

Tom Merrill: If I could have everyone's attention. Let's get started for the first of our two afternoon sessions. Both of them are about regulatory design. The first session deals with regulatory standards and the second one deals with the question of who should do the regulating. I'm very pleased for this panel to have three legal experts who have terrific background to discuss this issue. Our first speaker will be Hannah Wiseman. She teaches law at Florida State University. Hannah was I believe the first law professor out of the box to write extensively about hydrofracking and its environmental risks and she's written a number of very insightful articles on the subject.

She'll be followed by Chris Kulander who teaches law at Texas Tech Law School. Chris actually was a geophysicist in the earlier life and then a lawyer and has practiced extensively in oil and gas law in Texas in addition to being an expert on hydrofracking regulation at the state level. And finally Mark Brownstein who's a Vice President and Chief Counsel to the U.S. Climate and Energy Program of the Environmental Defense Fund. Mark also teaches here at Columbia at SIPA and has been active for a number of years in various nonprofit capacities dealing with environmental and energy issues.

So Hannah, take it away. Oh I should also remind people again to mark their questions down on cards and give them to the people at the outer aisles to be collected when you have them.

Hannah Wiseman: Thanks Tom and thank you to the dean as well for having me. I appreciate having the opportunity to be at the conference. I have the somewhat boring presentation that I'll try to make exciting because I'm setting the stage for the discussion of the content of statutes and regulation in this area. I'm setting the stage at the federal level and I'd imagine that most of you already have heard of most of the federal approaches that I will discuss today. But I'll try to add some normative analysis particularly near the end regarding potential holes left by the federal regulatory scheme and the extent to which states are filling in those holes or not. And then Chris will follow up I believe with a more detailed description of the substance of state regulations.

So I'll start out just by telling you a little bit about what the job of the federal government is in this area. There's an increasing role here, the federal government as you'll see. The EPA is quite active in expanding certain of its regulation of oil and gas development

and fracturing. Then I'll describe a little bit the substance of the statutes that do apply currently, how the federal government is going about applying those statutes – it's not always been through formal rule making. In some cases there's been soft law, agency threats and what not which I'll talk a little bit about. And then finally I'll discuss those gaps.

So the role, I believe Governor Freudenthal will disagree with the size of my state level here right because he suggested that cooperative federalism might involve more state power than he would like. But at least as I view cooperative federalism from looking at it on the books and from looking at the state permitting role and the state role in sort of assessing violations under federal acts, I do view the states as very core actors in this area. Because the states implement many of the federal environmental statutes that apply to oil and gas drilling and fracturing including many states implementing the Safe Drinking Water Act which applies to oil and gas waste disposal, Clean Water Act and other programs.

And then I want to just briefly bring up the regional governance of shale gas development especially in this area. The Susquehanna River Basin Commission, the Delaware River Basin Commissions I think will play a growing role. They're already playing an important role in governing withdrawals of water for hydraulic fracturing and the Delaware River Basin Commission as those in New York may know well proposed more detailed regulations over what it affected water quality. So they would have required some erosion control plans for a drilled and fractured well sites and other measures.

Those were challenged by New York State but New York State was found to lack standing at this point because the regional regulations had not been finalized. The federal government does have a role in those agencies. It has a federal representative. And there's been a question of whether these regional agencies, the water commissions are in fact federal because they have this federal representative. They receive some money from the feds. But I think that will be an interesting jurisdictional question moving forward.

So the primary role of the federal government here is to – there are several important statutes that apply. Most of them are implemented by the states through cooperative federalism and then also it has this slight rule within the regional commission. Moving

quickly to the substance to the regulations, I've highlighted in yellow the entity that I view as having more power with respect to particular impacts or alleged impacts that were introduced earlier today. I want to emphasize that I'm talking about all stages of the shale or tight sands oil and gas development process here.

I actually view most of the risks as occurring at the conventional stages of well development that have happened for many years. So I like to address the entire lifecycle of the well. It seems to me that the greatest change from a regulatory perspective that fracturing has caused is just the sheer scale as has been mentioned earlier today. And I believe that higher well densities can in some cases actually lead to new risks depending on the density, location and timing of this booming new activity. We may see new risks which although are already regulated may require re-visitation.

But currently here are the governments that I view as having more power over each of these impacts or alleged impacts, so ground water contamination, earthquakes at the waste disposal stage. This is when produced water flow back is injected into what's called a class two underground injection control well under the Safe Drinking Water Act. That is a federally regulated activity. Many states have primacy in implementing federal Safe Drinking Water Act standards so states actually issue the permit for the underground injection control well into which waste is disposed of.

But I'm going to give the feds more power here just because you know they do write the ultimate regulations that the states implement. Then we have potential groundwater contamination at the drilling stage. It is well known that improperly encased wells at the drilling stage can leak methane. It has been known for a long time that fracturing as we've discussed, that's much more disputed whether pavilion or otherwise we really have any problem there. But at the drilling stage this is squarely within the states. States regulate the casing of oil and gas wells, the strength of the steel tubing, the percentage of the calcium chloride in the cement. That is entirely within the realm of the states.

