

# Fracking News

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**Greg Dalton:** On Climate One today, we're discussing hydraulic fracturing for oil and natural gas. The injection of water or steam into shale rock at high pressure, a process known as fracking, is driving a boom in the United States of natural gas to generate electricity and oil to move cars and trucks. Increased supply of natural gas has fundamentally changed the energy, the politics and energy in America and economics undercutting the price of electricity powered by coal nuclear and renewable sources.

But fracking, which is mostly associated with drilling for natural gas, is highly controversial. Proponents say it can be done safely and responsibly with proper government oversight and company disclosure. Critics say fracking is not regulated adequately and is contaminating groundwater with toxic chemicals.

I'm Greg Dalton and over the next hour we'll talk about fracking in California and around the country with our live audience here at the Commonwealth Club in San Francisco. We're pleased to be joined by two reporters covering fracking for gas and oil.

David Baker has written about energy for the *San Francisco Chronicle* since 2004. He's reporting has covered nuclear wind and solar power and offshore oil drilling. Abrahm Lustgarten is a reporter for *ProPublica*, an online investigative news organization. His investigation of fracking for natural gas received an award for Best Energy Writing from the Natural Press Foundation and his reporting on BP on the Deepwater Horizon tragedy was nominated for an Emmy. Please welcome them to Climate One.

[Applause]

**Greg Dalton:** David Baker, let's begin with you. Tell us - describe for us the shale boom and what it's doing to the energy landscape in America.

**David Baker:** It's doing a couple of things and it's the most profound revolution that we've had in energy outside of the renewable stuff that's coming along online. The most profound revolution we've had in decades. It is unlocked natural gas supplies that in the past we just couldn't get to.

And more recently its unlocking oil supplies that were known for a long time but have just been not economical to produce, and so suddenly the dynamics and the politics of energy have been really upended within the last five or six years because we've got bigger supplies of these things than we thought just five, six, seven years ago.

**Greg Dalton:** So it's a real game changer. Abrahm Lustgarten, *Time Magazine* had a cover story with a shale rock and said, "This rock can power the world." Is that right?

**Abrahm Lustgarten:** Well, there's an enormous amount, as David was just saying, of both oil and gas trapped in the shale rocks. They don't flow out naturally. They're not what the industry had long called for 150 years of development conventional fuel.

So there's carbon in everything and there's carbon in these rocks and the whole idea is that this

technology releases a certain amount of carbon that's accessible at a certain reach that was just out of reach before. So yes, in terms of natural gas, there seems to be a very large supply. It's not quite clear if that supply is significant enough to last 100 years as some people say but it certainly could run power plants for the foreseeable future.

**Greg Dalton:** And the upside of it is that it's domestic, it's supposedly cleaner than coal - we'll talk about that - whether that's actually the case and it's cheaper. So it's cheaper, cleaner, sounds like a pretty good deal.

**Abrahm Lustgarten:** I think that remains to be seen.

[Laughter]

**Greg Dalton:** What are the possible downsides to natural gas?

**Abrahm Lustgarten:** Well, there's the risk of water contamination. We've all heard a lot about. Anecdotally, if you travel to - which I have done - the places where drilling has happened across the country, there are stories, complaints of serious environmental problems having to do with water risk, people's water taps, underground water resources surface water systems, those stories are prolific.

There's a lot of byproducts not just the fracking itself but from the entire drilling process that cause serious environmental risk. And you mentioned that gas is cleaner and it is when it's burned but there are still a lot of unanswered questions about how much gas both methane and then the lengthier hydrocarbons, like propane, hexane, how much they leak into the atmosphere when gas is drilled or when it's transported or when it's prepared for use. And the more we use gas, the more those leakage numbers add up and could also affect the climate equation.

**Greg Dalton:** So gas could be the same as or just slightly better than coal, is that right?

**Abrahm Lustgarten:** Yeah, it burns -

**Greg Dalton:** Depending on how its extracted?

**Abrahm Lustgarten:** It burns far cleaner than coal. The analysis that I've seen of the life cycle put it, depending on who you ask, put it as still an advantage by the consensus but maybe much lesser advantage than the energy industry would like you to believe.

**Greg Dalton:** David Baker, is it better than coal?

**David Baker:** Well, the main thing that's still outstanding, I think, is what he started to mention about the leakage. I mean that's potentially a huge problem. The reason that some people like the natural gas boom, who might not otherwise like it, is the fact that it has allowed us to start shifting away from coal.

And even before President Obama started talking about regulating emissions from coal plants, companies had stop proposing new coal plants because natural gas was coming online so fast, and was getting to be so cheap. And that's been a huge benefit in terms of trying to shave down our greenhouse gas emissions in the country.

But if it turns out the leakage problem is worse than we realize, all those gains could be erased

because methane is a much more potent greenhouse gas than carbon dioxide. It seems some estimate saying is about 20 times as powerful so you don't have to have a lot of leakage in order for that to wipe out the whole climate benefit that we're hoping to get from natural gas.

**Greg Dalton:** And how do we know that there's thousands of wells that are fracked in the United States and are they being monitored? Who knows if this leakage is happening? Abraham?

**Abrahm Lustgarten:** Well, we don't really know. The monitoring and observation of what happens in the drilling fields is increased and improved dramatically in the past four or five years, but I'd say it's still willfully inadequate. Most states don't have laws in place that would even require a driller to notify the state or seek a permit to hydraulically fracture a formation before they do it. A couple of years ago, none did.

And as far as monitoring for contaminants, that's pretty much a different conversation altogether and it almost doesn't happen, and it is subject to independent scientific research and financing and so forth. There generally is no system to monitor for groundwater quality. There are aquifers that we haven't even identified that are drinking water sources or potential drinking water sources.

But even those that we have identified, there's nothing like systematic detection of the quality in that water to tell whether there's contaminants, whether it's from agriculture or from fracking or what have you. And the same with the air quality concerns we're talking about. There have been localized research endeavors begun in a number of the drilling hotspots since this debate began in the last couple of years. But before 2009-2010, there was nothing being done to monitor air quality in drilling areas and it's still a miniscule fraction of drilling geographies now.

**Greg Dalton:** Let's take a second here to just basically describe what fracking is. There's oil and gas wells. What happens? David Baker, just give us a real brief sort of the objection of what's going on?

