm saying is that the people had deepened their understanding with the scientists and others and public radio helping people understand the huge existential risks from climate change. But one of the change they had at Paris was that people starts to understand what the transition looked like. Cities where you can move, cities where you can breathe; ecosystems which have much greater chance of survival and doing much more for you. The discoveries and inventiveness and creativity and innovation was already clear to many people. Examples of cities changing the way they're doing things, business changing the way they're doing things and doing very well as a result of it.

So for me the key change was the understanding of the real attractiveness of the alternative route. The investments that you make you shouldn't see as "costs" you should see them as investments with very powerful returns. Not only in reducing the terrible risks of climate change is fundamental but also in terms of the way we live and building a much more attractive and more productive way of living.

Greg Dalton: Steve Westly, as an investor in Silicon Valley, how did you look at the Paris agreement as a significant milestone in the move toward clean energy? Was it just the politicians talking or was it meaningful?

Steve Westly: Well, you know, it's clearly a big step. And it's a big step because you had leaders from literally countries in every corner of the planet all coming together and saying this is the new future we're moving forward into. What's exciting to me and you still understand there's a confluence of two things going on. First, there's a global political movement toward sustainable energy combined with really for the first time new generations of breakthroughs in clean technology. And it's happening across the board, whether it's low-cost solar, affordable electric cars, low-cost power storage which is really been the missing link of power storage for solar and wind, to affordable LED lamps. We're heading into a sustainable world. And if you think about it we're that close to having a world where you may not be having to pay a penny for electricity at home if you buy low-cost solar that's now at parity with carbon fuels. You may not even be paying a penny for gas ever again. And when you're not paying for electricity or gas, wow, that is a whole new world. And we're working on inventing a large part of it right here in California.

Greg Dalton: Steve, tell us about when you invested in Tesla there were 27 employees and what your wife thought about that investment.

Steve Westly: Well, yeah, I came over and told my wife, you know, I've just invested in this new company, there's this guy Elon Musk and 27 guys in a warehouse in San Carlos and we're going to revolutionize the global auto industry. And she said "You've lost your mind, go get your money back."

In the early days, it was not at all clear what would happen. But the fact is and our first car frankly wasn't so hot, but by the time we got to the model S, people said wow. It was car of the year, safest car ever made, best-performing car, highest reviews from Consumer Reports, it showed people you can make an electric car that's transformative but the narrative is always move forward by the naysayers. Okay, okay, it's a great car but it's a plaything for the rich, plaything for the rich.

So fast forward 24 months. We know what the world's been waiting for. And the narrative is people won't buy electric cars. Here's some easy numbers for you. Roughly 400,000 electric cars in the

world, 200,000 half of them in the United States 100,000 half of those here in California, 400,000 total. What the world's been waiting for is a low-cost electric car; read \$30,000 or less that goes 200 miles to deal with range anxiety. Tesla announced that car two weeks ago. Guess what; they've taken orders for 400,000 in the last 10 days. So doubling the entire world total in orders in two weeks. So this narrative, that people don't like electric cars you can't predict the future by looking backward. You can only predict the future by looking forward. And again I'm kind of excited because we're inventing a lot of it here.

Greg Dalton: Invented in California. Nick Stern, you spend some time in China at the highest levels of government. And tell us what you see in terms of EV adoption in China because the story has been if the middle class in China gets a family car, they fry the earth.

Nicholas Stern: Yeah, the pace has been changing. I've been working in China nearly 30 years, India for more than 40. So let me give you electric car reports back from both those places.

I was at the China Development Forum, which is a very big gathering of senior China economic leaders and the heads of big companies of the world. Whether they be Ford Motor Company or HSBC or Bombardier or whatever, DuPont. And there only the chairs and CEO's go. So at the end, we go and meet the, I'm not one of those but they have a dozen or so economists come into the cabaret and try to be interesting. And the - so we all go and meet, big meeting with the premier at the end of that and the head of Ford Motor Company set out activities in China what are we doing and Li Keqiang, prime minister, listens carefully. And he said, you know the sedans, the cars essentially that you predominantly make, have five or ten years in China and after that it's the electric car. And we hope you really participate strongly in this but I should mention that there are three or four Chinese firms that are moving rather quickly in this direction. And it was very telling and that's a big signal. You know, that's Prime Minister of China to head of the Ford Motor Company. Now we all know that Ford actually are developing electric cars and maybe they'll rise to that challenge. Piyush Goyal, the [Indian] minister - he's got a very, very interesting title of power, coal and renewable energy. So that's bundled in one sentence. And he said, in the signing ceremony for the Paris agreement on April 22nd that day I was speaking there along with Al Gore as you mentioned. We tend to end up in the same places. And he said that they are now, in the Indian cabinet looking at the possibility of insisting that all cars sold in India from 2030 should be electric.