Then moving to surface water contamination. I've put this more in the federal realm because there are Clean Water Act standards here, storm water standards for sedimentation as well as preventing direct discharge of waste into surface water. Also of course the federal government has control over POTW, Publicly Owned Treatment Water plant permitting. The states do play an important

role here and that leads me to soil contamination spills which is often connected to surface water contamination.

So states have a key role in spills of oil and gas and fracturing fluids as well as wastes because the Resource Conservation Recovery Act which addresses waste handling, transport and disposal exempts most oil and gas exploration and production materials and waste. So the states have control of the handling of the stuff and the spills can lead to both soil contamination and surface water contamination. Air quality, the states have historically had the most control, possibly minor source permitting. Federal government is moving in quickly though with these proposed standards for green completion.

And then finally surface to surface and habitat fragmentation. There are state standards for restoration of sites but my argument is that habitat fragmentation is largely unaddressed in a formal regulatory fashion. Okay very quickly let's talk about the substance of some of these regulations. Class two underground injection control permitting. These are the wells into which millions of gallons of oil and gas waste are disposed of. As I mentioned states often have the role of permitting. So the federal government write the standards such as the disposal well must be cased in a particular way to prevent leakage.

And then the states that have primacy then issue the actual permit. The states are supposed to require that underground sources of water will not be endangered by the injection. Here the green represents states that have primacy, so the majority of the states do. Pennsylvania and New York notably do not. There have been some issues with underground injection control wells. I want to emphasize that this particular issue, this well may not have accepted waste from any fractured wells. It was a disposal well that took waste from oil and gas operations in the Crittenden field in Texas and I have no proof that any of those oil and gas wells were in fact fractured.

But just to give you an example of what can happen with a disposal well, this well leaked into an aquifer. This is a disposal well, not a fractured well. It leaked into Midland, Texas's Cenozoic Pecos alluvium aquifer contaminating billions of gallons of water and this is a bankruptcy suit. Because the UIC operator filed for bankruptcy and there was an argument about who should

have priority in getting money including money to clean up the aquifer.

Moving quickly to possible methane contamination of underground sources of drinking water especially at the drilling stage, again this is all state regulated. There is also no federal regulation of the actual injection of the fracturing fluids underground because of an Energy Policy Act 2005 exemption except for fracturing with diesel. The EPA is currently writing guidelines for fracturing wells with diesel. There are of course examples of some problems in this area.

Again this is not a fractured well, this was into the Oriskany formation in Pennsylvania. Maybe the well is fractured, I have no proof of that. This is just an example of what can happen if a well is not properly cased under state casing standards. We have the well operator concluding a casing collar failure occurred which resulted in the release of natural gas into the subsurface. The gas released resulted in sediment and gas migration into streams, groundwater wells, etc. Because I have 13 minutes I'm just racing through this. Surface water, here we go.

We're moving on groundwater contamination, now we're at the surface. There are clean water act provisions here saying you've got to get a NPDES, National Pollute and Discharge Elimination System, permit if you want to just discharge oil and gas waste into surface waters. They differ depending on whether they're east or west. In the east you basically just can't do it. The NPDES standard is you can't discharge oil and gas – produce water into the surface. That's my understanding at least from reading the regulation. West there are some grease content standards so you can possibly discharge some produced waters.

My understanding is this is not a very common practice. And then waste water treatment plants. It was mentioned earlier that several treatment plants in Pennsylvania may not have been adequately treating waste. The EPA currently doesn't have guidelines for pretreatment of waste going to wastewater treatment plants. It's working on writing those. That's oil and gas waste from shale gas wells. And it's been primarily using threats while it is in the process of writing pretreatment standards.

For wastewater treatment plants that accept shale gas waste these were threats, they call them threats, they were basically strongly

worded letters from the regional EPA to then Secretary Krancer in Pennsylvania, Pennsylvania DEP saying we have indication that publicly owned treatment works are not adequately treating waste from fractured oil and gas wells. And Pennsylvania eventually discouraged the use of those plants. The EPA is also conducting studies in this area both of impacts on surface and groundwater. There's this large study that was encouraged by house report.

The EPA has issued a progress report. After this there will be a draft report, then more comments, and then a final report. The report addresses water acquisition, chemical mixing, possible spills during that process, injection wells and whether they're going to leak into groundwater, possible spills of flow back and produced water as well as problems with wastewater treatment plants. So this is really a lifecycle study of the use of water in hydraulic fracturing and potential water quality problems. Again this is a federal study. Who know whether it will result in any regulation. Okay that went much quicker than I expected.

States have core control over what I believe is one of the most important issues in this area and that is surface spills. This is an example of New Mexico collecting hundreds of instances in which it thinks that surface pits have caused contamination of groundwater. The reason the state governments have control in this area is that there is a RCRA exemption, Resource Conservation Recovery Act for Oil and Gas Exploration. Very briefly what are some other ways the federal government has been involved or sort of industry involved at the federal level?

There's a move toward possible uniform standards, voluntary standards. Stronger is a very important organization here. It goes around looking at different state regulations and seeing whether they're adequate in the oil and gas area. And then finally Chris will talk more about the frack focus chemical disclosure registry which is a national voluntary effort. So I'll leave that to Chris. Thank you.