**David Baker:** The basic idea is that you drill a well down into a shale rock formation, and you shove down into it a large amount of water mixed with a small amount of sand and chemicals. The chemicals are usually less than 5 percent of what you're shoving down but you pump it all in there under very high pressure and it will crack the rocks down at the bottom. And that will - you create sort of a network of cracks that allows either oil or gas to escape from the rock and get to the well and will come back up.

We've had this technology around for a very long time but what's happened recently that sort of revolutionized things is we've gotten better at combining it with horizontal drilling, which is drilling down and then basically taking a right turn when you get to the formation you like. And so instead of just fracking a little bit along the way, you're actually fracking a couple of miles of rock as you go and that's the basic technique. And there are tweaks on it that people have.

**Greg Dalton:** And Abraham Lustgarten, what's in the fracking fluid that this cocktail that goes down there to help get release those bubbles in the rock that come out as oil or gas? What's in the fluid?

**Abrahm Lustgarten:** Specifically, we don't know and that's one of the key issues. Generally, it's a mixture of lubricants and things called surfactants and other materials that are meant to reduce friction when these substances are put into the well and increase the flow rate when it comes out and have all these sort of different effects. But as far as what the actual chemical makeup is, it's a bit of a mystery.

The oil and gas industry claimed it protect its information as proprietary. They say that they're

competitive trade secrets. They use the analogy "Coke doesn't want to divulge its recipe to Pepsi." The federal government has accepted this so far as far as application to federal laws. It's exempted from parts of the law that would require disclosure and the industry kind of ambles along this way and lets the debate unfold.

And over the past couple of years, there has been a clamor of request to understand what's being put underground. There have been a lot of really substantive steps towards increased disclosure. A couple of states are now requiring it, which is a really positive development and the industry has developed a disclosure and quasi-transparency site that have caused FracFocus where they actually post all sorts of data about the wells that they drill, including what chemicals they put underground.

It's an improvement. We know a lot more than we did before but I haven't analyzed that data personally but those that have say that it's still has a lot of holes. And when I talk to state regulators in the places where disclosure is now required, places like Wyoming for example, they still make exceptions and they still allow for the protection of certain business information. And what they found after the law has been in place for a couple of years is that the company has really pushed the limits on what they can get away with so there's still a great deal of information that is not disclosed. So we don't know exactly how much.

**Greg Dalton:** David Baker?

**David Baker:** Yeah. We have in California, we have not previously regulated fracking any differently than we do any other form of oil and gas drilling but the State Division of Oil, Gas & Geothermal Resources are basically the regulators at the state level are developing instead of regulations that they're trying to finalize in the next year or so. Part of it does require reporting of the chemicals but they keep in that exception of, "Well, you don't have to publicize everything if you can prove to us it's a trade secret." Under these regulations, the companies would still have to cough up that information to the state if the state requested it but the state wouldn't release it to you. So it'll still be essentially a secret.

**Greg Dalton:** And companies doing this drilling often say that it happens very deep below aquifers and that basically the bad stuff can't get back up into water tables in supply communities. Is that the case, Abrahm Lustgarten?

**Abrahm Lustgarten:** This is a very logical sounding argument that is kind of the fundamental talking point on this issue. I actually just don't think we know enough to say whether that's true or not. I've done a lot of research into this issue and found a lot of geohydrologist and hydrologist who have more reason to think that it's not true than it is true at this point but they don't really know for sure.

I haven't seen peer-reviewed scientific journal research that substantiates that idea that has tested the hypothesis that something simply because of distance or because of the layers in the rock cannot migrate up into drinking water aquifers and there's a lot of new understandings, new discoveries about the extent of natural fracture systems underground, natural fault systems. Weird things about the way water flows and is pressurized that defies conventional understanding. And every time one of these things come up, it really changes the thinking around what's possible and what's not but often it comes up in other disciplines, whether it's geothermal energy instead of natural gas and they're not necessarily cross-pollinating.

**Greg Dalton:** And Abrahm Lustgarten, you've done reporting a couple of years ago where you said there was a thousand cases of documented water contamination, directly or indirectly, from fracking

activity. Explain that.

**Abrahm Lustgarten:** Yeah, that's right. That was just the start. I think it was the first or one of the first stories that I've done on this subject, and we're just trying to get a quick measure in some of the drilling hotspots of how much of an issue water contamination was. So that's a figure that includes - that's groundwater contamination but includes from all sorts of causes, including surface spills perhaps from fracking underground, perhaps from leaking in the pipe mechanism itself. We basically combined figures that were available from state agencies in the majority of them I think where that number came from New Mexico and from Colorado, handful from Ohio and Pennsylvania and so forth.

New Mexico, for example, had just completed it at that time of study, finding that in 700 cases, the waste pits that hold used fracking fluids had their unlined in New Mexico at the time and that they had leaked into and contaminated groundwater sources. Colorado state regulators, the state oil and gas agency has a really incredible dynamic data source on their website and you go in and search for whatever parameters you want, and one of them is groundwater contaminations.

So you can just run a query that selects natural gas wells and the state will say that 99 percent of the wells in the state are fracked. So natural gas wells with accidents or incidents that have happened underground and contaminated groundwater in some way, and that query contributed a couple thousand results the last time I've looked.

**Greg Dalton:** And what happens when water is contaminated then what? Can it be cleaned up? Who pays? Who's responsible?

[Laughter]

**Abrahm Lustgarten:** Well, there's a lot of different ways to talk about water contamination but to look at aquifer contamination, the prospect that a large body of water underground is polluted, generally can't be cleaned up and historically shows that it's very, very difficult to do so. I'm thinking of a federal study from on a related issue of waste injection but because back to the late 80s that looked at the government accountability office, looked at, I think, 23 different incidents across the country of aquifer contamination a lot from oil and gas but from various industries. And you just go down the list of what was done and one after one it says no remediation plan, too expensive. So generally, it doesn't happen.

**Greg Dalton:** So yeah. Okay. David Baker, any known water contamination in California?

**David Baker:** From oil wells?

**Greg Dalton:** Fracking oil or gas but most of the fracking in California is for oil.

**David Baker:** Yeah. I actually I asked that the other day of the guy who heads the state regulatory agency. He said he could not recall any instance in which there was actual aquifer contamination from wells. Now you could recall instances where they had problems with well casings and liquids did get out of the wells.

**Greg Dalton:** Casing is like that the exterior case of a well that goes down into the ground?

**David Baker:** Yeah. Essentially, oil wells are all constructed as like sort of like a straw within a straw within a straw. They have different layers to keep the fluids that your working with from

getting in to the surrounding rock but it can still happen. You can still develop cracks. The casing can fail. And this gentleman was telling me, "Yeah. They have had cases where the casing has failed and produce water oil will get out into the surrounding rocks."

