

# Coal Wars

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**Greg Dalton:** This is Climate One, changing the conversation about America's energy, economy and environment. I'm Greg Dalton. And today, we're discussing the future of coal in powering the economy. After World War II, coal consumption in the United States climbed steadily for 50 years until 2005 when it started a steep decline. American coal is on the ropes for many reasons, but internationally, the black rock is gaining market share. That's good news for people climbing out of energy poverty in developing countries, but its bad news for the climate. Coal is climate killer number one.

Over the next hour, we will look at the future of coal in powering homes and businesses with cleaner energy. Joining our live audience at the Commonwealth Club in San Francisco, we're pleased to have with us four experts.

Richard Martin is author of the new book *Coal Wars: The Future of Energy and the Fate of the Planet*; Bruce Nilles is deputy of conservation at the Sierra Club; and Frank Wolak is director of the Program on Energy and Sustainable Development at Stanford; Brian Yu is director and senior analyst at Citi Research. Please welcome them to Climate One.

[Applause]

**Greg Dalton:** Richard Martin, you write about a couple of characters in your book, Eddie and Danny Karst, father and son, one son -- the father who dreamed of being a coal industry person. Tell us about that family and what it says about some of the people who have been in the coal industry for generations.

**Richard Martin:** Yeah. So I met Danny Karst in Kingsport, Tennessee which is in far Eastern Tennessee sort of at the toe of the Appalachians.

And his father, Edward who is no longer living, was one of the rare miners who is able to save enough money to actually buy his way into being a mine owner, and so they've been mining there on a tributary of the Cumberland River for close to 50 years. And Danny is watching the market for his coal dry up. And Danny is a man of principle and a man of faith, and I really, I spent a couple of days with him traveling through Eastern Kentucky in the coal fields and I have a lot of respect for him. He's not ignorant or stupid about climate change at all, but it's his family's livelihood and he has children. He's wondering how they're going to continue to make a living. He considers himself fortunate that they've been able to continue to get royalties from these coal mines, but he's got miners on his payroll and it's a shrinking industry in that region, and he is facing a very uncertain future.

**Greg Dalton:** Bruce Nilles, the Sierra Club has a big campaign and some of it has been funded by Michael Bloomberg. What do you think about those people? People like that family, the Karst family, who recognize climate change but their livelihood depends on it. What's the path for them and what's the Sierra Club have to say for them?

**Bruce Nilles:** Sure. So Sierra Club represents a couple of million folks across the country, including people who live next to existing coal mining operations whose drinking water is being

poisoned everyday by coal mining.

They are folks who live in cities where it's unsafe to breathe many days of the year because of coal burning, producing huge amounts of smog pollution. And so we really have a choice. We have 13,000 people a year dying prematurely from relying on an old, dirty, inefficient fuel source. And today, we don't have to make a choice between that and expensive electricity. Today, the choice is between clean, affordable electricity like wind and solar, which is actually developing and providing more jobs today than in the coal mining sector. So our job ahead of us is overcoming the political barriers that the coal industry has put on our political process to make this transition as fast as possible, so that we don't have to trade-off providing electricity and people's health.

**Greg Dalton:** Frank Wolak, do you agree that America should get off coal as fast as possible?

**Frank Wolak:** Well, I certainly think that it makes sense to price the bad that is produced associated with coal and is produced with the consumption of all fossil fuels. I mean, in the greenhouse gases and pricing carbon, that really should be job number one, rather than saying coal is terrible. Greenhouse gases are terrible and greenhouse gases are produced by natural gas. They're produced by oil; they're produced by coal, as well as the local pollutants and the like. So I think that we want to focus on getting rid of the bad, rather than getting rid of coal.

**Greg Dalton:** Brian Yu, what do investors look at this? They just look at the short terms; they only look at the financial gains. How are coal stocks doing?

**Brian Yu:** Yeah. The way the investors are looking at it is essentially to look at the margins these companies are generating, how much they can get for the product. And I think the reality is, in the U.S. market where gas and coal are competing for market share, and gas prices under --

**Greg Dalton:** Natural gas.

**Brian Yu:** Natural gas prices.

**Greg Dalton:** Burn to make electricity.

**Brian Yu:** Under \$3 per MMBtu, it's very difficult for coal to compete. So essentially, we're seeing those companies lose market share, and it's having an impact on margin stabilities, companies who service debt, so many of the coal equities you've seen a steady decline in their market valuation as a result.

**Greg Dalton:** And what's been driving that? Has it been President Obama's war on coal? Has it been the EPA? Has it been the Sierra Club?

**Brian Yu:** I think it's predominantly driven by the low price of natural gas. The EPA and I think the administration is probably having some impact on coal-fired power plants shutting down, but the bulk of the impact is actually more economic driven. Utilities deciding that it is cheaper and more economical to run their natural gas fired power plants rather than coal.

**Greg Dalton:** And does coal deliver prosperity? Is coal a good thing? I mean, cheap energy, it's good for consumers who are buying products made from companies that have low cost of operations, it's tough for the U.S. to compete. Isn't cheap energy a good thing for American economy, Brian Yu?

**Brian Yu:** I think cheap energy, to a certain extent, it is a good thing if people can't really afford something better, and that's why you're seeing in China so much the power being generated by coal. But there is a cost to it - and which I think is part of this discussion - and that's the part where

somehow we need to be able to price the carbon correctly, so that we don't essentially take away from the future at the expense of some more modest benefit today.

**Greg Dalton:** Frank Wolak, you're the economist here. Does coal deliver prosperity?

**Frank Wolak:** I mean I think its --cheap energy certainly is one of the ways that we lift people out of poverty. I think a great example of this is, if you look at the periods 1870 to 1915 in the United States, you see a rapid increase in the consumption of coal in the United States, and at the same time, you see a rapid increase in GDP in the United States. If you fast-forward to 100 years later, you look at China, you see exactly the same pattern, which is a rapid increase in coal consumption and a rapid increase in GDP in China. It does deliver essentially rapid economic growth simply because of a very cheap source of energy. There are a variety of external costs associated with that, but that sort of paradigm has been repeated in countries around the world almost since the start of the modern society.

