Carbon Capture and Sequestration in Practice

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John Pendergrass: Our excellent faculty today includes Dina Kruger, director of the Climate Change Division of the Office of Atmospheric Programs at the U.S. Environmental Protection Agency (EPA); Kipp Coddington, a partner with Mowrey Meezan Coddington Cloud LLP; and Russ LaMotte, a partner with Beveridge & Diamond PC.

I. U.S. Environmental Protection Agency Initiatives

Dina Kruger: It's my pleasure to join you this afternoon and give you an overview of the work that we've got underway at EPA that may have some bearing on future carbon sequestration. First, I want to talk about the greenhouse gas (GHG) mandatory reporting rule that we finalized at the end of last year. We started implementing the monitoring portion of that program this year. I also want to touch on some of the other Clean Air Act (CAA)[1] actions that EPA has taken, final or proposed, and a little bit about how carbon capture and storage (CCS) could relate to some of those, and then close by talking about the Underground Injection Control Program that's operated by the Office of Water.

At the end of 2007, EPA was directed by the U.S. Congress in our Appropriations Act to develop a mandatory system for the reporting of GHGs both upstream and downstream. By that, we mean both at the facility level and also at the upstream suppliers of GHGs or products that will emit GHGs. The goal of this program was to enable us to collect data to inform future policy decisions both within the Agency and by Congress and the states.

We didn't quite meet the goal of promulgating the rule by June 2009, as Congress had requested, but we published it. We signed it in September 2009; it was published at the end of October in the *Federal Register*.[2] Those source categories covered in this final rule began their monitoring on January 1 of this year. They will monitor all year and then they will submit their reports to EPA by March 31, 2011.

Source categories that we cover in the final rule are things you would expect: coal-based liquid fuels; petroleum products; natural gas; and industrial GHGs. This is the manufacturer of things like HFCs [hydrofluorocarbons], PFCs [perfluorocarbons], and SF_6 [sulfur hexafluoride], which are used for a variety of industrial processes. Of interest are the suppliers of carbon dioxide (CO_2) category. We are requiring the suppliers of CO_2 to report in 2011 the amount of CO_2 that they are putting into the economy.

Then we have the whole suite of downstream sources covering a wide variety of industries and activities. Mobile sources are covered as well in a way that complements what we're doing with the light-duty rulemaking.

We proposed the rule back in April 2009 and got a very robust public comment. First, we heard that EPA should not assume or imply that all of the CO_2 that is supplied to the economy is actually emitted. We acknowledge that and in fact, in the final rule we modified the language to be clearer on that. We got comments from people who were trying to make the case that enhanced oil recovery is a closed system and that it should be considered nonemissive. We set that comment to the side because that was not germane to the CO_2 supplier subpart, but it does relate to ongoing work we have.

We were encouraged to look across all of our statutory authorities and our activities related to CCS and think in a comprehensive way. We've heard this message in all of our rulemakings related to CCS, the need for regulatory certainty in a coordinated, comprehensive, approach. That's another issue that has definitely been heard at the highest levels of EPA.

There was also a lot of interest in how we are going to assure that the CO_2 that's being injected underground is staying there and not going back into the atmosphere. When we put out our final rule, we responded to the comments by saying we planned to—in what we now refer to as a track two rulemaking—put out a proposal for how we would get a better handle on the reporting on the injection of CO_2 underground.

We have been working to develop a new subpart to the mandatory reporting rule about amounts injected and then

1. 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.

2. U.S. EPA, Mandatory Reporting of Greenhouse Gases Rule, 74 Fed. Reg. 56260 (Oct. 30, 2009) (to be codified at 40 C.F.R. §§86-87, 89-90, 94, 98, 1033, 1039, 1042, 1045, 1048, 1051, 1054, 1065.

how we might be able to confirm or assure ourselves that the storage sites are secure. That proposal is actually over at the OMB [Office of Management and Budget] right now. We're hoping to be able to propose that in the not too distant future. Over the course of this year, we'll be following up and either reproposing or finalizing the various subparts that were included in our initial proposal and were not completed with the final rule that we completed last October.

So, I will move on from what we're doing on the mandatory reporting rule now to some of the other CAA actions.