The way they usually deal with that is you stop up the bottom of the well. You start pumping out from the top, and you suck the stuff out, and that way you can usually get this. So it's sort of like sucking poison from a wound I guess. But yeah, he said there were - he could not recall any instance of an aquifer actually being contaminated in the end.

**Greg Dalton:** Let's talk about the environmental protection agency, which the national watchdog presumably watching over these things. Abraham Lustgarten, you've written in Wyoming and Pennsylvania and Texas about the EPA backing off so let's talk about Pavilion first in Wyoming in that case there, that story.

**Abraham Lustgarten:** Yeah, sure. Pavilion, Wyoming is a little rural town about 150 miles east of Jackson Hole or Jackson and it's a real intensely drilled area for natural gas.

Starting in the mid 1990s, residents there began complaining that their water was found that they're having trouble. One guy tells me that has a well across his field, was fracked, his washing machine turned black and cloudy. Others complained of bad taste. I went there and we filled the stock well with water out of another gentleman's tap and took a torch to it on the top and lit them fire and melted.

**Greg Dalton:** Just like the movie.

**Abraham Lustgarten:** Just like the movie. So they've been complaining for years and years, and the state had investigated not really found a whole lot of problems and wasn't pursuing it aggressively. And in 2008, the EPA stepped in under their Superfund program to figure out what was wrong with the water there.

This is a little bit pre-fracturing controversy and this wasn't - begun as an investigation into drilling per se just environmental concerns. And over a couple of years that followed, they did dozens of water test and they found pretty concerning evidence to EPA scientist anyway that the gas drilling was the cause that there are probably multiple potential causes but among them were wells that were fracked. They found trace levels of chemicals that are known to be used in hydraulic fracturing. They went through several layers of research, retesting different phases and the study became more and more controversial.

And then just this spring, last month, early June I think, the agency having completed all of its research and just on the end of its public comment period and about to peer review its findings, abandoned the study. Backed out of it completely and said it will not finalize or certify its results and it was turning it back over to the state of Wyoming.

**Greg Dalton:** And who is funding the study in the state of Wyoming?

**Abraham Lustgarten:** The state of Wyoming is using a \$1.5 million contribution from Encana, which is a Canadian oil and gas company that drilled the wells in Pavilion, Wyoming.

**Greg Dalton:** If you're just joining us, we're talking about hydraulic fracturing for oil and gas at Climate One. Our guests are Abraham Lustgarten, a reporter with *ProPublica*; and David Baker, a reporter with the *San Francisco Chronicle*. I'm Greg Dalton. Let's talk about one other case in Texas,

Goliad County and there are some people connected to Washington that had a similar influence on change of course there in Texas.

**Abrahm Lustgarten:** The natural gas related incident is -

**Greg Dalton:** Uranium energy, was that oil or gas?

**Abrahm Lustgarten:** That was uranium actually.

**Greg Dalton:** Okay.

**Abrahm Lustgarten:** So interesting different case. But in Parker County, Texas is another gas-related investigation.

**Greg Dalton:** Okay. Yeah, that's it.

**Abrahm Lustgarten:** Nearby but there's a good story about Goliad County as well that relates. But in Parker County, Texas also there was widespread methane contamination, flammable tap water coming out of people's taps and the EPA was quite alarmed, stepped in quite aggressively, filed a court order that stopped the drilling company there, Range Resources, from doing anything until they solved what was happening environmentally.

EPA hired a whole bunch of experts who found in their opinions very conclusive evidence that the two were connected that the gas drilling and the contamination were related. And once again, similar to Wyoming, abruptly dropped their case. There are a couple of other media investigations by the associated press and by a group called Energy Wire that separately found - reported that the EPA had agreed to a bit of quid pro quo to get the gas industries cooperation in other studies elsewhere, non-specified. And also that lobbyist for the industry had intervened on Range Resources behalf but there was never - the answer reason why they backed out of that study has never been clear and they never offered an explanation.

**Greg Dalton:** David Baker, Hinckley was a celebrated case in California where there was some water contamination related to natural gas distribution. You may remember Hinckley from *Erin Brockovich*, the movie, and that plume is actually getting bigger. And a 2010 test found that it actually is getting down into a water aquifer.

**David Baker:** Yeah. I mean that says a totally different end of the energy industry that you're talking about hexavalent chromium and it is their - it appears to be to stay. The plume is getting bigger. It's migrating. PG&E which is responsible for this has tried a couple of ways to pen in plume and basically like sucking water out of specific parts of the aquifer, hoping that you can sort of create a bit of a pen around it but it hasn't worked.

And I mean Hinckley, even though it's not about fracking, Hinckley is a pretty good demonstration of the dangers of toying around with an aquifer because if you taint somebody's drinking water, you have destroyed their property value from that point going forward. Nobody is going to want to buy your house and even if you got a replacement water supply, you're pretty much screwed in that way. And so that should be a big warning sign to people that this is not something you can monkey around with.

**Greg Dalton:** So when fracking is about to happen, do landowners need to be notified in advance that fracking will happen nearby, pre-notification, David Baker?

**David Baker:** Right now, no. There is a bill pending in Sacramento regarding fracking. There were actually about 11 of them at one point in this legislative session but there's only one remaining right now. It's from Senator Fran Pavley and it does require that. It does require a notification of surrounding property owners if you're going to frack a well.

It sets up a specific permit that you would need to get in order to frack a well. And so you'd have to notify the people around you. The proposed regulations that the state is looking at outside of that bill would not exactly require notifying your neighbors. It would simply require posting a notice that would go on a state website a couple of days before the frac job would start. I think its three days before the frac job would start. So you wouldn't have any specific warning that this was happening near you, you would just have to be very alert.

**Greg Dalton:** Until the trucks start rolling in. Abrahm Lustgarten, a lot of landowners are becoming instant millionaires by leasing their rights to natural gas on their land.

**Abrahm Lustgarten:** Yeah, absolutely. I mean this is - it's a mix bag like every part of this conversation but certainly energy development is something that can bring a lot of wealth to the places where it happens. And a lot of the energy development that we've seen in the last couple of years is in some of the poorest parts of the country.