**Greg Dalton:** Frank Wolak, is there a choice, though? Are renewables competitive with coal today?

**Frank Wolak:** Certainly, they're not cost competitive in the sense of on what's called levelized cost basis. But again --

**Greg Dalton:** What does that mean, levelized cost mean? Apples to apples.

**Frank Wolak:** A simple way would be to say just the average cost of producing a kilowatt hour over the lifetime of the project. I mean, if you take Powder River Basin coal, it's roughly \$10 a ton, which translates into the heat content of roughly about \$0.60 per million BTU. Think of natural gas is at the order of about \$3 per million BTU. So a coal-fired power plant in Wyoming is an extremely cheap source of electricity, but different parts of the country have different prices for coal because you have to get the coal to where you're going to burn it, and the railroads understand that in how they price. So there are differentials. But fossil fuels, unfortunately, and it's made even worse by the fact of the shale gas revolution, they're just too cheap at the moment if you do not include the cost of the CO2 emissions.

**Greg Dalton:** Bruce Nilles, do you agree that green is more expensive than brown?

**Bruce Nilles:** It's simply not played out by the facts on the ground, right? No one has built a coal plant or proposed to build a coal plant for the last six years because coal is too expensive.

**Greg Dalton:** In the United States.

**Bruce Nilles:** In the United States. If it was so cheap, why are people not lining up to build new coal plants? And the answer is --

**Frank Wolak:** Because they're building natural gas plants because natural gas is cheaper.

**Bruce Nilles:** That's the number one source of new generation 2012, 2013 and 2014 was clean energy. It wasn't natural gas. So if you look at what's actually happening out on the ground today, people are realizing that investing in wind and solar today with a rapid decrease in price is a much cheaper option. And we are in a proceeding in Oklahoma today, at this very moment, with industrial interveners arguing for more wind development in Oklahoma because it will lower electricity prices for factories in Oklahoma. In Oklahoma, home of Jim Inhofe, there is alignment because wind is cheaper than the alternatives which include coal and gas. So if you actually look what's happening on the ground today, clean energy is beating out fossil fuels head-to-head across the country.

**Greg Dalton:** Frank Wolak?

**Frank Wolak:** Well, then I guess we can get rid of the production tax credit and the renewables portfolio standards that exist in all the states in the United States because it's so cheap. I mean --

**Bruce Nilles:** Add subsidies for coal?

**Frank Wolak:** Again, I think it's -- I'm perfectly fine with, I think, we should -- we want to transition to a renewable future, but we need to be clearheaded about the relative costs and what are the cost drivers? That's all I'm saying. I think an RPS is great if people like that, but it is the reason that we do get these investments in renewables in California and other states, it's the existence of these state policies which I think many of the citizens support because they do exist.

**Greg Dalton:** Richard Martin?

**Richard Martin:** So if you look at what's happening in Ohio, it's really interesting because up until last year, Ohio had one of the more progressive RPS, in other words, renewable portfolio standards, which requires utilities to include a certain amount of clean energy in their portfolio, and it was repealed essentially by the legislature.

Technically, it was put on hold and Governor John Kasich was kind of forced into a corner to sign it. There was a coalition of manufacturers that included Honda - and you can probably name a couple of the others, Bruce - who were opposed to repealing the RPS because they see it as going backward and ultimately hurting the economy, the manufacturing economy in Ohio. So one of the Sierra Club representatives on the ground there said, "This is, Ohio is ground zero for a lot of these conflicts," so it doesn't -- the lines between traditional businesses supporting fossil fuels and the Sierra Club opposing them, those lines are blurring very quickly.

**Greg Dalton:** Brian Yu, is brown cheaper than green still?

**Brian Yu:** I would say with respect to natural gas, all the numbers I've seen suggest that it is cheaper than green. When you look at the cost per gigawatt of building a natural gas plant, it's probably a billion dollars for the same amount of capacity for something that's more green, whether it's solar or wind. I've seen numbers on the order of two to three billion, so it is more expensive. I think the other big difference is that, as we think about how we use power, the thing with electricity is it's not storable, you need it on-demand. So when it comes to wind and solar, that's more of -- I term it as pushed. It's there when the wind and sun are there, but you can't just flip the switch and generate electricity. So I think we need a balance of the two.

**Greg Dalton:** Bruce Nilles, what about when the sun doesn't shine, when the wind is not blowing? Those energies are not -- you can't put them in a bottle.

**Bruce Nilles:** It's exactly right. And so what utility after utility is doing across the country is working out, "Okay, how much wind can we get online? How much solar can we get online?"

If you think about Texas, in the northwest part of Texas, the wind blows in the evening. And on the southeast part of the state, it blows during the day. And you combine that with solar, you get coverage for most of the demand for electricity in Texas from wind and solar. Sure we need backup and that's what's exciting about all the new advances we're making in storage. Here, in California, the legislature and the Public Service Commission just mandated that the state install a huge amount of new storage over the next seven years, precisely so that we can address the issue that Brian is flagging. We know how to do this. This is not putting a person on the moon, this is about how do we integrate clean, affordable energy so that we can get rid of these fossil fuels that are

producing huge amounts of pollution, as well as fueling the climate crisis.

**Greg Dalton:** Richard Martin mentioned earlier that the old lines of certain people being, big business being for fossil fuels and environmentalists being for green fuels have blurred. How about the Republican and Democratic line, Bruce Nilles? Is it Republicans all for fossil fuels, not so much for clean energy? There's a lot of coal state Democrats.

**Bruce Nilles:** Sure. Again, I think in the politics, we're seeing the lines blend a lot. Today in Michigan, run by a Republican governor, in the last couple of months, he said, "Our state needs to get off of coal." If you think about Michigan, it has no coal reserves. It's kind of insane that today, they're getting 50% of their electricity from coal. Michigan is a --

**Greg Dalton:** Illinois is next door, so.

**Bruce Nilles:** Michigan is a big manufacturing state. And right now, they are not investing manufacturing to produce lots of wind and solar because they got this legacy of a coal fleet. And so what the governor, a Republican, is saying, "Let's invest in Michigan with manufacturing jobs to do wind and solar, and let's get this coal that is now taking millions and millions of dollars out of Michigan's economy, sending it to Wyoming coal barons, that makes no sense." So it's Republicans who are saying, "When you're honest about the economics and honest about the jobs, fossil fuels make less and less sense than they ever did."

**Greg Dalton:** Rick Martin, did you want to say something?

**Richard Martin:** Well, two things. Going back to the question of storage, you need to look at the cost curves for energy storage. There is a lot of money, a lot of smart people are working on lithium-ion and other advanced batteries and other energy storage technology, and those costs are coming down very rapidly. So I think we're going to see a shift really within ten years in terms of our ability to cost-effectively store the electricity that's coming from intermittent renewables.