My group was also responsible for the endangerment findings. In December, the Administrator signed two findings under CAA §202(a): first, the motor vehicles title found that GHGs endanger public health and welfare; second, the Agency found that six key GHGs emitted by light-duty vehicles contribute to this endangerment.[3]

EPA undertook this action in response to the U.S. Supreme Court's decision in *Massachusetts v. EPA*.[4] The Court in that decision told us that CO_2 was a pollutant under the Act and that the Agency had a responsibility to turn to the Act and apply the requirements of the Act in making an endangerment determination. These findings in and of themselves do not propose any requirements on industry or other entities; the statute §202(a) says that if we find endangerment, then the Administrator shall promulgate rules.

On September 15 of last year, EPA and the NHTSA [National Highway Traffic Safety Administration] jointly proposed the national program to reduce GHGs and improve fuel economies for cars and trucks.[5] This was actually something that the president directed us to do very early in his Administration.

We're setting GHG emission standards under §202 of the CAA, the NHTSA is setting its corporate average fuel economy, and the two agencies have been working very closely together to make sure these are a complete and consistent package. Essentially, the EPA proposal would increase fuel efficiency to 35.5 miles per gallon by 2016. The comment period on that proposal closed at the end of last year, and the Agency is now in the process of working very hard to respond to the comments to meet the president's goal of having that final rule promulgated later in the spring.

We also put out what we call the Tailoring Rule within EPA related to PSD [prevention of significant deterioration] and Title V, because when GHGs are regulated under the CAA, then the provisions of the PSD and Title V provisions will apply, and the requirements in the Act set a very low threshold for that application.[6] So, EPA proposed that large facilities emitting over 25,000 tons per year of GHGs would be required to make the demonstration that they're using the BACT [best available control technology] to minimize emissions. So, the Rule raises these thresholds to provide more of a focus on the larger sources and ensure that this is a program that states can implement.

The comment period on that closed at the end of December, and that was, I will say with understatement, a very robust comment period. I had the previous record with my endangerment finding of the most comments on any single rulemaking; the PSD team beat that. And so they are also now in the process of responding to comments, and you can imagine the range of comments that were received on the legal theories and the economics and the technologies and all the rest.

In parallel to the rulemaking process, EPA has also engaged with a variety of stakeholders to start to look at what BACT would be and how can we provide support to the states. There is a workgroup formed under one of the subcommittees of our CAA Advisory Committee, or FACA [Federal Advisory Committee Act], that has been formed to figure out how to talk about these issues and provide us with some advice for how we might move forward. They're looking at the kind of information that EPA would need to provide to discuss approaches that would help state and local permitting authorities apply the BACT criteria in a consistent, practical, efficient manner. The Committee is also exploring new and innovative approaches that can be incorporated in the BACT analysis within the framework of the current CAA.

It is in this context that the issues related to CCS have been coming up: discussions around when the technology will be available and how much it will cost, and discussions around many other possible approaches for BACT efficiency improvements. This is one venue where the Agency is hearing from an array of stakeholders about CCS as BACT. My colleagues in the Office of Air Quality Planning and Standards, who are responsible for the implementation of the PSD and Title V programs, are managing that particular subcommittee.

Over the last few years, we've either been petitioned or received notices of intent to sue on many of our new source performance standards and other actions. We received a whole set of petitions related to aircraft, ships, and non-road engines, bringing in other global warming substances like black carbon and asking EPA to take steps to regulate GHG emissions from these sources.

The Agency has been looking at how to respond to these types of petitions in a way that is effective and would make the most sense in terms of efficiency. The Administrator is firmly committed to pragmatism and prefers legislative solutions. The discussions are still very actively ongoing, but we do have a lot of these petitions in front of us and we're trying to sort out the most sensible way to move forward.