And at the same gathering, just an hour or two later, Bill de Blasio said that within a few years he wants the entire New York City, city fleet of cars to be electric. So that for me, that was within five or six weeks, Chinese Prime Minister, the Indian Minister of Power, Coal and Renewable Energy, and the mayor of New York. And they're all talking about entirely, entirely electric cars from someday not very far away. We don't know how fast that will go but that's going very quickly and this is global. And then about two weeks ago I was with Mahindra, a very big company in India at the London launch of an electric car for about \$15,000. \$15,000, now, it's not as fancy as a Tesla it's not meant to be but it's going for a different market, absolutely not the plaything of the rich.

Greg Dalton: Steve Westly, can American and global auto giants adapt to this? Your response to that.

Steve Westly: They're already adapting. And here's what I wanted to throw out. There's one race that's more exciting than the US presidential race. Even more exciting than Lester's race to win the premier cup and that's the race to drive the cost down for lithium-ion batteries. This is the ultimate big money race and you should just know. And there are numbers to guide all this, this is not a Democrat or Republican thing. Used to be about \$1,500 a watt to produce lithium-ion batteries it has gone down, down, down and when you get below about \$300 you can make electric vehicles that will blow away the competition.

We're getting very close to a point in LG chem and Korea is talking about a sub \$200 a watt lithium-ion battery. Mr. Musk is building the giga factory which I think will be the second or third largest building in the United States after the Pentagon and the Boeing plant. If any of you have been to Costco or a price club it's about hundred thousand square feet. This thing is 12 million square feet. So it's the size of 120 Costcos over a mile long. Mr. Musk is serious about producing lithium-ion batteries. But this is full on competition to replace what has been part of the global oil industry what powers cars. And one of the questions is, Korea gonna win, U.S., Samsung? This is the race to be watching and I'd submit it's a good race for the health of the planet.

Nicholas Stern: Absolutely, and Toyota are putting a lot into hydrogen. And I'm rather with Steve; I think it'll be more with the electric. But it may be for heavy goods vehicles. It may be that some will be creating the long distance travel through hydrogen. But the fascinating, exciting thing about all this is how much creativity. If you pose a question strongly - and one thing we have done over the last 10,000 years is to post the climate question strongly. If you pose it strongly you get a response. And the creativity has been absolutely extraordinary.

Greg Dalton: Steve Westly, what's the future for oil companies? They have funded a lot of campaigns to slow down this transition. Now that Paris brought the world together there was a big, Corporate America was there in Paris. What's the impact of the transition for oil companies ahead, do you think?

Steve Westly: So, you know, I used to teach on the faculty at Stanford Graduate School of Business. I spent a lot of time on this issue, corporate strategy. The oil companies are in a pickle and they're in the pickle for two reasons. Let me just say it flat out, you're seeing renewables at parity with oil and the cost of renewables only goes one direction, that's down.

And they're not, by and large, polluting. The world is moving that direction from a pure cost efficiency status. You throw in that global leaders are pushing things that way and it's just gonna happen quickly. But the whole second part of it is, there's this other shift in what we're starting to talk about and that is the shift from baby boomers like me, whose whole life has been about, alright and we're gonna get the biggest TV we can and then the biggest car and the biggest house and you throw it all out and you get a bigger one, that's going away. By January 2017 millennials become the biggest buying cohort in the world. By and large they don't like oil companies. So here's the punchline, I was just talking with a friend at Exxon. I said, well how's the oil industry? He said, oh no we're Exxon gas.

[Laughter]

We're not, no, the oil is - that's the past. Pretty soon, I want to suggest to you what I think what's gonna happen is the smart oil companies will diversify into renewables and other sources. They've got very deep balance sheets. The less smart ones will hang on for dear life and they, I suspect will go the way of dinosaurs because the world is changing real quickly.

Greg Dalton: Steve Westly, is a former board member at Tesla Motors, former controller of the state of California. We're talking about clean energy transition at Climate One. I'm Greg Dalton. And my other guest is Nicholas Stern, former chief economist of the World Bank. Nicholas Stern, on a country level, Saudi Arabia is looking at something comparable. This week they announced the \$2 trillion sovereign wealth fund, \$2 trillion. They have a young prince who is empowered to try to move the economy away from petroleum to, is that for real and what is the global economic prospects of that?

Nicholas Stern: I think one of the remarkable things is how countries like Saudi Arabia and Saudi

Arabia in particular have seen the way the world is going. And they know that their asset is one which doesn't have much of a future. If we're to hold to 2 degrees centigrade as increasing global surface temperature, about the second half of the 19th century, if we're to hold to that as we must because it's so dangerous to go beyond, then if we want a decent probability of that happening, we can't burn more than perhaps a third, or 40% depending how you look at the probabilities of success, of the reserves of fossil fuels that we already know about. They have to stay on the ground or it has to be carbon capture and use or storage.

