Dr. Frankie Wood-Black, Director of Consent Decree Compliance, ConocoPhillips — 10-13-06

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Our next guest is Frankie Wood-Black, Director of Consent Decree Compliance at ConocoPhillips. Wood-Black's responsibilities are focused on supporting refinery compliance with the Benzene Hazardous Air Pollutant and Leak Detection and Repair regulations. She also supports compliance with the Toxic Substance Control Act. Wood-Black serves as the Conoco-Phillips representative for Corporation Associates of the American Chemical Society. She is a contributing editor of the **Journal for Chemical Health and Safety**, with her co-authored column, CHAS Netways. She has one patent, several technical publications and has co-authored a book entitled, **Emergency Preparedness Planning, A Primer For Chemists**. Wood-Black regularly makes presentations at the American Chemical Society National meetings and is a registered environmental manager. Welcome Frankie Wood-Black.

Dr. Frankie Wood-Black: Good afternoon.

Lemberg: Frankie, thank you so much for being with us on SCIENCE AND SOCIETY. Can we talk about the overall idea of sustainability and why this is so important?

Wood-Black: Sure, I do want to make sure people understand I'm talking on behalf of some of my other work with the American Chemical Society and the National Academy of Sciences because we've been dealing with sustainability through those networks for quite some time. Recently, we have done a workshop on the Grand Challenges For Sustainability, and the focus of that workshop was really how do we institute change and why should we be instituting change? And so, sustainability means a lot of things to a lot of people. But, from an industrial point of view, sustainability is really what we refer to as the triple bottom line, where we're doing things that make economic sense, that make societal sense and that will help us to continue to have a renewable resource. So, that becomes very, very important when we want to deal with what do we want the future to look like and how do we want to view that future?

So, why we have to change is right now, we have a strong dependence on fossil fuels and we are a fossil fuel-based economy. We use hydrocarbons to make almost all of our chemicals and materials that you have in the marketplace. Hydrocarbons are precursors to our polymers. You know, we put a hydrocarbon in our fuel as part of gasoline. We burn natural gasoline in our

homes. People in the Northeast use fuel oil in their homes. So, the question is how do we change from the fossil fuel-based economy to something that's more a long-term or a renewable type economy?

And that fossil fuel issue brings up a lot of different things. Of course, we deal with the Clean Air Act. We deal with CO_2, which is carbon dioxide, and we have carbon dioxide in the atmosphere. And then, there's this issue about global warming, which we attribute to the CO_2. So, we've got to move away from that fossil fuel dependence. And part of it is we want to use our fossil fuels for more important things than just burning them in our furnaces and in our cars. We want to definitely use those for things that we want to have like our plastics, our pharmaceuticals. Those kinds of things, you want to do that versus necessarily, using them to be your fuel source. So, that's kind of why we have to change and some of the things we need to look at for change.

Lemberg: Thanks very much. You know, all of us, as a nation, we've been just happily going along, burning our fossil fuels and until gas prices go up at the pump, we tend not to think about this. Why should we be worrying right now?

Wood-Black: We know the economics of fossil fuel — recently the price of oil has been over $70 a barrel. Today, of course, it's much lower. Natural gas has also been high. And for us, fossil fuel has been a very, very cheap resource. But, at some point, we're going to reach a peak of what that fossil fuel will be. Historically, it's been very, very easy. Fossil fuels, when you get them out in certain areas, they're very easy to process. Crude oil has been very easy to process. But now, our crude oil sources are not so easy to process. And so, that makes it more expensive to get gasoline from that source.

So, we need to be thinking about what kinds of things are we going to have to do in the future, in order to move away from the fossil fuel dependence. We know that at some point in the future, we will have a peak, in terms of being able to produce those fossil fuels. And now, granted, it may not be until 2037; it may not be until 2050. It may not even be until 2080. But, changing the infrastructure in our country to moving away from that, going to the gasoline station to get our fuel to move our cars to doing something else is not going to happen overnight, either. And we don't have the technology right now to make that thing happen. And it will take time. So, we've got to start thinking about it now.

I'll give you another example: Water. Water's been a key issue for us and we don't tend to think about what's happening to that resource until all of a sudden, it's a crisis for us. And because water's cheap, you know, you go to the tap and you turn it on, well, you don't necessarily think about how it gets to your tap. Well, there's a whole set of infrastructure that causes that to get there. And it doesn't change overnight. You're not going to be able to change how you're going to get fuel to your car. You're not going to be able to change how you get water to your house without some time and planning on how you're going to do that.

Lemberg: So, major engineering problems are involved, at the very least. And then, changing your lifelong habits, so these have their own momentum. And if any change is going to occur, we're suggesting that now is the time to start.

Wood-Black: Exactly, exactly. Right now, if you think about what is our paradigm or what is our current status, you know we're a fossil fuel– . . . we're an energy intensive society. If you think about who uses energy, in order to have their society be the way it is or their quality of life, well the United States and Europe are very energy-intensive societies, which is very different than, say, somebody in Central or South America or in Asia. They're not as energy dependent. And we're very, very energy dependent.