The last issue I want to touch on is the proposed rule of the UIC [underground injection control] program. I expect that most people are probably familiar with the Safe Drinking Water Act (SDWA).[7] The UIC program operates under SDWA and requires EPA to regulate pretty much everything that gets injected underground with the goal of protecting

3. U.S. EPA, Endangerment and Cause or Contribute Findings for Greenhouse Gases Under §202(a) of the Clean Air Act, 74 Fed. Reg. 66496 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch.1).
4. 127 S. Ct. 1438, 1455, 37 ELR 20075 (2007).
5. U.S. EPA, *Transportation and Climate Regulations and Standards*, http://epa.gov/otaq/climate/regulations.htm (last visited Mar. 30, 2010).
6. U.S. EPA, *Fact Sheet—Proposed Rule: Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule*, http://www.epa.gov/NSR/fs-20090930action.html (last visited Mar. 30, 2010).
7. 42 U.S.C. §§300f-300j-26, ELR Stat. SDWA §§1401-1465.

underground sources of drinking water. This is our framework for how we regulate the injection of CO_2. The air and water offices started working on these issues several years ago, because we recognized that we needed to bring both the climate perspective and the water perspective together. We've also been collaborating with the U.S. Department of Energy (DOE) over this period.

Back in July 2008, the water office issued a proposed rule that there be a new Class VI to address the geologic sequestration wells that would reflect the unique characteristics of the CO_2 injection process. They took comments for several months. Last summer, they put out a notice of data availability and got some additional information. They had the information from some of the DOE pilot projects, and they are now on track to finalize their rule in late 2010. We're hoping that the action that we take under the mandatory reporting rule will be able to dovetail in terms of the completion dates with them.

I'll conclude by saying that from where we sit at EPA and certainly looking at this from a climate mitigation perspective, we see the CCS technology as an extremely important one and one that we want to work. It's our view that being able to assure the public that CO_2 injection can be done in a way that is protective of both the environment and human health is going to be very important. We believe that with an appropriate regulatory framework, we can give the public that confidence.

I think one of the things we hear from stakeholders across the spectrum all the time is that this needs to be a coherent and comprehensive framework, and the Agency agrees. We know that there are a lot of projects in the works. We want to be in a position where we've been engaged early and thinking constructively so that down the road, when we are at a point where we really need to deploy this technology, we have it ready and we know how we'll manage it.

II. Federal and State Overview

Kipp A. Coddington: I'm going to begin with just a brief political and legislative federal overview on what is currently going on with CCS, and then I'll cover some of what's going on at the state level. I'll close briefly with some practical deal considerations for those of you who find yourself in enhanced or recovery projects or detailing or other storage projects and you're trying to draft a CO_2 off-take agreement.

On Capitol Hill, from the 10,000-foot level, I believe it is fair to say that CCS has tremendous bipartisan support that has been exhibited in several different vehicles. The Waxman-Markey Bill in the U.S. House of Representatives, for example, was rich with numerous provisions incentivizing CCS, for example, through the issuance of bonus allowances. Those were some of the carrots. They were also some of the sticks in terms of trying to drive new-build, coal-fired power plants to meet particular CO_2 emission targets.

So certainly, in terms of cap and trade in the House, there was a lot there for folks interested in the advancement of CCS to like. Many of those provisions were also reflected in the Kerry-Boxer Bill that's out of the U.S. Senate Environment and Public Works Committee now. What we can certainly say is that CCS enjoys broad legislative support. I think we will see that again in a possible Senate effort this spring to climb up the cap-and-trade hill, and depending upon the outcome of that, I think we will see an energy bill that will be helpful in terms of advancing CCS.

As a matter of fact, yesterday, Sen. Byron Dorgan (D-N.D.) was quoted in the media saying he envisioned there being a Senate energy bill on the floor perhaps by June. And as everyone knows, the Senate Energy Committee actually passed their ACELA [American Clean Energy Leadership Act] Bill. ACELA itself also had CCS provisions to include an indemnification program for some initial CCS demonstration projects. The issue of long-term stewardship is a topic I'll be circling back up with separately. Although it's a great parlor game guessing what Congress will do in any session, if I had some money, I may be investing in the odds of an energy bill moving that has some CCS provisions in it.

Last but not the least, Congress already has enacted tax incentives for the injection of CO_2, the so-called 45Q tax credit that provides $10 per ton or $20 per ton, depending upon the formation into which you were making an injection. Last year, the Internal Revenue Service issued some initial guidance on how 45Q works. Certainly, the stimulus package that passed very early in President Barack Obama's first year in office had upwards of $3.4 billion for incentivizing and providing grants and loan guarantees for any number of CCS-based projects. We think the future is bright on the federal legislative front for this technology.