So in other words, those assets if we are to hold two degrees centigrade which is what we've agreed in Paris actually or below are not worth all that much. So it's very important that we plan ahead to see how we can manage that transition in a way that is cheerful positive invest in the alternatives. And all companies have to see that, and what you just described about Saudi Arabia is a manifestation of them doing exactly that because they have to, and they are going essentially to be pushed in that direction across a whole front. Sometimes it's gonna be direct regulation, but what we're seeing is something very significant; it's financial regulation. And the chair of the financial, I'd be slightly nerdy and find technical, you know, regulation of the financial industry but, you know, after what we've been through in the last several years, we will know why that matters. They, the Financial Stability Board is the one that looks after exactly that internationally from the Bank of International Settlements. And the chair of Financial Stability Board is Mark Carney, Canadian governor of the Bank of England and a very good one. And he asked Mike Bloomberg to come up by the end of this year with a protocol for reporting of financial risk. To put your money in fossil fuel companies is a risky way to invest your money because of the reasons I've just described that we can't burn all that anywhere near what we know already and stay within 2 degrees centigrade the Paris commitment.

So what Mike Bloomberg is putting together is a reporting structure for financial institutions on their climate risk. Not only the insurance companies which risk the buildings that they've insured being battered by the extreme effects of climate, which they do and that's a very big risk. Not simply the risks of litigation where you're held responsible as a firm for those emissions. But also and perhaps particularly the risk that the assets you hold, which have a strong fossil fuel element in them are not gonna be worth very much. And that's a risky investment and what Bloomberg is putting together for the world supervisory financial body is a requirement to report on those risks. So the financial companies are gonna have to know what the riskiness in the climate point of view and the commitment to fossil fuels are in the companies they invested. That's going to be a game changer.

Greg Dalton: Steve Westly, some people's response to this, keep it in the ground and the financial risk of fossil fuel investment that Nick Stern just mentioned is to divest. Do you support divestment, whether it's universities like Stanford or public pension funds like California, getting out of fossil fuels to protect their investments?

Steve Westly: It's gonna happen over time. And I think investing in fossil fuels is not only a poor investment financially, it's a poor investment for the planet. But I just want to come back to a point we touched on before.

Saudi Arabia is doing exactly the right thing to diversify its economy. They've been given this blessing of money, but they're smart enough to know that we're moving beyond oil. And I want to pivot here. What makes California great is we have a tradition of reinventing ourselves. We had a gold economy, a big gold rush; if we'd stayed with gold we wouldn't be doing so well. But we learned to reiterate and then we had a semiconductor boom. But we didn't stop there, we turned into PCs. We didn't stop there, turned into software. Before we knew it, it evolved into the internet then social media. We have learned through this extraordinary influx of immigrants to become adaptive. And I

think really the saying of the age comes from Steve Jobs who said "If you don't cannibalize yourself, someone else will."

That is exactly what the Saudi Royal family is doing. This oil thing is being minimized by the way, not just by solar and wind, but by these extraordinary new technologies, think the Nest and so on, that help reduce so it's not just new renewable energy but it's dramatically reducing the amount of power you use. Between the two, it's putting the squeeze on oil. God bless them for diversifying.

Greg Dalton: There's a debate that rages in the clean energy community about we need bold, big, bold breakthroughs. Whether it's fusion or a moonshot to discover big new things and others say, no. If we just fund what we have today we can do this. Steve Westly, which one is it?

Steve Westly: Look there are - you want the most cost-effective thing possible. I used to work with the Department of Energy. Solar used to cost over \$110 a watt. You're just not gonna sell a lot at that level. Today, we're at \$2 and heading down to one, that's transforming the world.

Who knows about fusion, I served on Secretary of Energy Chu's advisory board and even he would tell you that may be a few decades up, we don't have a few decades. We need to do the smart simple things now. Jerry Brown has been a global leader on this. California needs to continue to lead the way. There are a lot shorter ways to get from A to B, than fusion.

Greg Dalton: We're going to go to our lightning round. We ask some brief questions of our guests today. Nick Stern, former chief economist of the World Bank and chair of the Grantham Institute at the London School of Economics and Steve Westly, former board member of Tesla and a venture capitalist in Silicon Valley. I'm Greg Dalton. You can join the conversation using our Twitter handle @climateone.

Steve Westly, yes or no, green products are still too expensive for many Americans?

Steve Westly: No. Ten years ago, maybe. Today, no.

Greg Dalton: Nick Stern, in 2010, the G7 industrialized economies pledged to reduce fossil fuel subsidies. That's just a bunch of smoke and subsidies have not been reduced since. I think you were part of that.

Nicholas Stern: They've been reduced some. For example, I'm talking about the G20 now because the G7 is pretty marginal. In the G20, India has used the world fall in price of fossil fuels and oil and so on to reduce fossil fuel subsidies. Indonesia has a bit, but they should go much faster.

Greg Dalton: Steve Westly, new nuclear power plants have a place in a decarbonized economy?

Steve Westly: It's very difficult to get nuclear in the new world for three reasons. And again, this has nothing to do with Democrats. Number one, they're extraordinarily costly, \$10 billion to throw and they take at least a decade to get up. Number two, no one wants them in their backyard. Number three, we still haven't figured out what to do with the nuclear waste. That is not the long-term solution we need.

Nicholas Stern: The future of nuclear power is in China, they're gonna invest probably in 150, roughly one gigawatt power plants over the next 15 years or so. That's where we're gonna learn about the future of nuclear.

Greg Dalton: Nicholas Stern, the U.S. Congress has slowed down global movement toward cleaner fuels, yes or no?