Now, when you see India and China come on board, well they're going to have demands for those energies and as their societies increase to the same level as ours, they're also going to be very energy intensive. Also, our chemistries that we're dealing with and our processes, you know, you think about refining operations. The technology that went into making a barrel of gasoline 20, 30 years ago is roughly the same as it is today. Now, we've tweaked it, we've made it more efficient, we've made it more energy efficient. We get more gasoline out of a barrel than we used to. But, you're still basing it on the same kinds of science that we had back in the 1970s. So, you really need to start thinking about, well, what's our new science going to be?

And, those chemistries were developed when you didn't have as many people on the planet as we have today. So, not only did we do these chemistries, they're highly waste-generating types of chemistries to making certain products. You think about what we now call e-waste, think of all the computer waste that we're generating when you've upgraded your computer. All of the mobile phone generated waste, those e-waste kinds of things. So, these are also waste-generating type of activities. And so, we're not considerate of our earth systems. We're not considerate of the impact on the soils, the air, the water.

And we haven't really, necessarily, had to think about it because when we were a society that your neighbor was 10 miles away, well you could think about well, if I mess up this little spot, it's not going to be a big deal. Well now, if I mess up that little spot, I'm impacting hundreds of people. So now, we have to really think about that. So, that's our current status. And then, the question is where do we want to be?

Where we want to be is we want to have renewable feedstocks. We want to have renewable energy. We want to be able to have that. We want to consider chemistries that you look at as the atom economy. You want to make sure that you don't have waste. So, what you generate can go into something else or can be reused or recycled. And we want to be considerate of our earth system. So, we want to be definitely earth-system literate.

In order to get from our current state to that future state, lots of things are going to have to happen. And that's where the time comes in and what we're going to have to do, in terms of our research, in terms of our education systems, in terms of all of those things, we're going to have to change the infrastructure.

Lemberg: Frankie, thank you very much. I'd like to go into a little more detail on some points. You mentioned the atom economy. Can you say more about that?

Wood-Black: If you start thinking about the atom economy, if I'm going to make something . . . a lot of people are very familiar with the water cycle. And in the water cycle, I have fresh water and it's in the pond and then, it evaporates and then, we form clouds and then, it rains back down. Well, in a perfect system, in a perfect world, that would just continue to go on and on. So, that hydrogen molecule that was in the lake goes into, it evaporates and becomes a cloud. And then, it rains back down and that hydrogen molecule comes back down as rain. And so, it's a nice cyclic system. Well, we can think of the same thing, in terms of our products. We can think if I'm making a plastic, a lot of our plastics are carbon, hydrogen and oxygen-based materials.

Well, think about if I'm going to make a product, I want to have a balance of those carbon atoms. I want to make sure that as I take carbon from petroleum and I make a product, that I can bring that carbon back to, say, a fuel source and I can use that fuel source in a circle. So, I'm not throwing it away. I'm not taking something and throwing it off to the side and putting it in a landfill, for example. I want to create something that has a nice life cycle very similar to that water cycle, where I now have water that I can use to make my products. And at the end, I can have that water back again, or I can have that water for another use. Or, I can put that hydrogen molecule some place else and use it for something else.

So, I want to make sure that I have an atom economy where we're thinking about where our starting material comes from, how that material is going to be used, how that material is going to be, ultimately, disposed of or reused. That's kind of how that situation works.

Lemberg: Frankie, thank you. So, I'm getting that the key element here is renewable.

Wood-Black: Yes, it's got to be renewable.

Lemberg: And you'd mentioned earth-systems literacy. I love this concept. I'm thinking most of us are not.

Wood-Black: Well, and that's one of the issues we also talk about. One of the things we do as a society is that people don't, necessarily, understand how things work. You know, I go into classrooms all the time and I talk to kids all the time, and you can ask a kid, "Where does milk come from?" And about half the class will tell you it comes from the grocery store. Kids don't have that connection to the land, anymore, and so, they don't, necessarily think — unless they've been taught somewhere that milk comes from a cow, or a goat, depending on where you live — that where milk comes from, we don't necessarily see the link as we used to see the link.

And in our society today because we cram so much into our students, they're not necessarily scientifically literate. And because they're not scientifically literate, a lot of policy that we make in government, we don't think of the consequences of our actions.

I'll give you an example we've all seen. In the Northeast, there was a requirement the refineries put in certain types of pollution control equipment, which is all good and you know, we support that. And you want to make cleaner air. But then, when that raised the cost of gasoline, people didn't understand the link of well, I wanted this, but I have to pay a cost for that. And there was kind of a fallback of I'm not sure I want . . . I'm not sure it was worth that cost benefit. And we

still make a lot of science policy today, not evaluating the cost benefits of what it is we're doing, or looking at the unintended consequences of what we're doing.