Chris Kulander:

Hope that's a beer. Howdy everybody. Thanks for having me, I appreciate it. I'm going to talk about common state regulations that you see out there when you're looking at how the states regulate fracking. And thanks for having me. I want to start off with the gee whiz picture here. We've got a couple of new cities thanks to production. If you look up at the top of the – what is that, your left hand map there of the United States – you'll see a big

bright spot under the D. That's the Bakken, that's all the flaring. That other map is the southern part of Texas. In between the red lines is the Eagle Ford. You can see it from more but that's how much production is going on right now.

Okay. State fracking regulation. The first question you've got to ask is are you allowed to do it at all. In two states you're not and one province so you know that's kind of simple. You just can't do it. But what I found going through a lot of the state by state regulations there's common themes that come out of what they look at. First is how you get the water and use it. Second is well completion requirements. Third disclosure of frack and pollute ingredients. And fourth is flow back water disposal requirements. All right. Now a fifth might be kind of local rules about – and sometimes these apply to the state or local when you can develop, what roads you're on, that kind of stuff.

Your state, TxDOT or NYDOT I suppose would run that up here and they work with the local governments. Now what you'll find a lot of times is that in states with production, a long history of production, they have a separate oil and gas state agency which runs their production and oversight. And in Texas that's the Railroad Commission okay. Don't ask why we still call it the Railroad Commission. It's because the railroads had all the land which had all the oil so we still do it and won't change the name.

But up in the Northeast where you have new production you have a state agency, typically the Department of Environmental Protection or something of that. And then within that will be the oil and gas agency so it's nested in there like a Matryoshka doll or something, all right. Okay so let's look at some of these examples here and then you'll see some pictures of some frack operations that I've taken in my tervales as a professor. Now I can't go through and tell you what every state is doing in every one of these areas, I just don't have enough time. But what I'd like to do is maybe just look at one state per.

And an example here is where do you get your water and how do you use your water. In Texas it's the Texas Commission of Environmental Quality which runs the surface water. Texas Surface Water Acquisition, Texas has a relatively complex scheme where the surface water is managed by the state and the ground water is managed by your ground water conservancy districts. What they've done recently, TCEQ, they've been fairly quiescent

until the last couple of years about water use. But with the onset of significant drop down there, drop that you wouldn't understand up here, like it didn't rain for nine months in parts of the state near where I live and that would be unheard of up here I would think.

But they had to define drought and what that meant an emergency shortage of water and what that meant, and then once they did that it allowed them to say when they can curtail use. So we have prior appropriations as far as the surface goes, we'll say anybody who has a water right junior to this time you're cut off. You can't draw, you can't use your water permit. So once they define all these things, maximum period, how long it can go on and what not. Now when you go to the surface – or I'm sorry, when you go to the ground water realm it's the ground water management districts in Texas.

And they generally control, they cover almost all the states or all the state and it was accepted that exempt, or I should say the water code exempts oil and gas drilling from coverage by these ground water management districts. So for drilling or exploration operations you did not need a permit from the TCEQ to drill a water well or it was exempted. We're a fairly friendly state to the oil and gas industry. But with the onset of significant drought down there we've harshed out fracking operations.

So now we have this vector of control from the groundwater management district saying yes we can regulate or permit your use of the ground for drilling and exploration operations but we can't for fracking operations. And so they've just kind of assumed that in the last year. We have the legislature meets every other year down in Texas on odd years. It gets a little odd in Austin. And they're saying there's a couple of bills and it looks like it will pass where they will expressly allow groundwater management districts to require if they want permitting for groundwater use.

Now it all really depends on your state's water control regime. Here in the East everybody has a reasonable right to pull off the river which I guess is a good thing since like the Susquehanna I read a report that on average a drop of water is pulled out and put back in like three or four times before it flows out down in La Havre, Maryland into the Chesapeake Bay. So you really use a lot of it. Not so, it's still a little bit different in Texas. This is a frack water pit. You might pour one or two of these down a well behind

this goofy looking guy that might be familiar to you. They might pour one or two of those down a well.

Okay, completion requirements. Another one. We'll go to Ohio for this. A lot of times they want a well completion report, they do in Ohio and you're getting this in most states now. In Ohio they want the type and volume of the fluid used to stimulate the reservoir. When it broke down you saw that picture of those guys looking at the monitors. They can monitor in real time when the fractures actually occur, pressure differences or if there's been a breach in well integrity they can see that pretty much as it happens. A lot of times you'll see states require that if they have a breach like that they have to report it or make a log of it and maybe turn it in later.

Other things they require in Ohio which are important in other places, methods used for containment of fluids recovered, how did you do that, and name of the fracking contractor in case they want to go after him, and other facts. What else? Texas, they've had problems where they've actually come out recently and said we think these should be the best practices. And that's turned into kind of a regulatory quagmire that's still going on because of course they ask for comment and I don't think there was anybody who didn't comment. I mean there were thousands of these things pouring in.