Nicholas Stern: Probably yes but the -

Greg Dalton: You can meddle in U.S. politics a little.

Nicholas Stern: But one of the wonderful things about the United States which I say as an outsider is it's got so many bits to it. Like California, like the wonderful firms like Tesla, Walmart, which looks very closely its supply chains; cities in the New York and Mike Bloomberg and Bill de Blasio. United States is a complicated big place and there's an awful lot happens outside Washington. You don't need an outsider to tell you that but it's important.

Greg Dalton: Steve Westly, Californians concerned about climate change should eat less meat and animal protein?

Steve Westly: This is hard for me because I like meat, but the short answer is moving into the future, we're all going to be eating less meat. We just need to; it's the right thing for the planet.

Greg Dalton: Nick Stern, English potpie is bad for the climate?

[Laughter]

English potpie. Beef stew, beef pie? Shepherd's pie, okay.

Nicholas Stern: Shepherd's pie is -

Greg Dalton: American mistake.

Nicholas Stern: Can I just explain Shepherd's pie because it's part -

[Laughter]

- you threw me with potpie which is an American description of an English dish which will be unknown to an Englishman.

[Laughter]

Shepherd's pie is when you take your roast from Sunday because, you know, we weren't always, you know, as rich as we are now which is not as rich as you are but you would have a roast at the weekend. And then you wouldn't eat it all and you'd grind it up and you put it in a pie with potato on the top and that's Shepherd's pie.

I very much agree with Steve. We are going to have to eat less red meat and move to chicken and move to fish and move to vegetables will be part of the story and we'll be much healthier and fitter as a result. And, you know, if you feed animals with oats for a very long time as opposed to eating the oats yourself or the soy or whatever it might be, that's a much less efficient way of transforming input into output whichever way you look at it. So there's going to have to be some kind of reduction. But the important thing is to describe to people what's in what they eat, including, you know, the water and the greenhouse gasses and let them make up their own mind.

Steve Westly: Nicholas, I've seen the future: kale pie. It's gonna be big.

[Laughter]

Nicholas Stern: Californian kale pie.

Greg Dalton: Steve Westly, venture capitalists are not as smart as they think they are?

Steve Westly: Absolutely, correct.

Greg Dalton: Nicholas Stern, economists are people who don't have the personality to be accountants?

[Laughter]

Nicholas Stern: You've been meeting the wrong economists.

[Laughter]

Greg Dalton: Let's go to our quick word association. I'm going to mention something and you just mention the first word that pops into your mind, one word. Steve Westly, American coal.

Steve Westly: Over.

Greg Dalton: Nick Stern, American politics.

Nicholas Stern: Complicated.

Greg Dalton: Steve Westly, Gavin Newsom.

Steve Westly: Interesting.

[Laughter]

Greg Dalton: Steve Westly, Koch brothers.

Steve Westly: Wrong way.

Greg Dalton: Nick Stern, American manners.

Nicholas Stern: Wonderful.

[Laughter]

Greg Dalton: Last one, Steve Westly, English manners.

Steve Westly: The best.

Greg Dalton: Okay. How they do, I think let's give them a round, I think they did pretty well.

[Applause]

[CLIMATE ONE MINUTE]

Announcer: And now, here's a Climate One Minute.

Last year at Climate One, Former US Treasury Secretary Hank Paulson said that climate change is not only the biggest risk to our environment - it's the biggest economic risk we face nationally. So if we can see the crash coming, why are we still flying into the mountain? Paulson explained why he believes our government has been so slow to change course.

Hank Paulson: We tend to deal with issues nationally when there's an immediate crisis rather than it's a longer-term issue. And the terrible thing about climate change risk is that carbon emissions, essentially for all practical purposes stay up there forever, so it's cumulative.

So the financial crisis, as bad as it was, the government can come in at the end and do things that avoid the worst outcomes. The longer you wait here, the more costly and the more difficult it's going to be to avoid the worst outcomes. And also we tend to deal with issues if we handle them at the national level better than the global. So here we've got the double whammy.

The good news is I think we still have time to act to avoid the worst outcomes. And as public sentiment changes, you know, you have to be optimistic that we can get there because the technologies do exist today even.

Announcer: Hank Paulson, former US Treasury Secretary and author of "Dealing with China," visited Climate One in 2015. Now, back to Greg Dalton and his guests at The Commonwealth Club.

[END CLIMATE ONE MINUTE]

Greg Dalton: Let's talk about high-speed rails. Steve Westly, is that a good thing for California then I want to hear Nick Stern talk about high-speed rail in Europe because that's more popular there.

Steve Westly: Look, here's the issue with high-speed rail. I'm a big believer in public transportation. You want public transportation, and it works great in dense urban areas. Think Western Europe, think Boston, New York, Philadelphia corridor, Japan parts of China. We are a pretty large fairly rural state. And the rub here is the initial budget 33 billion then it jump to 60 may be on its way to 100 billion and we do not even know if we were to afford and pay for all that with the annual operating cost on top of that would be. On top of all that, it's not clear to me that if we were to build it and if we could afford it, whether using 40-year-old, you know, bullet train technology is the right thing, or perhaps we might be much better off using something like the hyper loop. My gut is and we should be reinvesting in education and make sure that the time is right before and the technology is right thinking about \$100 billion project.