When you look at Appalachian, West Virginia and rural parts of Pennsylvania, these are places that don't have a lot of jobs and haven't had a lot of employment and for some people have brought in a lot of money. I actually think there's really interesting questions to be answered still about whether they get the money that they're owed, whether they get as much money as they should be getting but no doubt there's a huge influx, not only of cash in terms of payments, but in terms of economic activity in new hotels and restaurant business and all the things that come along with having a boom.

**Greg Dalton:** Do some landowners have sort of lessors' remorse that they sell some leases and then have problems afterwards and go, "Oh, I wished I didn't do that." But then they're contractually obligated.

**Abrahm Lustgarten:** I talked to an enormous amount of people that have remorse of one form or another on this issue. Many from environmental reasons that we're talking about but others just for financial reasons they thought the payout would be bigger. They thought that the ratio of inconvenience or environmental impact or just disturbance to their property to payout would be different, that it would seem more worthwhile. There's a lot of people that kind of wish they could change the decisions that they made.

**Greg Dalton:** New York State, there's been a lot of fracking talk in New York State. There's currently a ban there. Let's talk about Governor Cuomo and where the status of fracking is in New York State. Abrahm Lustgarten?

**Abrahm Lustgarten:** I think Governor Cuomo is procrastinating and -

[Laughter]

**Greg Dalton:** He's running for president that's what he's saying.

**Abrahm Lustgarten:** I know Joe Martens, his environment commissioner, pretty well from before he was environment commissioner. There had been kind of an interesting bind and I think they're



just taking a very strategic path towards not making any decision quickly. If you watch closely New York politics, he'll move slightly incrementally when the pressure builds up and one side or the other, the drilling industry or the environmental community, really wants an answer. But there's no -

**Greg Dalton:** That's right. There was a whole film called *Dear Governor Cuomo* and a lot of Hollywood celebrities aimed - the film made basically, as the title suggests, for one person -

**Abrahm Lustgarten:** Yeah.

**Greg Dalton:** - to deliver that kind of pressure but it's coming from both sides. Sorry, go ahead.

**Abrahm Lustgarten:** Yeah. Well, I think a quick course in the background there is actually kind of interesting. New York was poised to plow ahead with drilling in the Marcellus Shale and they kind of turned on a dime and stopped all development in 2008, and ordered a new environmental impact study, which is a pretty big deal in New York state.

The idea was that that would go on for a year, year and a half. It answers some of these questions, and then probably proceed with drilling but maybe in a measured way or with certain precautions taken. And what happened since then is, well several things. I mean the issue became a huge national controversy. A lot of the opposition to drilling is in New York state, a lot of the environmental voice behind this issue.

Cuomo came into office. He wasn't at the beginning of this issue and he's kind of in a bind. It's potentially very unpopular to a Democrat to be pro-energy and anti-environment, and it's potentially lethal to any politician in the United States to be anti-energy. So take that on top of the opportunities that we discussed about gas being potentially cleaner in certain ways. It's just a very sticky situation and my read is that he intends to finish his term as governor without taking any stance on the issue.

**Greg Dalton:** And even some of the opponents of fracking in New York have run TV advertisements in Iowa for Presidential caucus sort of shot across the bow for Governor Cuomo's political ambitions on this issue. David Baker, in California, Governor Brown pretty sure is not running for president again. The -

**David Baker:** He says he's not but let's see.

**Greg Dalton:** Where is Governor Brown on fracking in California?

**David Baker:** He is not being quite as coy as Governor Cuomo. He's still up in the air, still on the fence and there are a lot of people trying to push him off of that fence. He has made very few public comments about it. The few that he has made sound like he is a little leaning a little more towards being comfortable with fracking than a lot of his supporters would like. He has talked a couple of times about what he calls the "extraordinary energy resources" that we've got here in the state.

He's talking about a specific shale formation called the Monterey Shale, which lies beneath most of the southern end of the Central Valley and then like going towards the coast, towards Vandenberg Air Force Base. It's estimated to be the biggest source of - well, the biggest oil-bearing shale formation in the United States at 15.4 billion barrels and so he's looking at those.

**Greg Dalton:** That's about half of all the oil in the Alaska North Slope. That's a ton of oil.

**David Baker:** It is indeed a ton of oil. And we, here in California, are actually becoming more

dependent on foreign imported oil than the rest of the country. The rest of the country is actually becoming less. So there's a real impetus for him to be interested in that. There is a report that USC put out a couple of months ago suggesting that if production really took off in the Marcellus Shale, that the state would add at least, I think 2.8 percent to its GDP.

**Greg Dalton:** In the Monterey Shale?

**David Baker:** Yeah.

**Greg Dalton:** Yeah.

**David Baker:** It's in the Monterey Shale if it really took off. So Governor Brown is still very much on the fence. A lot of environmental groups are trying to get him to take an anti-fracking position but he hasn't. There have been bills introduced to just halt fracking in the state. Those have all fallen apart. The bill I mentioned earlier from Pavley would have actually imposed a moratorium in 2015; if the state didn't finish its study of fracking is dangerous first. But in order to get the bill through the Senate, she took that out. So at the moment, it's still moving forward.

**Greg Dalton:** And the Monterey Shale could be a huge bonanza but do you think it actually will be developed? It's been known about for a long time and it's very knotty geography. It's hard to get at.

**David Baker:** Yeah.

**Greg Dalton:** It's not like Pennsylvania, Texas which is flat pancake, you kind of get in to it and you can suck lots of hydrocarbons out of it.

**David Baker:** Yeah, there's been a lot of hype and excitement in the oil industry about this particular formation but that's been true for four or five years now. And a lot of people are poking at it and trying it and fracking various wells here and there but it just has not taken off. It has stubbornly refused to take off the way production did in North Dakota or Texas and places like that.

When I ask why, I always get the same response so far which is that this shale formation, like all of the geology in California, is so crumpled, twisted, tilted and complicated that you can't necessarily use the same approach to fracking this well that you did at a well five miles away. So they can't - the companies can't do sort of a factory model approach where they know pretty much what they need to do well-to-well and just repeat it endlessly. It's much more complicated than that, and therefore, it may be much harder and more costly to produce.

**Greg Dalton:** Abrahm Lustgarten, and that much money in the ground, you think it will inevitably will come out and be burned?

**Abrahm Lustgarten:** I think eventually. I mean you can bet your lives on the fact that there really smart petroleum engineers trying to figure out how to solve what David is describing. Look at what's happening now in North Dakota and the Bakken Shale, and similarly, those are geologic formations that were known to hold oil back to the 1930s. And there were huge efforts to develop them in the 1970s and again in the 1990s, and it didn't really work out for various reasons, including frustrations with the geology and they've solved it now or they're solving it.