The other thing I'll just add to what Bruce just said is that there's a disconnect between the Republicans in Washington D.C. who can stand on the floor of the U.S. Senate and rail against the war on coal, and their party brethren who are in these communities who are mayors and economic development authorities and who have to look at their neighbors in the eye every day, especially in Appalachia, and they know that coal is not the future. So if Mitch McConnell wanted to serve the people of Kentucky, he would be working on finding an economically viable future for these families that are dependent on an industry that is going away and that's an irreversible trend.

**Greg Dalton:** Well, Mitch McConnell called for civil disobedience in state capitals, quite an extraordinary call for a leader of the United States Senate. What happened to that? Did he run into that conflict, Richard Martin, between sort of the Republicans in the City Hall and the State House and the Republicans in Capitol Hill?

**Richard Martin:** Well, what I found, Greg, is there's really sort of a divided mindset in a lot of these coal communities. I'll take as an example Craig, Colorado which is on the western slope. It's in the Yampa Valley of Colorado, only about 30 miles from Steamboat Springs. And the mayor of Craig is a 30-year veteran of the coal mines and what he said to me is, "We can either drive the car or we can be dragged along behind the bumper, and this shift is going to happen and we don't want to be dragged." So he supported the building of a small solar garden that is literally in the smokestack of the big 20-mile coal plant right there in the middle of Craig. So I think you're seeing that shift on the ground. And at the same time, certainly, the miners are angry, the miners are defensive, and they see this livelihood that has supported them for generations evaporating, and

they don't know what they're going to do.

**Greg Dalton:** Richard Martin is author of the new book *Coal Wars*. Our other guests today at Climate One are Bruce Nilles from the Sierra Club; Frank Wolak, the director of the Program on Energy and Sustainable Development at Stanford; and Brian Yu from Citi. Brian Yu, I'd like to ask you, what's the future for coal companies? Do they have a path to move into another industry? I mean, Apple is going to make cars soon, like what can coal companies do if they get out of the coal business or run out of the coal business?

**Brian Yu:** For these companies and where all the dollars invested, I think it's going to be very difficult to make the transition. Their assets are essentially coal, that's in the ground. Now you have some companies where in Appalachia where they've got coal in the ground and there's what they call coal bed methane, they can extract that for natural gas. But these companies are livelihood, in essence, its coal. So if coal prices stay low and demand stays weak, they are going to be under pressure.

**Greg Dalton:** So they're screwed?

**Brian Yu:** That would be another way of putting it.

**Greg Dalton:** Okay.

**Brian Yu:** If nothing changes.

**Greg Dalton:** Are they well-run companies?

**Brian Yu:** Operationally, I think these coal companies are fairly well-run. They've definitely gotten themselves into trouble over the last several years and it's not so much because of the operations. It's because they went out and made sizable acquisitions during arguably the peak of the market. And so paid the high prices and those acquisitions are not giving them the returns that they need.

**Greg Dalton:** They're going to go bankrupt?

**Brian Yu:** If nothing changes, I think you'll see a number of companies run into financial problem over the next several years.

**Greg Dalton:** Frank Wolak, could exports save the U.S. coal companies?

**Frank Wolak:** They already are. I mean, there's quite a few exports going out of East Coast ports. There are exports going out of West Coast ports in the United States. There are plans to build ports, perhaps not in the United States. The three states that the ports would be built in would probably not be too hospitable to them. But --

**Greg Dalton:** Thanks to the Sierra Club, but yeah, we'll get to that.

**Frank Wolak:** But there's also the rail lines go to Canada and Canada certainly exports lots of fossil fuels to Asia. There is a large market. I mean, I think the one thing that's important to bear in mind about coal is that if you take the total incremental increase in demand for essentially energy and millions of barrels of oil equivalent from 2000 to 2012, the total increase in demand for energy from coal exceeds that increase in demand for oil, natural gas, renewables, you name it, everything. So I mean coal is growing like gangbusters globally, and it is true in the United States that it is certainly having its trouble largely because we're the only people in the world that have harvest the shale gas boom and have extremely low natural gas prices. Gas price, natural gas prices in Europe are

significantly double to three times higher. In Asia, they're four to five times higher. So coal looks really good there and that's what they're doing.

**Greg Dalton:** And you think that it's better for China to burn American coal because it's cleaner, is that right?

**Frank Wolak:** Well, certainly, it is much better than the stuff at the margin that they are going to be burning in China is -- low sulfur, Powder River Basin coal is certainly going to have kill a lot less kids in China than it is going to be the very high sulfur, very high ash content coal that you might burn in, that you extract locally in China from the very small mines that Richard talks about in his book.

So I mean it's an unfortunate fact, but we produce coal very efficiently and western coal is quite clean in terms of its sulfur content. And the fact that you don't export the U.S. coal -- they're going to get coal. I mean, coal is plentiful around the world. There is coal in Australia, South Africa, Columbia, Indonesia --

**Frank Wolak:** There's plenty of coal.

**Greg Dalton:** Bruce Nilles, better for China to smoke our stuff than their own stuff?

**Bruce Nilles:** Well, here's the problem which is we sit on top of 25% of all the coal in the world. We know that if we burn that, our planet is toast. So we have a simple responsibility. Do we allow that to get mined at enormous cost to us? Shipped through our communities with a lot of coal dust along the way, plaguing our communities, and then ship it overseas so that we have the situation today where coal being burned in China is polluting us here in California. Kids are having asthma attacks here in California because of U.S. coal exports, and something is seriously wrong and insane about that situation.

So we have fought a very vigorous effort to stop new coal exports because as coal use has shrunk here in the U.S., there have been plans to build six coal export facilities in the West Coast: Washington, Oregon and California. We stopped four of them. We're down to the last two and we feel pretty comfortable that we will stop those last two from getting built so that we, in fact, won't be enabling the burning of coal across the globe. And in fact, what we're exporting is not a choice of X many death or slightly less death was described, but, in fact, we're exporting a cleaner and safer choice that doesn't either sacrifice our health or sacrifice the health of the Chinese. So we are vehemently against exports at a time when clean energy is cheaper today. So it makes absolutely no sense for us to be thinking about shipping coal overseas and hurting ourselves, hurting the planet, and obviously contributing to air pollution in China as well.

**Greg Dalton:** But do you acknowledge that if China doesn't get U.S. coal, they'll burn their own coal, and that dirtier stuff is going to come to Stanford and L.A. and San Francisco?