Greg Dalton: Nick Stern, as an economist, tell us about high-speed rail in Europe. Maybe it makes more sense there than it does this in California.

Nicholas Stern: It makes a huge difference to people's time. We're not that good at it than the UK, but much better at it in France and Germany and so on but also in China. And about six weeks ago, I took the train there and back from Beijing to Shanghai, about five hours. And I think it's roughly New York to Chicago. You won't do that in five hours, you don't have to go to the airport -

Greg Dalton: You don't have to undress.

Nicholas Stern: Yeah, you sit and work quietly for all that time. It's extraordinarily productive in people's time and convenience. So I think in Europe, it's been very good; in UK I wish we had more and in China it's been absolutely extraordinary.

Greg Dalton: Nick Stern, you wrote a book Why Are We Waiting. And it's, you know, behavioral economics, it's a big thing recently. So tell us, there's so much information abundance of facts, why are we as individuals as humans and countries not moving faster when our planet is on fire?

Nicholas Stern: The key is to understand what's possible and that it's extremely attractive. And I think that in Paris the tipping point came where the 195 countries really wanted an agreement. It came when they understood that this is not only possible, it's also very attractive. So that's the

argument that we have to win. We have been waiting because that argument took a long time to gain traction. I think it's gaining traction now, but we have to demonstrate how it works. And the road from Paris is the road that demonstrates that the alternative way of doing things is cheaper, more attractive, more exciting, cities where you can move, cities where you can breathe. That's the key and we're gradually getting there. It's picking up speed but we're not going anywhere near fast enough.

Greg Dalton: Steve Westly, if the economic opportunity is so big how come a lot of venture investors in Silicon Valley have pulled out of clean-tech. They are not there. They got burned. They swaggered in and said hey we'll figure this out, we'll tell you how it's done. They lost some money and there's not a lot of money in Silicon Valley going into energy other than some software type plays, Nest, et cetera. So is that accurate and why is that?

Steve Westly: Well, this is why you need to be investing in our fund today. Look, the simple reason is if you look backward people lost a lot of money because they came in too early. Just like if you saw one of the first mobile phones that weighed 10 pounds and cost \$5,000 you'd say no one's gonna buy these crazy things. Fast forward 36 months the cost goes below \$500. The weight drops down below a few ounces and you sell a billion units. We're in that same point. I used to serve on the board of Tesla. The first car we had the little roadster cost \$120,000; I could get in I couldn't get out, it was dreadful. Now we have a car at \$30,000 and it may become the biggest selling car in America. So the key is you look forward not backward. There's an inflection point in every area of the economy and I'm here to tell you we're hitting that inflection point in renewables now. That's a great thing for the economy; it's an even better thing for the planet.

Greg Dalton: But Nick Stern, cheap oil is going to make that transition hard. Because when gas prices are where they are, Americans buy SUVs, simple as that.

Nicholas Stern: One thing we learn from looking at the history of oil prices is that there's lots of fluctuation and not much trend. And we're going to see them go up and down. But what you learn from looking at renewables is that it's a very powerful trend downwards. So we're going to see those oscillations but basically renewables are going to replace those other things. But I do want to pick up a point that you made about Nest, Steve. It's about 40% or more of what we have to do to cut back on our consumption of fossil fuels 40%, 50% depending on the estimates but big is energy efficiency. And we always jump quickly to replacing the fossil fuels and we must. But a big part of that story is just using energy much more efficiently than we have in the past. And there's so many ways that we can do that. Designing cities that work and I keep coming back to this, but it's fundamental. Designing cities that work where you really can move around, the right combination of public transport and electric cars and cars that linkup and the distinction in public and private transport is going to start to get fuzzy. That whole story of using energy much more efficiently, Nest is a good example of that, is absolutely fundamental. So we have to do in our argumentation much better than simply talking about renewables versus fossil fuel are important that is because energy efficiency the way we organize ourselves in cities is such a big part of the story.

Greg Dalton: Steve Westly, what are some really exciting areas where you see big breakthroughs whether it's food, energy, et cetera, efficiency. Where are we going to see some real cool innovation?

Steve Westly: Let me just give you a two quick examples. One, what Nicholas said is absolutely true. People do not realize how much energy is just plain wasted.

Over 40% of the energy in this country is used by buildings more than transportation more than factories. Our buildings are sieves; they largely moved forward since the dark ages, you're going to see a revolution in the Smart building movement combined with this thing called the Internet of

things where your home becomes smarter overnight. You will have smart lights that go on and off; you will have smart windows that you can control with your smart phone. Keep an eye on a firm called View Glass, it is transforming thing. So a lot going on in the Smart building movement, but the other thing that to me is dramatic; it's not just this huge leapfrog to electric vehicles which I promise you is happening faster than you might think. It's the jump after that to autonomous vehicles. And there's been this raging debate: are they coming in 10 years or 15 or 20? And all of a sudden Tesla went and put this car out last October that was essentially 50% self-driving now. You can buy one this afternoon. And to give you an example two employees drove it from LA to New York, hands off the wheel foot, off the accelerator for 96% of the trip. It's like science fiction and what that did is created a collective holy S word in the auto industry and everybody said that plan about putting autonomous vehicles on the road in five or 10 years - better move that up to three or four. That is going to create a big shift. It's by and large good for the planet but it's going to create some seismic shift for our policymakers, insurers, and so on.