Depending upon what state you wanted to permit or develop your project in, it is quite possible that that particular state has already adopted a legislative scheme and perhaps even a regulatory scheme that would govern most if not all permitting requirements for your facility. It's unclear how these state laws and regulations may stand up in the face of forthcoming federal laws and regulations, for example, whether the state enactments will be preempted, but you need to know that in a handful of states today, if you wanted to get a permit for your project, in theory you could.

A number of state legislatures have already passed laws that authorize the subsequent rollout through regulatory action of regulations to cover A-to-Z permitting of CCS sites. The state bills vary, but the general themes are quite common. These laws typically begin with a requirement that the storage operator or the injector get a permit. Then there are lots of legal requirements that must be cleared in order to get that storage permit.

In some instances, the states will go on and say that the permittee has to comply with the forthcoming federal UIC rule about which we've previously heard. In some instances, some states have gone ahead and enacted what they consider to be the appropriate UIC approach in their state and then they make a choice regarding which agency should be the primary regulator. There was a split in the states as to whether the oil and gas operator in that state would regulate a geologic storage site or whether the environmental regulator in

that state would regulate it, or both. In some instances, the answer to that question turns on whether the storage facility is initially engaged in enhanced oil recovery or if another storage formation is being used.

The other aspect of these bills is that they envision that the storage facility will be heavily regulated throughout its life. When injection and a subsequent stewardship end, a certificate of completion is issued. Before that certificate is issued, the regulator will come in and, through extensive modeling and monitoring, make a determination as to whether the site is safe. "Safe" means the site meets all applicable environmental standards with respect to air protection, water protection, soil, and so on. Once that certificate is issued, you enter into a long-term stewardship phase. A growing number of states have enacted laws that provide for state assumption of long-term stewardship obligations at storage facilities that have obtained a certificate of completion.

So, this is quite notable in our opinion, because one of the major legal impediments that practitioners run up against is the question from the board of directors that goes somewhat like this: "okay, counselor, we're about ready to spend $10 billion on a gasification plant and we're injecting into this saline formation. What happens four years after we have done an injection and who was responsible for it?"

At the moment, the common perception is that there isn't a good answer to that question. But what you need to know is that in a growing number of states, if you have gone through all the legal and regulatory hurdles to get a certificate of completion, at that point, the site is truly effectively stable, and the state in one form or other will step in and say we are responsible for this site going forward.

The states are trying to provide investment certainty about the management of the long-term tail risk of a storage site, de minimis though that may be. So, while we continue to believe there was a critical need for an overarching federal long-term stewardship role as well, it's notable what the states are doing.

The other question that you hear when attorneys come up with a list of potential legal impediments to the development of the technology is, who owns the pore space? While we certainly agree that property rights issues are a consideration that must be addressed, it's our view that this issue is also being resolved gradually by the states. The general rule that's emerging is that the pore space, which is the little tiny void in a rock in which the CO_2 is stored forever, is owned by the surface owner unless there was a previous severance of that interest. The states were also making clear to the best of their ability that nothing in the exercise of the pore space ownership right can trump or diminish or impair mineral rights. In a typical situation, the mineral right interest would be the dominant estate, and the pore space would be an attribute of the surface estate. It would be helpful if Congress were to clarify this issue on federal lands as well. Indeed, there was a bill introduced last year in the Senate that would provide that clarity.

I want to close with some permitting and deal considerations. So, you've been hired by your client, a coal gasification plant or a CO_2 pipeline operator, and you're the third party to a deal. It's an enhanced oil recovery operator, a field operator, or someone that owns deep, deep saline pore space. What are some of the considerations as you do that deal?

You have considerations under the UIC program. How will the injection site be regulated under Class VI? Will a state version of Class VI be recognized? Will there be a delegation function under the forthcoming rule or has the state already done enough for you to basically understand the permitting requirements under the laws of that state?

The other issue is what the storage requirements will be in that state, and as I previously noted, there are states that have come out with fairly comprehensive regulatory schemes for the storage phase, all of which lead to the issuance of a certificate of completion for the facility. You need to make sure you've got a thoughtful understanding of how those requirements work.

EPA's treatment of CCS under the CAA will also be important. Will CCS be BACT? Is there going to be some constituent standard that's imposed upon the effluent from that facility? Unless the facility is discharging pharmaceutical-grade CO_2 coming out, you may have considerations regarding what else might be in the effluent that may have an impact on the permitting status and the performance of the reservoir.