**Bruce Nilles:** I don't. One of the most historic things that happened in the last 12 months is the leaders of both the U.S. and China stood together and said, "We're going to work together to cut coal use." And that was because for the very first time in U.S. history, the U.S. is showing some leadership on climate change. We've shut down -- we're in the process of shutting down 188 coal plants here in the United States. It's the largest cut in carbon of any industrialized country in the world, major effort over the last five years. That has finally given the rest of the world some faith that we the U.S. is serious about doing our part on reducing coal use and cutting carbon emissions.

That was the underpinnings for the two leaders of China and the U.S. to sit together, stand together

and say, "We're going to work together as the two largest emitters of global warming and finally do something about it." And so we're doing our part. China will do its part. Which means China will be burning less coal going forward. And in fact, that's what's already happening. Beijing has just shut down its last coal plants because it said the health costs are just too great. And so U.S. leadership is critical and we just don't buy the argument that the U.S. shouldn't be playing a leadership role both in doing the carbon reduction and also helping countries make the transition as fast as humanly possible.

**Greg Dalton:** Frank Wolak?

**Frank Wolak:** Oh, I certainly think the U.S. should take the leadership role big time. I think what the U.S. should do is price carbon. That is the leadership role. If you price carbon, you will certainly reduce greenhouse gas emissions. If you prevent coal exports, you'll do nothing to stop greenhouse gas emissions globally. If we price carbon in the United States, we said, "Look, we're willing to pay dues for the cost of the emissions and the carbon content of the energy we consume." That will be an enormous step. That is a leadership effort that I would really hope that the environmental community would get behind and really support because that would really have meaningful change in terms of the global greenhouse gas emissions.

Because one of the things that happens if you price something and it's more expensive, people consume less of it and that's what's going to do it. I mean, simply jawboning and saying, "You can't export," is not going to change the fact that all the coal is going to get consumed. And there's many other countries in the world willing to sell China the coal. China has power plants that they built. They basically built the installed capacity of California every year for the past 15 years. Those power plants aren't going to get shut down, they're going to burn coal in them and that's the unfortunate reality.

**Bruce Nilles:** Waiting for a price on carbon with this Congress is saying, "We're doing nothing." We fundamentally disagree and that's why communities are saying, "We're shutting down our coal plants and going clean."

**Frank Wolak:** I completely disagree.

**Bruce Nilles:** So sitting around and saying, "Let's do some policy" which is not a reality. It's saying -- we're not accepting that defeatism.

**Frank Wolak:** No, I completely disagree with your premise in the sense that I think that there is a growing bipartisan support for pricing carbon. It's just that everybody has got to get behind and push it. So I think that there is a recognition that this is what's necessary. And so let's focus on what's really going to solve the problem, rather than vilify producers of a product that we all consume.

**Bruce Nilles:** We're solving the problem.

**Greg Dalton:** Richard Martin?

**Richard Martin:** I just want to elaborate on something that Bruce said that it's already happening in China. And in fact, China's coal consumption was flat last year after growing at a high percentage rate for decades, it was actually flat. And there's a forecast that's often quoted that China's coal consumption is going to double by 2035. And actually, there's, I believe, it was Citi that put out a report last year called Peak Coal in China saying that actually the use of coal in China could peak by 2020 or so. It may already have. And so this export strategy that Peabody Energy and other large



domestic coal producers are banking on is based on a fallacy, which is that coal consumption in China, and more generally in Asia, has only one way to go and that's up.

There have already been huge coal mining projects abandoned or canceled in Australia, which is the largest exporter of coal to China, because they don't see the future demand. So that curve is already starting to flat.

**Greg Dalton:** Frank Wolak, China's economy grew last year, greenhouse gases went down. That's a good thing. It's also happened in California. A little positive news.

We're going to turn to our lightning round here and we're going to ask each of you a yes or no question. I'm going to ask each of you this one. Stanford's divestment from coal stocks was a symbolic act lacking real substance. Frank Wolak, yes or no?

**Frank Wolak:** Yes. Of course, I have a policy brief on my website that discusses that. I think a far more productive approach is for Stanford again, to price carbon. I think Stanford can set the tone by essentially pricing the carbon content of all of its activities, and other major research universities can do the same. The interesting thing is Yale University is actually implementing a carbon charge and moving forward on that, and I have been participating in that process. So I think this is the way forward that's why I'm not pessimistic about the ability to price carbon. We send a bunch of students out that understand how that works and they're going to change the world. That's the way it's going to happen.

**Greg Dalton:** We'll try to get this. Okay, that's interesting. Thank you, Professor Wolak. We're going to try to get through this yes or no. Bruce Nilles, Stanford's divestment from coal was a symbolic act lacking real substance.

**Bruce Nilles:** It was terrific. Everyone needs to do their part to solve the climate crisis so that's getting money out of coal stocks.

**Greg Dalton:** So that's a no.

**Bruce Nilles:** Yes.

**Greg Dalton:** Richard Martin?

**Richard Martin:** Yes, it was symbolic but it's an important symbolic move.

**Greg Dalton:** Brian Yu?

**Brian Yu:** Yes, I think it was symbolic.

**Greg Dalton:** Symbolic but not financially meaningful?

**Brian Yu:** No.

**Greg Dalton:** Okay. Next question, the impact of President Obama's clean power plant on the coal industry has been exaggerated by the industry. Brian Yu, yes or no?

**Brian Yu:** Yes.

**Greg Dalton:** Richard Martin?

**Richard Martin:** No, I think they're right. It's the death knell.

**Greg Dalton:** Bruce Nilles?

**Bruce Nilles:** It hasn't happened yet but when it does, it will have a huge impact on the coal industry.

**Greg Dalton:** Frank Wolak, the clean plan, exaggerated or not?

**Frank Wolak:** Like I said, it's all being driven by the price of natural gas.

**Greg Dalton:** So not exactly. Richard Martin, China could clean up its conventional air pollution and still fry the Earth by moving coal plants to remote regions populated by ethnic minorities.

**Richard Martin:** Yes. And unfortunately, that is happening.

**Greg Dalton:** Bruce Nilles, the Sierra Club has no real answer for a 50-year-old coal miner who could be thrown out of work.

**Bruce Nilles:** We support Obama's plan to transition Appalachia.

**Greg Dalton:** You think they have -- Brian Yu, 2014 was a record year for financing coal projects by banks, such as Citi, J.P. Morgan and RBS. \$66 billion by one count. Yes or no? Big money last year in coal? He's thinking about the lawyers back at the office. Okay.