Nicholas Stern: And it doesn't text while it's driving, it doesn't drink while driving. It doesn't have an argument with a family member while -

Steve Westly: We'll be free to do all those things.

[Laughter]

Greg Dalton: Doesn't flip the bird, yeah, all those things. Nicholas Stern, one way that lot of people will feel climate impacts is on water. And I want to talk to you about the pricing of water and the impacts of water, whether it's too much floods or too little with droughts. So what do you see the output, the global prospect for water?

Nicholas Stern: Absolutely right there Greg. Climate change is largely about water. It's about the extreme weather events and storms. It's about the desertification in some places; it's about sea level rise. It's about flooding; it's about water or the lack of it in some shape or form. Southern Europe at not much above 2 degrees could start to look like the Sahara Desert. We don't know exactly where and how these things are going to happen, but the effects on water either place are being submerged or places turning into desert so places battered by very heavy rainfall and very compressed period of time. That's going to lead people to move and that's going to - hundreds of millions, possibly billions if we are reckless. We know that we shouldn't be and we know how not to be. But if we were reckless and let that happen, you'd be seeing conflict on a massive scale with those that number of people moving and it would be about water. So it's very important to understand how the dangers will happen through largely rewriting of our relationships with water.

But also there's a tremendous amount of water management we're going to have to do anyway because of the climate changes that are happening and some which will go on happening even if we act as we should very strongly. And London's on a floodplain and it's not the only city, many of our cities are where they are because they're near the sea or they're near the rivers; that's why they're there. So our city management of water is going to have to be enormously improved around the world and we're going to have to invest in doing that.

There may be some places which I mean the stress on water in California is probably going to get a lot worse not better. And so management of the water that you've got is going to be extremely important. And part of that would have to be water pricing and so on. You let people use world's scarcest resource, and nothing?, you know I mean, it's not going to work if you don't have some way of allocating and saving water much more carefully. So all the way from flood control to husbanding very carefully the water you've got. And there's so much that we know we can do. I mean water harvesting is extremely important to saving the water you got run into a bath and use it. And

designing your use of land so that - for example in the UK we've had terrible floods and it's of course large measure to do with climate change. But it's also because the way in which we've manage our land up in the hills in a way so that they don't absorb and they're not the sponge that they could be.

So there's so many dimensions to water control. Looking after the forests and so on, up the hills, water harvesting wherever flood control pricing water properly. You know, it's mad that you grow rice in California and I understand why you do it. Because you use something that is extremely valuable to make something that's not very valuable, doesn't make any sense.

[Laughter]

And it's everywhere, it's everywhere Greg. And there's so much we can do to manage it much better.

Greg Dalton: Steve Westly, on future of water in California?

Steve Westly: Well, there's three steps here. First, we've come to realized that you can produce energy in almost any part of the planet. Maybe solar, it may be wind, it may be gas but you can create energy where you want.

You can't create water out of thin air. And what we're realizing as the planet gets warmer is that these ice caps in the mountains where there's the Himalayas, which serves about 3 billion people or the Andes or the Rockies, is these things slowly melt and there's less, we've got to get smarter. And that means three things. Number one, we got to get smart about conservation and that means social behavior, software and just saving more. Second step is we need to do a better job with capture and storage. So long before you do 44 foot tunnels and massive projects we need more storage. And then the third thing is recycling. And that's going to mean gray water use and it's going to mean municipal recycling. And people say what, did he just say we have to drink water that people have peed in? And the answer is, yes. Get used to it. You will see recycling it's part of the new future if we're smart, we'll do a much better job with conservation and with storage and we can avoid the expensive step of recycling. But we're probably looking in the world with all three.

Greg Dalton: Leslie Stahl did it on 60 Minutes. So I think the rest of us can do it. We're talking about climate change and clean energy at Climate One. I'm Greg Dalton. My guests are Steve Westly, former board member at Tesla and former controller of California and Nicholas Stern, former chief economist at the World Bank and climate expert.

Nicholas Stern: You keep saying former, isn't it? Quite a lot of the thing we do at the moment, you know.

[Laughter]

Greg Dalton: Your current title is so long that's what it, yeah. I want to go to our audience questions in a minute but first I'm going to ask each of you briefly what gives you hope and fear? Nick Stern, about climate.

Nicholas Stern: Paris agreement gave me hope not only because 195 countries got together to agree on something tough but very valuable. But also because it was founded on an understanding of how attractive the different way of doing things could be and was becoming.