So it might be more complex here. I think David is probably a lot more familiar with that than I am but I do think that there's - I mean just from a research and development standpoint, there's not many things in this country that get the amount of resources and effort and attention that the oil

industry puts into accessing reserves of that size and it's just huge.

**Greg Dalton:** Abrahm Lustgarten is a reporter with *ProPublica*. Our other guest today at Climate One is David Baker, reporter with the *San Francisco Chronicle*. I'm Greg Dalton. Water is a big issue. We've been talking about contamination, not so much about competition for supply. Let's talk about how fracking can compete with agriculture and other people who want to use water. David Baker, I mean there is an ag versus oil scuffle over water in California.

**David Baker:** It's popped up in other states more than it has here. Colorado is sort of the poster boy for that. We've seen it also happening in Texas. And yeah, I mean if you get into a competition of bidding, oil companies are going to win. They can outbid ranchers and farmers pretty much any day.

California, so far, it hasn't really become an issue largely because the frac jobs in this state, so far, have not used nearly as much water as they have elsewhere in the country, and again, that's due to corks of geology. The formations that we've got here are very heavily loaded with briny, brackish water that it's not drinkable but it's locked in the rocks with the oil. And as a result of that, you don't actually have to pump as much water and chemicals and sand down into a fracked well in order to crack those rocks. You don't have to add as much to get the pressure that you want.

Also, so far, because of the geology down there, most of the fracking done in this state is not being done in connection with horizontal drilling. It's mostly going down and then fracking there. So you're not talking about as long a well in the end that you need to pump with water so whereas in other parts of the country, they're talking over a million gallons per well. Here in California, it's more on the order of a hundred thousand, two hundred thousand, three hundred thousand gallons of water per well. And as a result of that, we're not - we haven't seen the same kind of like really - we haven't seen the same kind of bidding war over water that you get in the few other places.

**Greg Dalton:** Abrahm Lustgarten, let's talk about that in other places, your experience on sort of the competition for water supply.

**Abrahm Lustgarten:** Yeah. I usually talk about Texas when this question comes up because I think it's the most interesting example of a water-starved area that is from a policy standpoint and industry standpoint plowing into the drilling opportunities that had long.

Texas is experiencing - has multi-year experience from one of the worst droughts on record. It has serious water demands that aren't being met. It's going to extraordinary measures to find those water resources in a lot of different ways, whether it's drilling for new aquifers or taking a dispute with neighboring Oklahoma to the Supreme Court of the United States over water rights or looking at like exotic plants to pipe water in from elsewhere.

And at the same time, Texas has tens of thousands of these horizontal wells, which use up to 10 million gallons of water a piece and can be fracked four to eight times. So there's a real contradiction in the water that they're using for the fracking unlike a lot of other industrial processes is for the most part removed from the water cycle.

There's some efforts to explore recycling but for the most part the waste water to the extent that it comes out of the well, if it does at all, is just pumped back down to the well where the expectations that we'll never see it or touch it again. So and there are similar tensions whether it's in Michigan or Pennsylvania or Texas and I think there will be in California to some degree.

**Greg Dalton:** But really if you were to describe a person that pursues something that's not good for

it is a junkie that needs to get it fixed. It doesn't take care of its nutrition and hydrate itself. If you would - well, I would say if Texas was a person, right? It really sounds like self-destructive, crazy behavior to pursue this profit of this addiction at the expense of the health of everything else.

**David Baker:** Short term, it's awesome.

[Laughter]

**Greg Dalton:** I'm not sure if that was the question what that was. Let's talk about internationally. Is this something that's happening just in the United States or is fracking happening overseas as well? David Baker?

**David Baker:** Well, there are definitely companies that are looking at it overseas, Chevron in our backyard here is moving aggressively to look at this in Eastern Europe and also down in Argentina. But so far, we're ground zero for this.

**Greg Dalton:** Is this something that we can export, an export industry for the United States?

**David Baker:** The industry hopes so. I mean the technology that's made this possible is largely American based is Halliburton and other American companies. Schlumberger is a French company that does a lot of fracking but it's a U.S. operation still where this has evolved. So the questions in a lot of places where they want to drill aggressively like Eastern Europe or South Africa or places like that is how do you get the infrastructure and the technology that we have here, there and so far that's proven to be extremely expensive or impractical so that seems to be the hold up.

**Greg Dalton:** Some advocates of fracking say that technology can improve that water can be recycled; the frac fluid can be done cleanly. Halliburton has a so-called clean frac fluid that sells for a premium. I'm not sure how clean that is. So far, I think a lot of drillers aren't using that more expensive option because they don't have to. And I've even heard talk about research or the concept of waterless fracking. So can technology improvement make fracking safer in a way that we've been talking about? Abrahm Lustgarten?

**Abrahm Lustgarten:** Yeah, definitely and not just technology but the implementation of better practices of just safer drilling. And between the two, there's a lot of techniques that I think we have the potential to develop and many that are developed that would go a very, very long ways towards mitigating the majority of the risks that we identify now. I think there's certain risk what happens to aquifers deep underground is something that technology isn't going to be able to address.

But many of the cases that - you asked about my count of a thousand cases, the vast majority of those could be dealt with by better practices waste pit if they're lined or if they're not used at all, which some states are moving towards would eliminate those 700 cases of water contamination. A lot of what we look at our problems with well cementing and the structure of the well itself and leaks coming up the wellbore. We talked about the isolation of contaminants miles underground but the thing that connects them to the surface is the wellbore itself. And so if it was sealed off at one point in time, humankind has broken that seal with a well. So there's a lot you can do in a well itself to make sure that it's constructed properly in a way that would at least reduce the number of accident.

**Greg Dalton:** David Baker?

**David Baker:** I think one of the issues that you hear though that has alarmed so many people is we have such a boom of this practice in places like Pennsylvania and North Dakota that we seemed to

have had a gold rush mentality a lot of small companies moving in to operate very quickly without a lot of oversight. And pretty much whenever you have that, you're going to have people getting sloppy.

And I think there are best practices that can really improve this and the company is along with one environmental group I know of are trying to come up with like the absolute gold standard of how to do it. But if you don't have - if you have that kind of environment where too many people are rushing in to do it and they're not all being careful, you are going to have accidents. And I think that's why people have been clamoring for and somewhat disappointed in the way states have been regulating those because in that kind of environment, you really do need a tough regulator to come in and keep an eye on things.