[Laughter]

**Brian Yu:** I'm going to plead the fifth. No. There were a lot of coals that needed refinancing their debts.

**Greg Dalton:** We talked with your lawyers just to get him up on stage here. Frank Wolak, environmentalists raise the cost of energy. Yes or no?

**Frank Wolak:** I don't know how to answer that. I don't know what -- sorry. I mean, certainly, I think that's the goal but whether -- it's unclear whether or not that's the case. I don't know.

**Greg Dalton:** Whether they do.

**Frank Wolak:** I haven't seen any studies to look at that.

**Greg Dalton:** On environment, okay.

**Bruce Nilles:** But you support a carbon tax which by its definition is going to increase the price of electricity.

**Frank Wolak:** Yeah, of course, but that's not environmentalists.

**Bruce Nilles:** Okay. So environmentalist we're in agreement.

**Frank Wolak:** That's a good policy. That's not environmentalist.

**Richard Martin:** That's making evident the costs that are already there that we just don't price into.

**Frank Wolak:** Yeah. I mean, so I think if you say that there are environmental costs associated with fossil fuel, I completely agree, yeah.

**Greg Dalton:** So that is --

**Frank Wolak:** That's why I want to price them.

**Greg Dalton:** So that's a social cost of carbon. So Brian Yu, is there a social cost of carbon recognized on Wall Street?

**Brian Yu:** No, I don't think there currently is.

**Greg Dalton:** Like, they know it's out there, but we don't pay it so we don't care?

**Brian Yu:** Well, part of it is difficult to quantify. I think you got a lot of countries that have tried. Australia tried it with a carbon tax a couple of years back. It got repealed. The EU tried it, they had a carbon tax in place, but I think that the cost of a ton of carbon these days is less than \$5 a ton. So it's been attempted. The tough part is we really don't know what the social cost is. So essentially, it's a stab in the dark.

**Frank Wolak:** We have a --

**Greg Dalton:** Frank Wolak?

**Frank Wolak:** I should just emphasize, we have a cap-and-trade market in the United States in California that I've actually devoted a lot of effort to. The current price of a ton of carbon in California is about \$12 a ton, and it's -- the market's working quite well. I think that California should try to spread it to the rest of the United States and certainly to the world. One of the big disappointments to me is the fact that the politicians in Sacramento aren't out there publicizing the fact that, "Look, there is a price on carbon in California, the economy is booming, you can do it too, the rest of the world." I mean, it really is a travesty that they're not doing that. I mean, if anything, they are keeping quiet about it which is something that they shouldn't be doing.

**Greg Dalton:** British Columbia also put a price on carbon pollution. They have a tax. Frank Wolak, did they do a good job there?

**Frank Wolak:** Well, I think there is a case -- in their case, I think it's a case of it's just a gas tax and most people don't like a gas tax. I mean, British Columbia gets virtually all of its electricity from zero carbon sources.

**Greg Dalton:** Hydroelectric.

**Frank Wolak:** So it's not like it's really costing them anything. I'd say if you want to say virtuous, we're more virtuous because we get most of our electricity from fossil fuels and we're willing to pay at least \$12 per ton cost for that. So I think that's great and I think we should publicize it.

**Greg Dalton:** Take that Canada. Okay.

**Frank Wolak:** Yeah.

**Greg Dalton:** We're talking about coal and other forms of energy at Climate One. Our guests are Brian Yu, director and senior analyst at Citi Research; Frank Wolak from Stanford; Bruce Nilles from the Sierra Club; and Richard Martin, author of the new book Coal Wars. I'm Greg Dalton and we'll be right back.

[CLIMATE ONE MINUTE]

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

*Maria Gunnoe is from a four-generation coal mining family in West Virginia. But when she saw how industrialized mining was destroying her land, water and community, she became an advocate for shutting it down. When Gunnoe came to Climate One in 2014, she told us that times are changing for the coal industry - and that miners need to be prepared.*

[CLIP]

**Greg Dalton:** *If you're successful, mines will be shut down and men will lose their jobs.*

**Maria Gunnoe:** *Including my son. And as a mother, I can't wait. [Laughter]*

*I love my son very much and I also -- he is a hard worker and he's never missed a day's work. He's a good employee. I also have two brothers that work in the coal mines. And he has learned the hard way that it's very necessary to be able to stand on your own and not depend on these companies for your life because you can't. I mean, it's not only environmental laws or regulation that shuts these companies down. When their bottom line drops, these men get laid off, period. In 1960, for instance, we had a 125,000 coal miners in the state of West Virginia. Now, we have less than 12,000 coal miners. And that's because of mechanization. That's not because of regulation.*

**Announcer:** *That was Maria Gunnoe in 2014. Her fight to stop mountaintop removal in Appalachia earned her death threats - and a Goldman Environmental Prize. Now, back to Greg Dalton and his guests at The Commonwealth Club.*

[END CLIMATE ONE MINUTE]

**Greg Dalton:** We're back at Climate One, talking about coal and energy. I'd like to ask Richard Martin about this place in China that you write about called Datong. It's kind of like the end of the earth. I went there 20 years ago. It is dark. It is gray. It's hard to describe how dismal this place is. You went to a particular mine there and you talked to a person who's in charge of the coal there. So tell us the story about you kind of finagled or maybe wiggled your way into this coal mine there in China. So set the scene for us there.

**Richard Martin:** Yeah. So Datong actually doesn't fit that description anymore, Greg. It's a thriving city of close to five million people, but it's a monoculture. It's all based on coal. And so yes, we went to a small mine near Datong, outside the city limits, and just kind of walked up. And it's an interesting dynamic in China. If you try to take a picture of a lone protester in Tiananmen Square, you're going to have police on you rather quickly. But out in the provinces where we were, where western journalists seldom venture, people are actually quite open and there was very little resistance as it were. So we walked up, talked to him a bit. The manager of the mine, the quality manager of the mine, invited us into his office. We talked to him for about an hour. And he is planning his future and his family's future as well because he makes small loans on the side to his colleagues and other townspeople. So he's kind of a financial operator in that sense.