What makes me fearful is how slowly that process is moving even though it's picking up and accelerating. The next 20 years are absolutely decisive. We've got very little headroom on greenhouse gases if we're to hold temperatures to levels which are not dangerous. And we will be building infrastructure around the world in the next 20 years. We'll be adding one and a half to two

times of the infrastructure that we've already got. And if we do that badly, lock in dirty unsustainable infrastructure, any chance of holding to 2 degrees will be absolutely gone. So tremendous excitement as to what we can do. We can see we can do it now and how attractive it will be but worry that we'll dither and delay and if that dither and delay goes on for 10, 15, 20 years we'll be in very difficult circumstances.

Greg Dalton: Steve Westly, hope and fear?

Steve Westly: Let me start with the fear part. I used to be an elective office and gee whiz I'm fearful of elected officials, having been one. It just takes a long time and you worry about hard to manage countries like India, can they move off coal quickly enough to save this planet we all share?

What gives me hope is that we're seeing these dramatic breakthroughs in technologies from electric vehicles to efficiencies in solar. The stuff we're seeing is dramatic and it is cost competitive. There is no reason not to move into this greener new world. But what really gives me hope are millennials because they get it. They want a smaller footprint. They're used to measuring everything and they are by and large consumers that are making smarter decisions than their parents ever did. That gives me hope.

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

Male Participant: Thank you for this great discussion. Peter Joseph with Citizens Climate Lobby. Carbon pricing, I was in Paris and heard Jim Hansen call the whole COP 21 thing a fraud because there was no outcome that produced a global carbon price. I was here right before COP 21 and heard Christiana Figueres say carbon pricing would not be on the menu. On day one of COP 21 the carbon pricing leadership coalition was launched. Please can we discuss how do we get from here to there, decarbonizing without putting a price on carbon and how do we do that? Thank you.

Greg Dalton: Nicholas Stern.

Nicholas Stern: Carbon pricing is very important but it's not the only weapon in the armory. You can get very quick movement by regulation, efficiency standards, safety standards for example, on the use of coal and enormous potential in research and development and innovation. And they support each other. So I'm a huge admirer of Jim but I don't believe that there is just one single shot on this. And that if we lose on that one, we're bound to lose overall. We should be doing all those things together and I don't believe Paris was a fraud.

Greg Dalton: Next question. Welcome to Climate One.

Male Participant: Thank you. My name is John Balbek and I'm president of the global innovation exchange which is a mini NASDAQ for climate solutions. And my question is about finance and I know that both of your minds are fantastic on this. When we look at the dollar amounts needed to keep us at or below 2 degrees Celsius, the numbers I've seen are 16 trillion to 22 and it call it over the next 10 years I guess. First, do you resonate with that number and absent the governments forcing the markets in some fashion, how do you see that amount of capital moving within a 10 year timeframe? Thank you.

Greg Dalton: Steve, where's the money going to come from? Lot of number, big, trillion like.

Steve Westly: Look, the big number doesn't bother me, here's why. Two points, first, consumers make choices all the time and the good news here is that renewables are largely reaching cost parity with carbon-based solutions in this new millennial marketplace. And frankly their parents as well are going to say given a choice if it's at cost parity I'll take the cleaner fuel. And again, cost of oil goes

up and down; cost of renewables only goes down. That's a pretty straightforward choice.

Point two; there's been no charge or tax on carbon or pollution. Elon Musk said yesterday it's like throwing your garbage to the road and not having to pay for it. That's essentially what we're doing in the air. Today, in this millennial world it's easy to measure everything. There will be a cost on carbon. I don't know whether if it's two years, four years, six years, we're measuring it, it's becoming a big deal. Even in China, they now know; they used to sort of sweep it under the rug but the amount of pollution there is not sustainable. It leads to social unrest. The Chinese understand this and that's why even in China, they're cutting back on coal production. The world is heading in the right direction. We just need to help get it there sooner and don't underestimate the role California can play in doing that.

Greg Dalton: Steve Westly, is a venture capitalist in Silicon Valley. Let's go to our next question at Climate One. Welcome.

Female Participant: Hi, my name is Michelina Johnson, I'm a junior at UC Berkeley. Thank you for coming. My question is directed for Mr. Westly. I'm wondering how California will afford the new water projects and if it will consider hydroelectricity a form of clean alternative energy?

Steve Westly: So hydroelectricity is absolutely a form of clean alternative energy. We have a lot of it; in fact we depend on it. The big rub is what happens if we have another 10 or 20 years of drought, then we got to move to Plan B quickly. Again, I start with storage. It is hard to build these enormous tunnels up and down the state and by the way they use a huge amount of energy. Storage, conservation is where you start and then storage and capture. We need to start on that now.

Greg Dalton: Fabulous to see students from Berkeley here. Thank you. Welcome.

Female Participant: Hi, my name is Catherine I work at a shared electric vehicle startup called Ever Car in the city. And I was just wondering, I love hearing you talk about the race in electric vehicles. I was wondering if both in the U.S. and elsewhere if we're seeing a race in the proliferation of charging stations. And if charging stations currently will be able to handle the influx of people buying electric vehicles and what are the challenges that exist there.

Greg Dalton: Steve Westly.