So the state agency's still rolling through that. You can make them report it on a well completion but telling them what to do seems to be a significant step further. Now the disclosure of fracking fluid ingredients, this captured a lot of media attention recently and I think it's attenuating now somewhat because we've gone to this in most states. Starting with Wyoming and then Arkansas but then Texas we had fluid ingredient disclosure for that chemicals that make up the one or half a percent of the fluid that's being poured down the well.

At Texas at the start of 2011 it really didn't have any regulations on disclosure. And by the end of the year they did, they moved very quickly on this. They latched onto this online form called frackfocus.org. What you do on that is you enter the volume of water used and the chemical ingredients basically. Now trade secrets, how you mix it up, the secret formula that you want to protect because other firms are trying to copy it so they cannot spend the money on the research and design that you did. You can

keep that as a trade secret but nondisclosure in Texas and other states may be challenged by landowners or neighbors, all right.

What a neighbor is exactly hasn't been defined in statute. I'm sure we'll see that in the regs. What that means is that a first responder has to have access to the information. So frackfocus.org, it started on April 11, 2011 so it's a fairly recent groundwater protection counsel and the Interstate Oil and Gas Compact Commission put it together. It contains general information. You go to the site, you can state by state and kind of click and go to where their regs are that cover fracking. It has an explanation of what the process is.

But the big thing is it's a well by well list of the chemicals and the volume that's put down each particular well. And it kind of looks like this. I know you can't read this but this is what a single well looks like. This is in Haskell County, Kansas, which I know you can't see but you have the ingredients and the supplier and what not. Let me blow that up a little bit. Here's what frack focus requires. Well information, so that's kind of where it's located or its individual API number. That's kind of like the Social Security number for that well, just for that well. The chemical trade name, the supplier, the purpose, because the trade name plex break 134, I don't know what that is.

But you can go out to a glossary that says oh that's a breaker. What does a breaker do, and so on and so forth. And there's been some complaints by folks on the environmental side that say you need to elaborate on what these are. A lot of common people don't quite know what that might mean. So we're moving towards what they call frack focus 2.0 where the software allows you to scan so that you can see how many wells in the area are using this particular chemical or something as opposed to just having it on a well by well basis which might not be so useful, chemical abstract number, maximum ingredient concentration and other things.

This is a frack operation in Texas. I'm looking down from the top of the sand truck. Flow back water disposal requirements. What do you do when you get it back from the surface and how much you get back really varies? You might get up to 80 percent back, you might get down to 25 to 30 percent back in South Texas. I'll go to West Virginia, that's supposed to be mountain air colors there but the yellow kind of maybe shows up, I don't know. Operators of Class two wells, those are those oil and gas wells, the disposal

wells for the waste, are required to permanently dispose of wastewater from fracking, all right.

Now this is kind of in contrast to what we see in Texas where there's kind of some agitation at the legislative level to not have disposal be the first refuge of a scoundrel maybe but to have it be recycling because in West Virginia they are blessed with more water than they have particularly in South and West Texas. So in South and West Texas we'd like to see recycling more than just taking that fluid and pumping it down, that used fracking fluid and pumping it down a disposal well. Hopefully that would make oil companies look more at recycling or perhaps using brackish water, we call that livestock grade water out in West Texas.

And that's the fastest 13 minutes of your life. We're right here right at the end. You'll have your hydrofracking reporting form you've got to fill out with each one of the what you've done, the amount and location of the water that was used, the amount injected, well's location and so on and so forth. And then finally this is the last slide. What would a model regulatory scheme look like?

This is a good way to review what I just talked about. Control of acquisition, use of water, you could maybe try to uniform, make that uniform across the state. Casing, tubing and cementing requirements, disclosure of your fracking, fluid ingredients – the feds are now requiring that or will be on the BLM lands – flow back water disposal requirements. And these slides are available. Just email me and I appreciate your attention.

Mark Brownstein: Okay. So I was at a conference last night and I was introduced by saying first we're going to talk about lead and then we're going to get to something really sexy, natural gas, which tells you something about the conferences I've been hanging out in lately. It is an interesting topic. And for the environmental community it's definitely a mixed bag. There's no question that the change in the supply and price of natural gas has had profound impacts on how we think about energy options in the United States. And it is fair to say that the increase in supply and the decline in price has played a significant role in the recent displacement of coal that we've seen around the country.

And I will tell you that's a fundamentally good thing. We could have a whole conference on coal and it would be quite eye opening

for those of you who are not familiar with it just exactly how problematic coal is as a fuel. But that being said, right, there are significant risks associated with public health and the environment with unconventional oil and gas development. And as I've often said just because coal is awful doesn't mean that natural gas get to be terrible. And so we're here talking about the ways in which we try to assure ourselves that natural gas development will not be terrible.

And of course it starts with strong regulation and enforcement and much of what you've heard about over the course of today so far has been really about the fact that at the end of the day this is not about whether fed or state or local regulation should be paramount. It's really about how that web of regulation works because it has historically been a web of regulation that has governed oil and gas development in the United States and it will remain that way and I would argue it should remain that way. That being said what you want to make sure is that the strands of the web are strong enough and that you're not missing key strands.