And it was interesting, sitting in his office, I was looking through the window and it's actually next to a PLA, People's Liberation Army base, and there were big wind towers on the hillside literally overlooking this small, very dirty mine. And so what China is doing - and this is a very mixed blessing - is shutting down those illicit, unlicensed mines that for years and years have been operated in the provinces. What that means, unfortunately, is they're concentrating the coal mining and these huge operations. And they're -- as you alluded to earlier, they're building big power plants and cement plants and other industrial facilities that rely on coal right essentially at the mine mouth.

They're undertaking the largest electricity transmission project in the history of the world to basically ship that electricity to the coast. So as Bruce said, they're shutting down the coal plants in Beijing and Shanghai, but essentially they're moving it to the interior which is not going to help the climate.

**Greg Dalton:** What plan does China have for workers? There's a lot of concern. They want political stability in China. Coal workers that are displaced, are they taken care of?

**Richard Martin:** No. I mean, I talked to a couple of retired miners at that same site, and they're taken care of. They've got their pensions. Their health care is taken care of, et cetera. I mean, after all, it is still nominally a communist country. But what I was told was that there are kids who are still working in the mines that haven't been paid in months. And so what's happening in China is, there's been this implicit bargain for decades during this economic miracle. We will give you 10% economic growth a year, we'll bring millions of people into the middle class, which is an astonishing achievement. In return, you will give us political acquiescence and acceptance of severe environmental damage, and that bargain is breaking down. And I think the leaders in Beijing are fearful that they're going to have a revolution on their hands if they really try to shut down the coal industry quickly. So that's a bit of an insoluble problem at this point.

**Greg Dalton:** If they don't shut down the coal, they've got middle-class property owners and people who want to breathe and there's now environmental refugees from China. But if they do shut it down, they've got social instability.

Brian Yu, let's ask you about the prospect of clean coal. Can coal be cleaned up with some kind of new technology? Basically, filters on the top of smokestacks or other technologies? We hear a lot of advertisements used to be about clean coal.

**Brian Yu:** Yeah. You've got different types of technologies out there already and there's what they call scrubbers. It takes out a lot of the SO<sub>x</sub> and NO<sub>x</sub>, sulfur dioxide and then nitrous oxide. But the one part that really we really haven't been able to see people remove is carbon and there's been talk about what they call CCS - carbon capture sequestration - but it is extremely expensive given where the technology is today. So in essence, we've been able to get rid of a few pollutants but not carbon.

**Greg Dalton:** Frank Wolak, clean coal, is that kind of an oxymoron or is that something that could really happen?

**Frank Wolak:** Well, certainly, I think as was alluded to, there's carbon capture and sequestration and I think -- I mean, personally, I think one thing that would be a very interesting prospect is to say, "Look, what we want is a zero-carbon portfolio standard. Solar provides it. Wind provides it. Carbon capture and sequestration that sequesters the CO<sub>2</sub> associated with coal, that could provide it too. I mean, let's see." Largely because I mean the simplest way I think about it is, is that China's coal consumption is four times, at least four times the United States. They built all these power plants. If we want them to essentially reduce greenhouse gas emissions, we got to come up with the technology that's going to allow them to burn coal.

Because I mean, if we could reduce our greenhouse gases to very little, we still don't solve the problem. So the big thing is we need to develop the technology that we can then hopefully export to China to help them to effectively burn the coal that we know that they're going to burn, to essentially mitigate the climate implications of it. And so getting out there and developing this technology, I think is something that really is unfortunate but essential to really addressing the problem.

**Greg Dalton:** Bruce Nilles, clean coal worth pursuing?

**Bruce Nilles:** So we spent many years at Sierra Club trying to work out, is there a path forward for coal? And when you look and you're honest about the impact of coal has on the mining, the burning and disposal of coal ash and the pollutant, there is no step in that lifecycle where there is the local community is being protected and not enormous environmental cost. Here in California, we love our mountains. Imagine if someone said to us, "The price of prosperity is we're going to blow up 500 of the mountains in California in the next ten years, and pollute 10,000 miles of rivers." Do you think that would ever happen in California? It would ever happen anywhere but Appalachia? And that's what we have done in the last ten years in pursuit of this prosperity of continuing our reliance on coal.

So when we think about clean coal, it is truly an oxymoron because as long as we are using coal, someone is getting screwed somewhere. That's the hard and fast reality. The workers, you mentioned the workers, the coal mining industry has done a terrific job of busting all the unions. And so as the coal industry is shrinking in the United States, these workers are being laid off with no pensions and no rights, and a lot of healthcare costs. We, as a country, owe it just as we did to the Pacific loggers, the loggers in the Pacific Northwest, the tobacco farmers in the south. We need, as a country, to come together and help Appalachia and the workers make this transition with healthcare and pensions and say, "Coal may have served us well over the last hundred years, but it is time, it is long due and over time to move on as fast as we possibly can because there is no such thing as clean coal.

**Greg Dalton:** Richard Martin, you write about President Obama's all-of-the-above strategy and you have an interesting sort of personal healthcare analogy for that. What's the personal healthcare analogy, or dietary analogy, for all-of-the-above?

**Richard Martin:** Yeah. So anyone who has an all-of-the-above energy strategy, the translation of that is, "I am in the pockets of the fossil fuel industry." So that's my personal view. But what I said in the book was that an all-of-the-above strategy is like an alcoholic who smokes three packs a day, saying, "I'm also going to drink some vegetable smoothies, but I'm not going to quit smoking or drinking." So it doesn't really accomplish the task that is before us.

I just want to add one thing on clean coal technology. I talked about storage earlier and there's really exciting technological developments on the horizon in energy storage. That is not the case in cleaning up coal. It is a brute force technology. You have to force the smoke through a membrane, and there is no technology on the horizon that are going to bring those costs down. So that is a way for the coal industry to pay millions of dollars a year to say, "Yes, we're going to clean up coal" while they keep burning it in the meantime.

**Greg Dalton:** Frank Wolak, do American taxpayers get a just price from coal extracted from public lands?

**Frank Wolak:** I don't know what a just price is. Sir Thomas Moore knew, but I'm an economist, I know what a market price is. But it's up to the political process, I think, to decide what it is that they're going to charge for extraction on government lands, and I think that's up to the political process to determine. There are, for example, in all of the states that have mineral resources, there are severance taxes that are charged to the resource extractor to pull the resource out of the ground in places like --

**Greg Dalton:** Except for oil in California. Well, that's a separate story.

**Frank Wolak:** Yeah.

**Greg Dalton:** Right.

**Frank Wolak:** No, that's true. California is one of the peculiar states in the sense that that's another one that's kind of a puzzle for California. But Wyoming and Montana both have fairly substantial severance taxes on coal extraction within their boundaries. But I guess I would just take issue with the point about CCS. I mean, knowing at Stanford and at MIT and at other places, there's lots of research that is going on and there's lots of research on battery technology. So I mean, I'm a technological optimist. I think there's a lot of smart people working on it. So if they thought it was a dead-end, I think they'd stop working on it. So I think that we'll see. But I mean, to me, if you're at all serious about the climate, it's got to be there because the Chinese are consuming coal at a rapid rate.