So, you have a lot of different issues there, and if we don't get our folks educated and scientifically literate . . . I'm not talking about going in and taking a whole bunch of science. But, I am talking about being able to understand some concepts that you have to balance certain things.

You start thinking about OK, now, we say, "Well, I'm going to send a Congressman to Congress to do that." Well, our Congressmen aren't trained in science. We have one medical doctor in Congress. You only have a couple that are scientifically trained. Most of them are coming through law or someplace else. And so now, you don't have the people with, necessarily, the understanding or the fundamentals to be able to say, "Well, how do I balance this regulation against this regulation?" Or, "How do I balance the need for being able to support the land to be able to support growth of crops for us to eat vs. the growth of crops for us to put into renewable fuel?"

So, we have a lot of those issues that are going to come to us in the next 20, 30, 50 years that if we don't start educating society and educating our students, we may make some bad decisions. And we have a history of making bad decisions. We need to make sure we have people that at least understand the pros and cons and understand the cost benefit.

Lemberg: Frankie, thank you. You identified key areas of research, education and infrastructure. Could you talk about the kinds of activities that need to occur and then, what are some current barriers?

Wood-Black: Some of the things include wanting to reduce our energy intensity. A lot of our manufacturing goes into, when I work, do work to make something, I have a lot of friction involved. And a lot of our energy that we put into that is to overcome friction.

So, one of the areas of research you think of, well, I've got to overcome friction, so how do I do that? Well, I need new lubricating oil. You've seen a lot of those developments. Most people started seeing these longer, extended motor oils. Well, you know, think about doing that in some of your aerospace applications. I'm making smaller parts and I'm trying to deal with that so I'm reducing friction. So, that's one area of research.

Dealing with carbon dioxide. How am I going to manage carbon dioxide? So, carbon management is another issue. And that's got a lot of technical problems. There's a lot of ways to extract $C0_2$ — we know how to do that because we sell carbon dioxide. It goes into your Coca-Cola and it goes into Pepsi, and so, people actually use it. But, the question is, if I'm starting to take that out of the atmosphere, where do I put it so it stays where I want it to stay? And so, that's going to take some time and effort.

We want to look at our processes. For example, when I manufacture that cell phone, are my processes what we refer to as green? Am I using less toxic materials? Can I substitute so I'm not producing as much waste? Can I use water as a solvent vs. using a hydrocarbon as a solvent? All

of those kinds of areas where there's lots of research. We also need to understand the impact of how do these things, when they get into the environment, how do they act in the environment? Is it something the environment's going to be able to deal with? Or, is it something that's going to accumulate in the environment?

And we don't have good models for a lot of things we make. You know, we have a good idea, but we don't have really good models. So, those models are going to need to be out there, and then, this whole renewable fuel, you know, what is going to be the fuel of the future? Is it going to be a mix of materials? Are we going to add ethanol to gasoline? Are we going to have something else? Is the hydrogen fuel cell going to be there? Is it going to be bio-diesel? Is it going to be wind? Is it going to be solar? We still don't know what that's going to be and we need to look at how we're going to do it. Or, is it something we haven't even discovered yet?

those are some of the things. And what are our barriers? Our barriers are we don't have as many kids going into science.

We don't have as many people working in fundamental research. A lot of our research in the United States is applied. So, we don't have the folks, necessarily, working on that and we don't, necessarily have the research dollars. And some of the reasons are because there's not a crisis, so to speak. Like water, water's in part of all of this, but trying to find funding for water research, people say, "Well, water's cheap if I live on the East Coast. But, if I live in Nevada, water's not so cheap." And so, there's not necessarily a crisis or a big concern as to well, this isn't a problem for me yet. And we all know, people don't necessarily react until there's a problem.

Lemberg: Right.

Wood-Black: We're like the frog in the pot. Water's starting to heat up, but we haven't figured it out yet.

Lemberg: Frankie, thank you. We've got a little time left. Can you tell us whether you're optimistic and are there people that you'd like to recognize?

Wood-Black: Sure. I'm very optimistic about the future because I think people are . . . if you start reading the paper now, you're starting to see all kinds of things. And people are definitely working in these areas. There's a nice core group in sustainability and they're working towards that. So, research activities are getting up and they're starting to move forward. The National Science Foundation and National Academies are working in these areas, so I'm very optimistic we're going to solve the problems. We're definitely going to do it.

And I'd like to recognize the committee that worked on this Grand Challenges report because without those folks, we would not have come up with some of these key areas and really kind of spurred what we're looking at. And those people include Jim Trainham, Victor Atiemo-Obeng, Mike Bertolucci, Joan Brennecke, Berkeley (Buzz) Cue, Jean De Graeve, Jim Hutchison from the University of Oregon, Andrea Larson, Pamela Marrone and myself. We all worked together. It was a great group of folks coming together on that committee and I think we came up with a wonderful work product.