And I think that that fundamentally is what this conversation and other conversations about regulation and the space are all about. And of course you've heard a lot about the things that need to be done and I won't repeat them for the sake of time. I will emphasize that you know we've done a lot of work in partnership with Southwestern Energy – you'll hear from them in a little bit – around things like model regulatory framework for well construction. And we're pleased to see that in Ohio for example some of those principles have been picked up.

They are currently now being picked up by Texas in some of the work that Texas is doing. And I highlight that because although there is plenty of room for improvement in the quality of state regulation and some states do lag, we are seeing changes. And that is a result largely of community pressure because at the end of the day what ultimately matters here is not what I think from Environmental Defense Fund, right. It really matters what the local community things about whether or not production is being done safely in their communities.

And so the most powerful agent of change that I've seen in this space has been the communities themselves speaking out in terms of what they want and what they need. I've noted that as the presentations have taken place that one thing that has gotten a little

bit of a short shrift, actually two things that have gotten a little bit of a short shrift are number one air emissions. It's appropriate to focus on water quality and I think that that does get a lot of attention.

But actually when you talk about sort of the tangible impacts that gas development have been having on communities, I think air emissions are basically an underreported and underappreciated phenomena. And I'm not just talking about air emissions at the production site itself where you can have methane and VOC and hazardous air pollutants as the gas comes up if it's not properly controlled. But I'm also talking about the air emissions associated with the gen sets that used to compress the fluid to send it down there, and most importantly the trucks that go back and forth, literally the hundreds of trucks that go in day in and day out.

And finally right in those jurisdictions that still allow open pits to be used for the storage of flow back or produce water, right, the VOCs that are often entrained in that water that volatilize out into the atmosphere over time. And although I am no public health expert and I will not pretend to be one, I think that some of the claims that one sees in communities about respiratory distress in and around production sites is related to in some combination of the truck traffics and the VOC is volatilizing off these pits. And that is something that I think needs to be addressed as we go forward.

But the other issue that tends to get short shifted, although I understand this morning that it was talked about a little bit, is the issue of fugitive methane emissions. This is not a public health issue per se and in fact many local communities may not care about this so much. But from an environmental standpoint this could be perhaps the most lasting and important of the issues that we face with unconventional gas development and that is the question of fugitive or leaking methane emissions right. Methane, the prime ingredient in natural gas, is a powerful greenhouse gas.

We're used to saying it's about 23 times more powerful than carbon dioxide and that's true after it being in the atmosphere for about 100 years. But actually methane is much more potent a greenhouse gas early in its lifetime and I would argue that the time value of greenhouse gas pollution is a critical issue in terms of managing both the rate and the severity of climate impacts. And so this is something that we cannot ignore. We actually are

working with industry to do field studies of fugitive methane emissions beginning with the well through the gathering infrastructure that brings the gas to the processing plant.

The processing plant itself, then to the interstate pipeline system, and ultimately into the pipeline system underneath the city streets that brings the gas to your homes and businesses. We're looking at each point in the supply chain to understand how much of this methane is lost at each point. So we first get some better understanding as to the magnitude of the problem, but then also to use that information to improve how we're managing to reduce these leaks.

And I think the good news here is that whether you think the number is big or small – and there's plenty of debate about it because right now there's no really data, people are just estimating – so whether you think the number is big or small the fact of the matter is that there are technologies and processes out there to reduce these emissions. We've seen some of that in our own work so far. And we know from conversations that we've had with folks in industry, and I'm not just talking about producers, I'm also talking about folks in the midstream and the downstream, that there are in fact strategies that can be done to reduce emissions.

Some of this will ultimately depend on the development of cost effective emissions monitoring technology that would allow you to have more consistent monitoring of systems and more rapid response when you detect an exceedance or a leak. And that is a priority for us in Environmental Defense Fund is working to bring those cost effective monitoring technologies to market.

Three more points that I would like to make. First of all for all the talk that has been had about regulation let's not lose sight of the fact that words on a piece of paper don't mean much if there aren't the resources there to implement and enforce. This is a big issue because most states are under budget pressures as is the federal government. And we would submit that one of the priorities as we move forward here is in particular as states continue to refine their fee structures for things like royalties and taxes associated with gas production that some of that revenue needs to come back into the system to make sure these programs are well funded.

Now that's not just me as an environmentalist talking. You could read the National Petroleum Council report called Prudent

Development that was released in 2011 and they too will talk about the fact that there is support in the industry for better funding, for implementation and enforcement of programs. So I think that this is an area that we can come together on.

Second point that I would like to make is for all the talk about regulation and enforcement it is incredibly important that we keep a focus also on strategies to improve the culture in the industry itself. Several weeks ago Environmental Defense Fund and others announced the initiation of something called the Center for Sustainable Shale Development based in Pittsburg. And what this organization is is it is an organization that has established 15 performance standards for production of unconventional oil and gas and a process by which producers can certify to those standards and be audited against those standards.