**Greg Dalton:** And the argument is often made that the large companies with the big brands are more responsible and safer because they have more to risk. They can't afford bad PR whereas the wild catters that are out there, trying to just get it out as much as fast, as fast as they can and then move on. Abrahm Lustgarten, is that accurate?

**Abrahm Lustgarten:** I think there are some truths to that but I don't it's an absolute. Surely the big companies have a bigger brand reputation at risk and they also have the finances to work and buy better methods without costing them as much as it will some small wild cutter. But in general, I think that the industry is out there to make money. Their top concern is not always to protect the environment except to the extent that it also affects their brand and reputation.

And for the most part, with a couple of welcome exceptions, companies are going to meet the minimum requirements whatever they may be to do this, whether that's a regulatory requirement or sort of a public perception requirement. But I haven't seen a whole lot of examples of them exceeding those requirements by any wild distance.

**Greg Dalton:** If you're just joining us on the radio, our guests today at Climate One are Abrahm Lustgarten, reporter with *ProPublica*; and David Baker, reporter with the *San Francisco Chronicle*. I'm Greg Dalton. You can find podcast of this and other Climate One programs in the iTunes store and follow us on Twitter at @climateone. Let's go to audience questions. Welcome to Climate One.

**Male Participant:** Thanks, Greg. In California, we have big problems with aquifer contamination principally from runoff of fertilizers in the Central Valley. Do you have any sense of quantitatively of the threat of fracking either in California or other areas versus what we've already seen with these nutrients that have gotten into groundwater and taken cities like Modesto and Davis that had to give up their wells and switching to other sources?

**Greg Dalton:** David Baker?

**David Baker:** Yeah, I don't. The quick answer is no. I don't have a good way to quantify that. I would note though that the stuff that you're talking about there is basically a surface problem migrating down into the aquifer. Whereas with the oil wells, frac or otherwise I'm talking about extracting something from below the aquifer and making sure that it doesn't get in as it comes on the way up.

No, I haven't seen anyone try to like make a comparison of the numbers on that. I'm not sure if anyone's working on something like that. I would say that there are different forms of contamination in terms of where the problem is coming from, either above and below.

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

**Male Participant:** Hello and thank you for joining this Friday. Mr. Lustgarten, one of the things I saw in your Deepwater Horizon articles otherwise is that the capacity of the regulator to do some of these things, especially as the industry gets really complex new technologies that it's implementing just doesn't keep up and the regulator doesn't really know that much about what its regulating, especially can't get that expertise sold in the industry. Is that the case regarding fracking as it was with say deepwater drilling? And if so, what pathways out of that or what approaches to getting that expertise do you see that we can still do as a country?

**Abrahm Lustgarten:** Yeah. I mean speaking really broadly I think it's an issue. It's sort of fundamental dynamic with regulating resources in general oil and gas more specifically. The dynamic looks something like this. State agencies are resource-starved working with small budgets. Their staffs are paid a very small amount.

And as the expertise of any given staff person grows, they're worth more and the industry pays a whole lot better and there's a bit of a revolving door for very understandable reasons. So you have a bit like a suction phenomena where the best talent, the best technology, the best technological understanding flows towards the industry on one hand. So you just don't have the best oversight in those state agencies.

And on the other hand, you have a real closeness through proximity, sometimes through funding and state financing and the tax structure between those regulators and the industry that they're regulating that kind of compounds the problem. The caveat, certainly, there's really talented state regulators who really dedicated their jobs and many of them are right across the board the dynamic is problematic.

**Greg Dalton:** Welcome to Climate One. Thanks for that question. Let's have our next question. Welcome.

**Female Participant:** Hi. Thank you. My understanding is that fracking requires significantly less drilling but that the effects on land are about five times as much. What are the implications for archeology and the preservation of historically significant spaces? Thank you.

**Greg Dalton:** So the land imprint. David Baker, if you're fracking and going horizontal, don't you need fewer wells and less impact on land or is that -

**David Baker:** Well, are you talking in terms of surface impact?

**Greg Dalton:** I think she was talking about surface impact.

**David Baker:** Yeah.

**Greg Dalton:** She mentioned archeology and those sorts of things.

**David Baker:** Yeah, I don't see that this would cause problem for archaeologist anymore than regular oil drilling is. I mean essentially you're still drilling a well. The difference here is what you do once you get it drilled. You're going to have a lot of more truck traffic on the surface because they need to bring in water, and you're going to have a lot more sort of industrial activity right around the well itself when they bring in the machinery that does the fracking.

**Greg Dalton:** What's the surface footprint around the well? How many acres? I mean is this sort of a little needle?

**David Baker:** I don't know industry standard. It's about five or seven acres for a well pad and the questioner gets like one of the best practices that is increasingly being used, which helps in this regard is that horizontal drilling makes it possible to put multiple wells on one well pad and that's one of the things that's happening a lot in the mountain states. So you can have a five-acre or seven-acre disturbance that facilitates seven or eight wells instead of all of those wells being half a mile apart. So from a land disturbance perspective, that's a huge improvement.

**Greg Dalton:** But David mentions that the trucks, it's actually the industrialization of rural America. It's one of the big objections to this. There's water et cetera but it's all the trucks trembling down small town roads and that's really tough to avoid unless water is recycled but that's another aspect of this. David Baker?

**David Baker:** Yeah, I think that's one of the sort of one of the core problems in terms of the way fracking affects a community. Even if you're not getting contaminated water, even if everything goes right, you're taking some place that used to be a rural area and might have been farm fields, might have been ranch land and basically turning it into an oil field.

And if you're here in California and you want to buy a house next to like one of the big Bakersfield oil fields or the San Ardo Oil Field that we all pass and the one when we drive down to L.A., if you want to buy there, more or less what you're getting what it looks like and all that. It's the sudden transformation of landscapes that has really freaked people out. And I spent a little time really on my career reporting for a paper in Western Pennsylvania. It's absolutely a gorgeous area. The idea, to me, of trying to imagine that place if fracking really took off right around there is I mean my instinct reaction would be just horror. It would really horrify me.