Steve Westly: I love this question. Go Bears, three points. First, the best news of all here is not just that there's a proliferation now of electric charging stations. I've had an electric car for three or four years. When I first had it, there weren't so many around. It was a bit inconvenient. That issue has largely gone away. It's improving, it is improving a lot, by the way there are websites you can go to, your car and they will not only say hey you can plug in here or there. There are some that will say come to my house and you can charge in my garage and I'll give you a cup of coffee, it is dramatic.

But here's the other thing that I think is so interesting. In my generation a lot of us would count down the days til we're 16 to get a car, our own car. Americans had to have a car, that's changing. The new generation knows better they're willing to share cars, that's the way of the future 20, 25 years from now people will be saying who's going to want to own a car, that's a big shift.

Greg Dalton: I've talked to someone at Ford Motor Company recently they've done a reform on their finance arm where four people can now buy a car together. They could, it's like car, that's really car sharing when four people buy it, figure out the finances of that. Let's go to our next question at Climate One.

Female Participant: Hello gentlemen, I'm Jodi Carter. I've worked in the energy industry for a

number of years and I appreciate all the attention that these electric cars are getting. But there's still two questions that I am grappling with as hopefully a responsible citizen is, where all those batteries going to go in the future and how are we going to know where to improve our infrastructure because we don't know necessarily where everyone's going to be buying those electric cars to plug them in. And so those are two questions I have not yet heard good answers to.

Greg Dalton: Steve Westly, I hear that one a lot. I own electric vehicle. What about the batteries? What about the batteries? I hear that a lot.

Steve Westly: First, batteries are not inherently clean. You need to be very careful with batteries. Two, we're getting a lot better at recycling batteries. Three, what I find very interesting is there's a two-step lifecycle for batteries. You can use them in cars but as they begin to diminish their power storage capacity you can then use them in other capacities like storing electricity in solar and wind. So we're getting better at this lifecycle and because we've had batteries in PCs for a long time, the state-of-the-art is good, but it can get a lot better. We think some bright new entrepreneurs, maybe someone here, will come up with the next great battery recycling technology. will be very interesting because you're going to see a lot of batteries on this planet.

Greg Dalton: We're talking about climate and new energy with Steve Westly, venture investor and economist Nicholas Stern. Let's go to our next question at Climate One.

Male Participant: Hi, my name is Wayne, I'm with 350.org. I'm very encouraged by listening to both of you particular you Steve and you also Nick. I am concerned about how little time there is left for us to get off of carbon. There's a website trillionthtonne.org which basically tracks how much carbon dioxide we've added into the atmosphere; roughly 600 gigatons up to now and roughly 1000 gigatons is all we can add and after that we have to go to zero carbon. So how can we do this quicker, how can we get the sense of urgency that I heard Cristina Figueras talked to about - on climate - on living on earth recently.

Greg Dalton: Nicholas Stern, the urgency.

Nicholas Stern: You're absolutely right that the urgency is intense. We have to make virtually all our infrastructure from now on almost entirely clean and sustainable. And the good news is that we know how to do that. We're going to have to do that very quickly with things that we know. We're going to have to invest strongly in research and development to develop others, and we're going to have to look after our sinks much better than we do. There are sources of greenhouse gas emissions and there are sinks for the greenhouse gas emissions. And the best sinks are in the forest and in the land. And rehabilitating land gives you more land to grow food and it gives you a place to store carbon. So as well as thinking very quickly now about how to bring down our emissions very quickly we have to invest in the and look after the sinks, the land and the forests in particular.

Greg Dalton: One of the hottest areas in Paris was a group of people the global landscapes forum. People looking at soil, taking carbon out of the air, putting it to the soil, managing lands differently, lot of optimism there. Let's go to our next question.

Nicholas Stern: The reason the soil is black is the carbon.

Male Participant: I'm Tony Bernhardt from E2. Lord Stern, you did pioneering work on the social cost of carbon. Can you tell us what your latest thinking is on what the cost of carbon needs to be?

Nicholas Stern: I can tell you what's much too low and that's the price of carbon you use in the United States. So, for \$35 a ton roughly of CO2 because the models that get to that level leave out

most of the big costs associated with climate change in terms of severe weather events and so on. I think that you have to think of a path that gets fairly quickly up to \$50 and then maybe in 15 years also goes up to \$100. They already gone up in Sweden the price of the carbon dioxide well above \$100 a ton and that's one of the best performing economies in the world.

Greg Dalton: I want to wrap up briefly by asking you quickly what you do to minimize your own carbon and what an average person can do to minimize theirs, Nick Stern?

Nicholas Stern: I'm not as good at that as I should be but I use ground source heat pump and renewable energy. So all the electricity and all the heating in my house is renewable.

Greg Dalton: Steve Westly.

Steve Westly: We have solar, electric cars. It's not enough we're going to double down and I just need to get my daughter to take shorter showers and we'll be there.

Greg Dalton: I have to end it there. Steve Westly is a venture capitalist head of the Westly Group and Nicholas Stern is chair of the Grantham Institute for climate change and the environment at the London School of Economics. I'd like to thank our audience in the room at the Commonwealth Club and online and let's thank them. I'm Greg Dalton. Thanks a lot.

[Applause]