Now let me tell you 15 standards is not a comprehensive list of everything that one needs to do to be a safe producer of natural gas. But these 15 standards were intended to focus on some of the most critical issues that are happening in the Marcellus Region. Second these standards are not in the whole process of the CSSD, is not a substitute for regulation, it's a compliment to it. And here the analogy is the nuclear industry, where the nuclear industry after Three Mile Island got together and formed the Institute of Nuclear Power Operators on the theory that the worst nuclear operator set the tone for the entire industry and that that needed to change.

And NPO as it's called developed a series of what were known as leading practices for managing both operations and safety at nuclear units and began to audit all nuclear operators against those standards. And I would submit to you having come out of the utility industry that this has been one of the important changes in the industry that has actually worked to make performance in the U.S. nuclear industry among the best in the world. It's not a substitute for the Nuclear Regulatory Commission but it's an important compliment to changing the culture of operation in that industry and I would submit to you that this can and should be done in the gas industry as well, it needs to be.

Because again you're talking about hundreds of wells over thousands of miles and environmental protection for any specific community rests on what any one crew decided to do on a day in day out basis. The number one source of water contamination associated with oil and gas production today are truck accidents,

okay. This is not high tech stuff but it talks about the management culture and the incentives that employees have to do their job properly and it's no easy thing but part of it is work culture.

And then finally, all right, I believe that much of the anxiety that you're seeing in the environmental community as it relates to gas production has nothing to do with production itself or even necessarily with fugitive methane emissions as important as that is, but what is the energy future of the United States. So I started my talk by saying that this change in gas production has yielded some important near term environmental benefits in terms of helping us to displace coal. And that's true. But natural gas is not a long term solution to our energy future given how much we need to do to get to a low carbon future.

And so while we're developing this gas now and working to make sure that its development is as safe as possible understanding that this is an industrial process and no industrial process is 100 percent risk free, we need to also be focused on those strategies that help bring the next set of technologies into our energy mix, renewables, energy efficiency and the like. I take comfort in the fact that last year when natural gas was at a 20-year low in terms of price was also the year of the greatest amount the wind deployment in U. S. history.

So the simple fact of cheap gas is no obstacle to continue development of renewable resources but the challenge is to make sure that we do not lose focus on maintaining the policies that have gotten us to this point on renewable energy and that we not only continue those policies, we double down on them. Thank you.

Tom Merrill:

So we have about 17 minutes for questions and I have a few good ones here but if you have questions please give them to the people on the side. I'm going to start with a question for Hannah just so you'll listen to the question because you've written on this I think. So the question is numerous panelists have mentioned the scale of fracking as being unprecedented. In light of the scale how important is the proper level of enforcement? Has any state adequately enforced existing laws? If so, what states would be models of adequate enforcement of existing laws? So you've written about cumulative impacts and this might be a version of that.

Hannah Wiseman: Sure. Thanks. So I call this diseconomies of scale in my latest paper and the argument is that just looking at the long known conventional impacts of oil and gas development the fact that hydraulic fracturing has enabled wells in some states to increase by 300 percent in one year. That happened in Pennsylvania between 2008 and 2009. Just that fact alone, the expansion and scale can cause new risks because of cumulative as well as interactive effects, the density of wells, the timing at which they are drilled and fractured matter a lot.

So if you're fracturing 50 wells in one day in a particular area of Pennsylvania and everyone's trying to withdraw from the same river during a drought, all of those conditions can come together and cause a potential risk. And this does raise the enforcement question certainly because when you increase well numbers by 300 percent you typically don't increase the number of field inspectors by that amount simply due to budgetary limits. But some states are taking relatively aggressive measures to enforce more.

I'd say Pennsylvania is doing a good job of slightly expanding the numbers of inspectors but also just reporting the notations of violations of state oil and gas regulations and that's very important so the public can know what the inspectors are finding. So you can go to Pennsylvania and download a comprehensive Excel database of all the violations and that's very unusual. Most states do not comprehensively report online those types of issues. West Virginia's legislature has been surprisingly progressive on this as well, implemented a \$10,000.00 per horizontal well permitting fee.

I'm not sure if that has been actually used in West Virginia yet but the legislature also suggested that field inspectors must have minimum qualifications – energy, environmental experience – and receive minimum salaries, \$35,000.00 for an inspector, \$40,000.00 for a supervisor. I think efforts like that are encouraging and other states like Colorado have doubled most of their penalties in oil and gas. All of these efforts can help to fund the expanded enforcement efforts that are necessary as scale expands.

Tom Merrill: Okay. This question I will answer myself but I'll invite the other panelists to weight in. What role has private and public litigation played in forming the current regulatory scheme for fracking or are the primary rule makers legislators and regulators? My own impression at least is that public and private litigation has played virtually no role in the development of the regulatory scheme.

Arguably the 11th Circuit Case on the Safe Drinking Water Act played a role in stimulating Congress to exempt fracking from the Safe Drinking Water Act but I don't see any other evidence to date of litigation having any formative influence but maybe the other panelists have different impressions about this.

Chris Kulander: I think litigation helped steer the formulation of some surface damage acts which is where the mineral developer goes in and negotiates or at least notifies the surface owner of what's going to happen and when it's going to happen and if he's going to pay any damages as might be required by state law. That might bleed over I think a little bit into some of the regulations such as how your pit liners, those kind of things that would affect all production including enhanced recovering due to fracking.