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

**Mark Schwartz:** Thank you. Mark Schwartz, former candidate for mayor in Berkeley and out looking for a job in the state department. It's a two-part question. One, wouldn't it be wonderful if we actually got our oil from Venezuela than just fracking? And the second part, from what I understand from the Bay Guardian and Amy Goodman, is that the oil companies are only paying, I think, \$4 to \$10 an acre creating only \$100,000 worth of state, when my feeling is that we should be getting a million dollars per acre so that each of our people can be met such as housing for the homeless. So just -

**Greg Dalton:** Let's talk about pricing of extraction on federal lands. David Baker?

**David Baker:** Actually, they are getting less in California largely because the stuff that has been auctioned off by the federal Bureau of Land Management on top of the Monterey Shale has not generated that much interest in the auctions. They've had fewer bidders here than they have elsewhere in the west, and they're coming up with lower prices as a result. Those auctions quite are more or less on hold for probably about a year after the judge toss out some of the leases and all the lawsuits. But yeah, we're getting less money and that's largely a function of the auctions that we've had is that we don't have nearly as many people bidding as you have in North Dakota and Texas. As for Venezuela, we do get oil from Venezuela and the Persian Gulf as well.

**Greg Dalton:** Because Alaskan suppliers are declining.

**David Baker:** Yeah, good point.

**Greg Dalton:** Abrahm Lustgarten, let's get you on the price that taxpayers are getting paid for extraction of these resources on public land.

**Abrahm Lustgarten:** It's worth a little bit of scrutiny and I'm taking a look at that now. The government accountability off targets the federal government's revenue program for collecting royalties onshore and off from oil and gas drilling as one of the single largest. It is one of the largest sources of revenue for the federal government, and also one of the single largest areas that suffers from a lack of organization under collection of funds.

So it's really hard to quantify how much money is being left on the table but the general consensus is that it's many, many billions and not a small amount. States vary as far as how they - whether they take up percentage of royalties or they take what they call a severance tax, an amount every time a well is drilled. But in general, the oil and gas industry seems to get access to the resources for what they would describe as a pretty good deal.

**Greg Dalton:** So it's cheaper to get it off of public lands than to negotiate with private landowners?

**Abrahm Lustgarten:** It depends. It's hard to generalize.

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

**Patricia Sun:** Hi. My name is Patricia Sun and I am the director of CarbonLiberty.org. And Carbon Liberty basically has the idea that we have to just jump the track entirely and stop causing ourselves to be addicts in being focused is coal worse than fracking? We're being pushed into the constant battling each other. Instead of making the big leap to hydrogen is the most common atom in the universe and we have lots of it and we could be at sea using solar and wind causing hydrogen delivery to power plants on the coastlines. We would have no carbon. We could put at least our energy in that direction and study that.

So I think the big problem is money that we are all scared of the government, the big corporations are kind of mindless for money and so everything just keeps going in this paralysis. So I appreciate your work very much because we need to have people informed and I just hope that maybe sometimes you could bring up - we could jump the track on this entirely. We could solve this with other - in other ways solve the problem.

**Greg Dalton:** Thank you. David Baker, is hydrogen the answer.

**David Baker:** I actually was speaking at a panel here a few years ago and we're talking about the future of transportation. And at the moment that I mentioned the word "hydrogen", people in the audience hissed so.

**Greg Dalton:** Thank you for not hissing today.

**David Baker:** Yeah, exactly. Now, hydrogen that really would be jumping the track because if you think about that as like a transportation fuel, you can't put that in the pipelines of what we have already. You need an entirely different distribution system.

**Patricia Sun:** How are plans holding?



**David Baker:** So switching everybody to electric vehicles and then -

**Patricia Sun:** Yeah.

**David Baker:** - the idea of that's a very big track. I mean there you're talking about something that might be feasible just as a thought experiment but man, I don't. I can't begin to imagine how expensive that would be.

**Greg Dalton:** The infrastructure cost of switching to hydrogen are huge.

**David Baker:** Yeah.

**Greg Dalton:** There's also a question of where does the hydrogen come from? It can sometimes cost a lot and take a lot of energy to generate the hydrogen. It can come from nuclear from other industrial sources. Let's have our next question. Thank you. Thank you for that question. Hi.

**Kelly Hammargren:** Hi, my name Kelly Hammargren. I'm not a usual public speaker so I'm a little bit nervous and this is my first time here and this was a wonderful presentation. So I have a couple of comments and then I have a question. I had read that five percent of the bores, the cement bores fail immediately and that 50 percent fail by 15 years and -

**Greg Dalton:** How about we get to your question? Maybe we can talk about some of the other things afterwards.

**Kelly Hammargren:** Okay. So my question was about the water tunnels that Governor Brown has been pushing. Rumor has it that the water tunnels are being built so water can be diverted at Bakersfield for fracking?

**Greg Dalton:** So is the state water system, there's some water bonds that been on the state ballot that keep getting pushed back. Is fracking part of California's water bonds and water plan? David Baker?

**David Baker:** I haven't actually heard that before. We don't know. We don't know is the easy answer. I'll put it this way. I'm not a huge fan of that particular infrastructure but it's been pushed along for reasons very different from fracking. And if you're in Southern California, you probably feel very differently about it then. Those of us up here though because they have still a growing population and they have tapped out their water.

And if we don't have those tunnels or something in their place and there's a major earthquake on the Hayward Fault, Southern California is going to be in deep, deep trouble. So I fully accept the idea that fracking is not the main purpose of those tunnels. Would they get some water out of it anyway? They might. They might be able to buy it off from one of the water agencies that would be getting the supply.

**Greg Dalton:** California has lots of water issues independent of fracking. Let's have our next audience question. Welcome.

**Male Participant:** Thank you, Greg. And David and Abraham, I want to thank both of you for your reporting on this issue. My question is about a *ProPublica* investigation released late last year of aquifer waivers around the country, and there were some of those waivers granted for oil and gas activity here in California. And I'm wondering Abraham if you can talk a little bit about those waivers.

**Abrahm Lustgarten:** Yeah. I'm eager too. I'm glad that it came up. This whole conversation gets very lawyerly when you talk about what you're asking out which is what's called "aquifer exemptions." The basic idea is that despite all of our conversation about how to protect aquifers from contamination. The EPA, which is largely responsible for protecting them, has an entire program that exempts certain aquifers from protection so it allows the pollution of those aquifers explicitly, and the vast majority of them are for oil and gas waste disposal wells.

Many of those, I forget the numbers because it's been a long time since I wrote the article but tens of thousands of the wells that we're injecting into exempted aquifers are in California. And it gets lawyerly and legalese because when you talk about what contaminates drinking water when you go and ask a state official whether there's an example of a drinking water aquifer being contaminated?