**Greg Dalton:** The business models of a lot of fossil fuel companies are banking on that. Without that, Brian Yu, they're in real trouble. But I want to ask you about churches and universities around the country are debating the morality of fossil fuels. Some are divesting. Does that having any impact on coal or other stocks, Brian Yu?

**Brian Yu:** No, I don't really see them having much of an impact largely because if you look at the publicly-traded companies out there, especially in the U.S., they're such a small portion of the overall market that I think it would be a good illustration of what their -- it sends a message, but it really doesn't have an impact on the stocks themselves and how they trade in the marketplace.

**Greg Dalton:** Could it if more institutions divested or is it just makes it cheaper for some of your clients to buy?

**Brian Yu:** I think there's very little institutional ownership at this point in time that it's an easy call to make.

**Greg Dalton:** Who's buying these coal stocks?

**Brian Yu:** There's a lot of trading activity, but I think a lot of big institutions have already divested interests. I'm not even talking about churches, these are your pension fund investitures.

**Greg Dalton:** Smart money's out of coal.

**Brian Yu:** Smart money, they're essentially out of coal, not necessarily for environmental reasons, it's just economic reasons. When you have low oil prices, low natural gas prices, you look at the price of coal, whether it's in Europe or in China, they've dropped dramatically that the U.S. companies it makes it very uneconomic for them to even try to export any material at this point in time. It just doesn't make any sense.

**Greg Dalton:** We're talking about coal and energy at Climate One. I'm Greg Dalton. We have Brian Yu from Citi Research; Frank Wolak from Stanford; Bruce Nilles from the Sierra Club; and Richard Martin, author of Coal Wars.

**Frank Wolak:** I mean, I would just wanted to comment on something that Brian said. I mean, if you look at 2008, when the price of oil was \$140 a barrel, Central Appalachian coal was selling around the order of \$140 a ton. Right now, where the price of oil is in the range of probably \$50 a barrel and selling for \$45 a ton so it's the substitute for oil. And when oil is expensive, you get more substitute to coal.

**Greg Dalton:** Let's have our audience question. Welcome to Climate One.

**Rick Mikhalevsky:** Hi. My name is Rick Mikhalevsky. Both my grandparents and both grandfathers and most of my uncles were working-class coal miners. Today, I looked at Arch Coal and Peabody, their stock performance over the last -- since 2011, and I saw just toiletizing, shall we say. What I'm concerned about is the people who are working in the coal mines, or now are not working in the coal mines. There's been some noise about a carbon fee and rebate program, where the rebate would be spread to the population. Wouldn't it make more sense to spread that, take that rebate, and give it to the workers who are being displaced?

**Greg Dalton:** Frank Wolak, big fights in California about where the money goes from pricing carbon? Everybody in the legislature has an idea. What about the workers?

**Frank Wolak:** I certainly very much think -- I mean, personally as a voter, I think that's a great idea. I mean, it makes a lot of sense. The unfortunate thing is who knows how the political process will work. But if offered as a ballot proposition in California, I would vote for it.

**Greg Dalton:** Governor Jay Inslee in Washington, his idea is to give it to education or something else. Every politician has a different idea. Let's go to our next question. Welcome to Climate One.

**Anna Foreman:** Hi. My name is Anna Foreman. I was just wondering if I could hear from you guys how you think we could realistically implement a triple bottom line in a capitalist society.

**Greg Dalton:** Explain what triple bottom line? Brand new. People planet profit, is that what you have in mind?

**Anna Foreman:** Yes. Yeah.

**Greg Dalton:** Okay.

**Anna Foreman:** It goes along.

**Greg Dalton:** Different kind of capitalism, Brian Yu.

**Brian Yu:** Boy, I don't know how to answer that. I mean, I would generally agree with what Frank. If you're trying to improve the situation, basically you'll put a cost on coal emissions essentially the cap-and-trade type of system, and try to redistribute those dollars that come in, in ways that essentially benefits the people that are displaced by the regulation.

**Greg Dalton:** One of the big drivers is compounded quarterly profits. We all like that for our retirement plans. That drives a short-term behavior. It means that we don't -- company's executives are not incentivized to consider long-term things that don't hit their balance sheet, things that might happen after they leave office. So realigning the investment horizon and the incentives might be one way.

**Brian Yu:** Yeah. I think it comes down and the way I look at it and me being a numbers guys is that I think that the numbers make the world turn around when you look at why China is burning coal. It's because coal is cheaper.

Why are we burning more natural gas here? It's because gas is cheaper. So the way to make people move in a certain direction, you got to put a price on certain things. And then, again, I agree with Frank that we need to put something in there, maybe that's a carbon, some sort of a cost on carbon, but I think the biggest issue is how do you do that not only on state level or on national level, on a



global level so that it's equal playing field. Some of the companies that I follow who are metals producers, what they'll say is, Fine. You put a carbon tax in the U.S., it makes us uncompetitive. We're not going to make as much steel, not as much aluminum. China is going to get the business." So does that make it any better if we move our manufacturing offshore where they're doing even less to try to improve that?

**Greg Dalton:** Bruce?

**Bruce Nilles:** And it's a fact that sometimes our markets don't work, and we have to ban something, right? The reason we don't have lead in gasoline is not because we put a price on lead in your gasoline and said, "It's okay to kill X number of kids." We said, "No, the health evidence is uncontroversial. We need to ban the use of lead in gasoline." If you think about the history of coal, it was 700 years ago that the first King of England said, "We need to limit coal burning in London because it's creating problems," 700 years ago. It took until 1956 for these health studies to catch up with what everybody knew when you're breathing that junk, it's really bad for your health. In 1956, London banned the use of coal in the urban area. It wasn't a market based because the market wasn't working.