Hannah Wiseman: Just briefly at the federal level Tom you also mentioned in your paper the storm water permitting which Congress tried to exempt oil and gas, essentially exempt oil and gas sites from storm water permitting and clean water act. But the suit by the Natural Resources Defense Council I think largely – I don't know if they gutted that exemption but oil and gas sites are now subject to storm water permitting largely due to that energy C case as well as the earth justice petitions for TOSCA disclosure which maybe we mention later, disclosure of chemicals at the federal level under TOSCA.

Tom Merrill: But I would agree that not much has been carried out. I want to throw this one to Mark. What if anything is different about rogue methane emissions from fractured unconventional versus conventional wells? Similarly are there any differences with respect to I think it says midstream and long haul pipeline businesses?

Mark Brownstein: Now once you get to – so I mean first of all once you get past, essentially once you get to the gathering infrastructure the issues are common. So I think that one of the reasons why this is coming up now of course is the greater volume of gas that's being produced and the need to build new infrastructure to accommodate that. And the new uses for natural gas that people are talking about whether it's in transportation or in generation or like here in new York City quite appropriately so planting number six fuel oil with gas and other lower polluting fuels.

I think the issue itself with unconventional may have something to do with the produced water that's coming up along with the gas and the need to make sure that there's separation technology there. But that can be in both cases, conventional and unconventional. A lot of what we're seeing in terms of methane pollution now is the concerns that you're seeing with say the flaring that's going on in the balkan where you've got a lot of associated gas, you're going after the oil because that's what's most profitable, and there isn't really the gathering of a structure in place yet to bring that associated gas to market.

And so right now it's either being vented or it's being flared. If it's being flared the question is how effective is the combustion efficiency of those flares, how well are those flares maintained even when they have high combustion efficiency. And in certain cases as I said for example in the – I mean this was going on in the Barnett where companies were intentionally not flaring it because the local communities found the flares more discomforting than the idea that methane was being vented.

And since you couldn't see it or smell it it was better to just vent it. The recent EPA new source performance standard for oil and gas will address some of that but in fields where it's associated gas arguably they're still allowed to do that.

Tom Merrill: Okay. I'm going to give this question I think to Chris. To what extent should gas companies be permitted to require complainants victims to sign agreements, settlements that are contingent upon their keeping quiet about the problems that led to the complaint? Isn't this a violation of public policy?

Chris Kulander: Well I think it sounds like it would be. I think money makes a lot of things go away so if there was maybe a check that was stapled to the back of such an agreement, I mean realistically that's a lot of what a service damage act is. It's we pay you for this or that that happens. You know if this happens we pay you this, and if that happens we pay you that. To strong arm somebody into saying well we'll stop development you know if you complain or something like that, that doesn't sound like a very good methodology.

Tom Merrill: This question is for Hannah. Do you believe federal superfund laws apply or the superfund law applies to surface spills of fracturing fluids and wastewater?

Hannah Wiseman: Thank you for asking me all of these questions for the slides I didn't have time to get to. Yes, the Comprehensive Environmental Response Compensation and Liability Act definitely applies to surface spills of fracturing fluids as well as fracturing and oil and gas wastes. The only substances at oil and gas sites that are exempt expressly from CERCLA are petroleum resources themselves, a pure oil and gas. And Professor Gerard brought up earlier potentially even if that oil or gas were mixed with flow back or other substances that could also be subject to CERCLA because of the mixing rule, right.

You can't mix the hazardous substance with something that's exempt in order to get out of RCRA or CERCLA. So I do believe that CERCLA is perhaps the most ignored statute in the oil and gas industry. I'm concerned that some operators aren't thinking about – I mean there haven't been massive spills. We don't have any superfund size I believe caused by oil and gas recently. But I think it is something that operators should at least keep in mind, being knowledgeable that down the road they may be liable for large clean up costs in the event of an unusual spill.

Tom Merrill: I don't know who's going to take this one but it's a good question. Is there any progress on reducing the toxic chemicals used in fracking? And then there's a little calculation done here. Four million gallons of water per frack times .001 chemicals equals 4,000 gallons of chemicals per one frack.

Chris Kulander: Yeah, it's that old argument that you'll hear from folks who are opposed to development. Where if this glass is you know 1 percent cyanide it will still kill you dead. I think that you're seeing a lot of – first you saw eliminate diesel was the first big imbroglio that broke out over whether or not you should use this or this can contain carcinogens, turn to benzene or something like that. And by and large they had an agreement to not do it with coal bed methane but then they kept doing it with shale.

It seems to be going away. When one particular chemical seems to be targeted the industry seems pretty good at getting rid of it. But to some extent it's like putting your finger down a mercury. I know there's other types of fracking that use a lot less water like jell based. Propane is used in Texas primarily I hear, CO2 slurries and other things like that. So I think as particular ingredient or identified as being problematic substitutes will be found for them.