We all think that it might be a fairly descriptive clause but it actually has a very specific meaning in federal law, "Drinking water aquifer needs certain scientific standards." And if it's been exempted from the law, it no longer meets those standards and it's no longer drinking water aquifer so it cannot be contaminated.

So if your mind can process those kind of flips, the bottom line is that in California, most of the areas where drilling has been happening for close to a century, the drinking water quality aquifers that could foreseeable provide water, a good quality in the state have already been exempted. And we don't know whether they're being increasingly polluted or disastrously polluted or protected or what but they don't count in the conversation.

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

**Male Participant:** Thank you. It's a really good discussion but I'm a native Californian and the one thing I haven't heard you talk about is a quake risk, although I have read about that in the east. Can you address that issue? Thank you.

**Greg Dalton:** David Baker, can hydraulic fracturing cause earthquakes?

**David Baker:** Hydraulic fracturing almost always causes at least a tiny quake because you are after all breaking rocks underground. The fracking itself, most of the time, does not produce quakes that you can feel on the surface, although sometimes it does. The largest one that I know of has been directly tied to fracking was about a 3.6 up in British Columbia.

But here's the caveat, they do have to get rid of the water. They usually do it by deep injection disposal well, which until recently was considered the environmentally friendly way to go about it and those wells can and do cause seismicity. They do cause earthquakes and we have a lot of them around the state, a lot of those wells.

We haven't had people actually go out and really study this over the years, even though we've had those wells for decades. And I'm so kind of flabbergasted that some grad student or the USGS hasn't done this at some point but we do have a lot of them. We're the perfect laboratory for it. We know this can happen and we've seen it happened in a bunch of places so yeah. The fracking itself is not the problem but disposing the fracking water is.

**Greg Dalton:** We're getting – Abrahm Lustgarten, do you want to add to that?

**Abrahm Lustgarten:** I was going to chime in quickly that one area, one discipline where they are

looking at this locally is when it comes to geothermal energy and particularly up in Sonoma and so Lawrence Berkeley Labs has a huge staff that's devoted to that. And you can go to U.S. Geological Survey website and look at recent seismic activity in the Bay Area and you'll see constantly a little fireworks display up around Sonoma. That's induced seismicity and they're actively measuring what the Department of Energy its water that they're injecting is not frac fluids but it's the same basic principle and they're actively measuring there how much water under how much pressure results in what kind of quake. But that area in Sonoma is seeing 3 to 10 earthquakes a week related to injection.

**David Baker:** And there's a similar study that just came out for the other big geothermal area in the state, which is down by the Salton Sea. There you have very, very active earthquake zone and largely because they're injecting the stuff in.

**Greg Dalton:** Thanks for that question pointing out that we had overlooked earthquakes in our conversation here at Climate One about hydraulic fracturing. We have just a couple of minutes less. I want to hear your thoughts on where the media - has this been covered well and is the media doing a good job covering hydraulic fracturing outside of your respective organization? Abrahm Lustgarten, does this get a lot of good fair play?

**Abrahm Lustgarten:** It gets an enormous amount of play compared to what it used to. So in terms of the media landscape, that's hard to describe as anything but an improvement. When I started writing about this in 2008, it got no play. I mean it was hard to spread it around. It was hard to find publishers for the stories I was writing. So I think just by the sheer number of stories, whether they're good or bad, there's an improvement in coverage and generally yeah, there's been an improvement in stories that go deep and look hard at these issues as well and a number of outlooks.

**Greg Dalton:** Partly, there's good visuals on this. Lighting faucets on fire makes for good for TV that sort of thing, which is not the case for some of the other more abstract things. David Baker?

**David Baker:** I think it has definitely improved over the last few years. I think you personally are probably a big part of that improvement.

**Abrahm Lustgarten:** Thank you.

**David Baker:** You've really followed this amazingly well over the years in terms of locally. I've been the energy reporter at the Chronicle for quite a while. I wasn't writing about fracking until a few years ago, about three years ago when it became apparent that we're finally getting more of this activity in the state. And at that point, our paper got interested. So I was definitely part of the problem. I'm trying to be part of the solution at this point.

[Applause]

**Greg Dalton:** Real quick, just wrap up. Is natural gas a bridge to the future? From what I have heard today, you both think it can be done safely better with technology. You're not against fracking or natural gas, writ large, is it a bridge to the future as its proponents describe? Abrahm Lustgarten?

**Abrahm Lustgarten:** I think it has a potential to be but for it to be a bridge, there has to also be policy action and investment action that's going towards constructing what the other end of the bridge looks like. And I don't necessarily see that to the same degree that you see a huge investment or commitment to natural gas. You saw power plant emissions decline dramatically in the last couple

of years. There seems to be an agreement that that's largely due to the increased use in natural gas.

I think there are parts of that that are debatable but let's accept it on its phase for the moment. That's definitely a sign that there is good to be gained through this process while we transition to something else but I think we've just talked about all the long term potential consequences. And if there isn't, another landing point on the other end of that arc then I'm not sure we'll be left with something that's better than what we already have.

**Greg Dalton:** David Baker?

**David Baker:** I think it can be a bridge. Our government is certainly hoping that it's going to be a bridge. If any of you watched President Obama's climate change speech at Georgetown, he never once said the word "fracking", but he did spend about two minutes talking about how wonderful it was that we had all this new natural gas, and this is going to be what gets us to the other end.

I think it has become such a controversy and I think that the issues raised about it are so worrisome and legitimate that if it's going to be the bridge, it's going to take a very different response from the federal government than we've seen so far and a stronger hand. And frankly, if the oil and gas industry wants this to be the future as well, they actually have to work more with the federal government.

There needs to be a concerted effort at the top of the government to say, "Okay. We're going to study each of these issues in depth. Here are the answers. We're going to set these regulations to protect against these potential problems. They're going to be universally applied." And that I see could, if we have that kind of system, then I can see it being a bridge. If it stays this sort of piecemeal approach, people are just going to remain suspicious and hostile. You can have more of the fighting.

**Greg Dalton:** We have to end it there. Our thanks to David Baker, reporter of the *San Francisco Chronicle* and Abrahm Lustgarten, reporter of *ProPublica*, I'm Greg Dalton. Thank you all for coming to Climate One.

[Applause]

**Greg Dalton:** And you can listen to Climate One in iTunes and also follow us on Twitter at @climateone. Thank you all for coming.

[END]