We knew that the problems associated with coal burning in London was causing huge amounts of health impacts and it was time to phase it out. And so there are certain things that we just need to not wait for the market because the market is sort of just one mechanism to get there. When we have a problem like climate change, let's get on the path of phasing out fossil fuels and we know how to do it. Clean energy is scaling up at rapid levels today here in California and around the country. And so this notion of trying to come up with some fancy policy around the market, let's just agree that fossil fuels are having profound impacts. We don't need them. There are cheaper alternatives, and let's get on that reasonable glide path over the next 10 to 15 years to phase them all out.

**Greg Dalton:** Let's have our next audience question. Welcome.

**Male Participant:** How long will it be before the Sierra Club goes after big oil after they calm the coal industry down?

**Greg Dalton:** Bruce Nilles?

**Bruce Nilles:** Our board recently adopted a policy to say that our goal that we are working through our advocacy to accomplish is, in electric sector, all fossil fuels, coal and gas, are gone in the next 15 years. Yes, that's aggressive. We think it's doable. We think it's what the science requires. In terms of oil, our current policy is that we cut our U.S. consumption in half, which three months ago seemed very audacious and then Governor Brown announced the same goal for California. And so I think there is a growing consensus that through the use of electric vehicles and a whole bunch of other rapidly emerging technologies, we can slash our oil use very, very quickly, and that's what the science demands. So at least half the oil by 2030, and then all the oil out of our economy over the next 35 years.

**Greg Dalton:** We're talking about coal and energy at Climate One. You can follow us and join the conversation using our Twitter handle @climateone. Let's have our next question.

**Male Participant:** Hi. Thanks for the panel talk. I'm wondering if the panelists could comment on Harvard Professor Laurence Tribe's recent activities on behalf of Peabody. And also think maybe more broadly on the endgame for these politically powerful companies and sort of how that can be managed best for everyone.

**Greg Dalton:** Who wants to take the constitutionality? Richard Martin?

**Richard Martin:** Well, I'm not going to comment on the constitutional issues on which Professor Tribe is much more of an expert than I am. But what he said was, "Yes, I am getting paid to do this by Peabody Energy but I'm independent." And he may well be but let me assure you that by taking money from a coal company to study this question, automatically disqualifies him from any legitimacy on the issue. So it was sort of distressing because I have great respect for the guy's work, but he's just disqualified himself as far as I'm concerned.

**Greg Dalton:** Does the same apply to university research that gets energy company funding?

**Richard Martin:** I personally don't think so largely because I mean you're subject to peer review in a university, thank goodness. I wish that there were more peer review in other parts of the economy. I mean, if what you want to do is actually take your research and publish it, you actually -- and your claims and actually promulgate those -- you actually have to get them reviewed by peers who perhaps may not have the same perspective as you, and who will say, "Look, you are grinding an axe for say the funder or whatever, we're not going to publish your paper unless you basically address this issue. Do this additional analysis to buttress what claims you are making."

So I think that -- I mean I guess there I think that you're giving up on a very valuable sort of source of funds, information, knowledge, by not working with the industry as an academic. The other thing is, in the most cases, the academics aren't getting paid enough probably for it to matter, but maybe it does, but I still think that the peer review process is a very effective discipline on a lot of the stuff you might be worried about.

**Greg Dalton:** Yeah. Let's go to our next question on Climate One.

**Male Participant:** Hi there. This is probably a better question for Bruce or Richard, but I was wondering if you could comment on how important it is to overturn the decision on Citizen United in terms of being able to move climate change and resources forward?

**Greg Dalton:** Brian, I guarantee you, no lawyer at Citi is listening.

**Brian Yu:** I'm not even sure how to go about answering that.

**Greg Dalton:** Richard Martin?

**Richard Martin:** Well, that's a question that applies in many fields beyond climate change, but I will say here's a piece of full disclosure. The company I work for, Navigant Research, has done work for an organization called Advanced Energy Economy which is largely funded by Tom Steyer who, of course, is the billionaire hedge fund manager who has made it his life's mission to limit global climate change. And so, in that sense, he's kind of becoming -- he's often been called one of the Koch brothers of the left. And so I think what we're seeing is it's not just the right that is taking advantage of the sort of un-limit, the lack of limits on money and political campaigns. And whether that's a good thing or a bad thing, I'm not going to get into but it is happening. I think, fortunately, there's money on the other side as well is all I would say.

**Greg Dalton:** Tom Steyer made some of that money in coal and oil sands and other things. We are gonna wrap up here at Climate One, asking each of you, what's the next thing you're going to do, Frank Wolak, to reduce your personal carbon footprint?

**Frank Wolak:** Well, the thing that I'm doing is, there's actually a website. It is called [universitiespricecarbon.org](http://universitiespricecarbon.org). I'm trying to encourage all universities to join in pricing carbon

through the effective teaching the future generation of students that yes, it can be done and it can be done at your university. They go out. They actually implement that at their universities. They go out into the world. And this will be much less of a challenge so that we can actually make meaningful progress to address the climate challenge.

**Greg Dalton:** Great. So tuition will go up even more. Okay, Bruce Nilles.

**Bruce Nilles:** So I was just able to buy a home and looking to buy to put solar on the roof as the quickest, easiest and cheapest way to do a lot in my own personal home. So I'm very excited about going solar very shortly.

**Greg Dalton:** Richard Martin?

**Richard Martin:** So I live in Boulder, Colorado. And Boulder, as some of you may have heard, there was a referendum last year to municipalize which means we're going to run our own utility and break off from the wider power grid which is run by Xcel. And there's a long section in the book about that and I think it's a questionable move, but it is a way of sort of breaking the monopoly structure of the utilities in many parts of the country. It's a growing trend. You're seeing municipalization happening in many communities around the country.

**Greg Dalton:** Brian Yu?

**Brian Yu:** I think for me it's probably fairly simple in terms of you're trying to just use less electricity around the house, switching out those bulbs for LED, and just reduce my own personal consumption of electricity.

**Greg Dalton:** I want to thank our guests today at Climate One. We've been hearing from Richard Martin, author of *Coal Wars: The Future of Energy and the Fate of the Planet*; Bruce Nilles, deputy conservation director of the Sierra Club; Frank Wolak, director of the Program on Energy and Sustainable Development at Stanford; and Brian Yu, director and senior analyst at Citi Research. I'm Greg Dalton. You can join the conversation on Twitter using our handle @climateone, and find a podcast of this and other programs at our website [climateone.org](http://climateone.org). Thanks to our audience here in the room, and also online and on air. Thank you all. Thanks for coming.

**Richard Martin:** Thanks very much.

[Applause]