Mark Brownstein: Look, here's the deal too, right. I mean if your well casing is good, okay. If your wastewater management system is good, if your waste disposal system is good, right, none of this stuff should be finding its way into groundwater in the first instance, right. That being said green chemistry is a good thing to do, right. Trying to detoxify the chemicals that are used in the frack process is important but what I often remind people is is when companies talk about food grade ingredients, right, salt is a food grade ingredient and yet you wouldn't want a lot of salt in your drinking water.

So just because you're moving to less toxic substances doesn't change the nature of what you need to do to isolate the fluids from groundwater. That's the important thing to keep in mind.

Hannah Wiseman: One company, I forget if it's Chesapeake, has a green frack solution with lower toxicity. I think the hardest substance to make less toxic are the biocides necessary to clean out the shale. I'm not sure, I've heard that. And then one state to look at that interesting, Idaho has discouraged use of Benzene Taloween, Ethylene Zileen and BTEX in fracturing so Idaho is one of the few states that's actually addressed the fracturing process itself and discouraged certain chemicals.

Tom Merrill: Here's a question for you. How much fracking does Idaho have?

Hannah Wiseman: Okay, okay, fine.

Tom Merrill: I think there's some over near in Washington County but there's –

Hannah Wiseman: Easier.

Tom Merrill: Yeah.

Chris Kulander: It's like Vermont has banned fracking. A very bold move on their part.

Tom Merrill: There is some kind of a video or something – I haven't seen it but it's referenced in our paper of executive drinking fracking fluid just to prove that it's safe.

Mark Brownstein: Actually I was at the conference where the CEO got up with the fluid but then had his CFO drink it. It was like something out of the Simpsons you know, Smithers.

Tom Merrill: Question. I don't know again who to take this but if somebody would like to elaborate a bit on exactly what are the health risks from fracturing both short term and long term. Do we know much of anything about what kind of health risks could result from exposure to these chemicals?

Chris Kulander: I don't know much about that. I mean some of these, they're said to be carcinogens.

Mark Brownstein: So here's the challenge, right. Here the challenge, right. Define health risks.

Tom Merrill: I just read the question.

Mark Brownstein: No, no, no, no, no. And it's an important question. I don't mean to be flip about okay. But there are a variety of challenges, right, associated with this. Some of them are ones that are, well like we were just talking about, right. We know that if you get Benzene into water there are health problems associated with that. In fact we know if we get too much salt into water there are health problems associated with that, okay. And we have a long history of environmental regulation in an effort to try to minimize those types of events.

What this process though challenges us with a little bit is as we talked about the intensity of development which has impacts on things like air quality. Not because any one well necessarily is exceeding any health standard but because the accumulative impact of a lot of wells may contribute to as we've seen out in Wyoming exceedances of the Federal Health Standard for ground level ozone. And also because you know frankly intensity of development in a suburban or rural area changes the character of the area and that in turn creates stresses on communities that have secondary effects.

So it may not be the pollution that's problematic but it may be the stresses that are created in the community that create public health impacts. And I think that's part of the debate you've been seeing in New York is how best to define what is the universe of health impacts that is appropriate to study or to monitor and how are you

going to do that. One of the things that I would have added in my comments if I had a little more time so I'll do it now is I do think that it is useful for states like New York okay to baseline public health metrics now and then put in place efforts to monitor any changes in those metrics over time if and when development is allowed to go forward.

And in that way you've done two things. One is you've created some kind of measures to be able to assess what impact if any development is having on communities. And you're also gathering information that may help you to revise your regulatory regime if you find that there are changes that are of note. You know one of the things that's really troubling about this is you can go to site and ask a site manager if production there is safe and he will tell you yes.

And yet if you ask him for the air emission data that's been collected at that site he will tell you there is none. Just like he will tell you in most cases that there is no data as in the chemicals or the substances that are in the water in that holding pond. And so if and when the truck taking that water away overturns on County Road 523 the county health official can't be assured of what was in the water that just got into the stream as a result of that spill.

And so there's work to be done here to make sure above all else that there's information available about what is being produced, what's being emitted into the air, what's being transported from A to B. And in that way you can do a much smarter job of not only regulating but also give people information and actually reassure them that although it may look nasty it's actually not all that bad.

Chris Kulander: There hasn't been a lot of litigation that's gone successfully forward against this. There's just not a lot.

Tom Merrill: I'll squeeze I one more question because I think it's one that's probably on the minds of a lot of people that are reading about this and we need very brief answers. How can you be 100 percent certain that there will be no long term effects on this says water tables – I think they mean water supplies and water aquifers caused by fracturing.

Hannah Wiseman: We can't be. I mean this is why Texas is studying the trinity aquifers and others because even though it's only 1 percent or less of total water consumed or used in the state I think there's still

concerns especially at the local level of over withdrawal too quickly too much.

Chris Kulander: One hundred percent is something I don't think you can ever guarantee one hundred percent. You can never guarantee that there's not an old well out there that could be a conduit for even if you had a perfect casing set there might be an old well out there that could be a conduit. That would be a very rare circumstance but you know I mean that knocks you down from 100 percent right there.

Mark Brownstein: I'm not 100 percent certain of anything.

Tom Merrill: With that the panel is adjourned. We'll take a brief break and be back at 2:30.

[End of Audio]

Duration: 64 minutes