The laws may reach—for better or for worse—different conclusions on requirements for injecting into an active enhanced oil recovery facility, an inactive enhanced oil recovery facility, or if you are just in a green field without any oil and gas production and you're going deep into a saline formation. Understanding that geology and the subtleties of the law around those formations will be important.

Folks have been selling CO_2 for a long, long time in the oil patch and elsewhere in the United States, and there are certainly model CO_2 off-take agreements that can be used. Those agreements will likely have to be revised, however, to address topics such as long-term stewardship and environmental responsibilities. You also have Uniform Commercial Code (UCC) considerations; there are some risks that CO_2 could be deemed a "good' that is subject to the UCC. We typically recommend that UCC waiver language appear in a CO_2 off-take agreement with respect to CO_2.

A party spending lots of money on projects needs to have a very clear understanding of what their responsibilities will be with respect to injecting CO_2. As previously noted, many states are starting to address those issues, and we would expect a favorable outcome, but until there is complete legal certainty, some careful drafting of the legal documents will be required.

III. International Context

K. Russell LaMotte: I will be rounding out the discussion, which so far has focused on the U.S. context, with some international information, shifting gears for a couple of reasons.

First, those who have followed this ELI series or the Senate legislative process will of course be aware that even if

there's dramatic progress in emissions reductions or mitigation techniques here in the United States, that's going to be insufficient to deal with global climate change, unless it's connected with significant progress at the global level, particularly in countries like China and India that rely heavily on coal as a fuel source. Indeed, IEA, the International Energy Agency, last fall published a report showing that there was an urgent need for CCS projects globally in order to reach the limit of global warming to close to two degrees Celsius by 2050.[8] What they called for, in fact, was for 100 CCS projects to be deployed by 2020, one-half of which they envisioned being deployed in developing countries with all of the assorted infrastructure that goes along with that, including an estimated 10,000 kilometers of pipelines, some of which are likely to involve transboundary movements of CO_2.

That finding by the IEA was then recognized by an intergovernmental body called the Carbon Sequestration Leadership Forum last fall. These are 24 governments, including China, the European Union (EU), and the United States, along with other key players. That group also confirmed last October that there's a need in order to make all this happen for assistance from developed countries to help developing countries achieve that level of CCS deployment required to fight climate change. The IEA estimated that the funding requirements for CCS demonstration projects in developing countries between now and 2020 would fall somewhere between $1.5 billion and $2.5 billion annually, so a significant demand for resources to jumpstart the deployment of CCS technologies overseas.

The second reason we're looking at these international issues is that it's worth being aware that many of the thorny issues that have been in play domestically with CCS, including a lot of those that Kipp just described for us, are issues relating to storage design, property rights, and long-term stewardship. Those have also been flagged or indeed are being addressed in overseas projects and even in international frameworks.

I'm not going to try to capture all of the CCS-related activities in play internationally. I'm going to cover essentially two tracks of activity: first, developments relating to CCS projects in the sub-seabed under the London Convention; and second, other CCS activities under the global policy architecture dealing with climate change, namely, the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

There is already in place today an international regulatory regime for CCS, and it applies to sub-seabed CCS projects. It rises under a maritime environmental protection treaty regime housed at the International Maritime Organization in London and known as the London Convention and the London Protocol.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter was adopted back in 1972, and essentially it required a permit for offshore waste disposal from vessels and platforms. That agreement was then updated and replaced in 1996 by the London Protocol, which is more stringent in that it prohibits all offshore waste disposal from vessels or platforms with the exception of certain green-listed substances or waste categories, and even those categories are subject to a permitting regime. CO_2 was not on that green list in the original protocol, and the protocol specifically addresses and includes sub-seabed disposal. So, the protocol entered into force in 2006 and would have in its original form essentially prohibited sub-seabed CCS projects in countries that were party to the protocol.

Meanwhile, offshore carbon injection for enhanced oil recovery projects had been underway for a number of years in the North Sea. Arguably, they wouldn't constitute waste disposal, and therefore may not have come under the waste disposal regime in the London Protocol, since they were an industrial use of the CO_2. But there were some entities and governments, including Statoil, the huge Norwegian mostly state-owned oil and gas developer, that were interested in doing more, and in fact, Statoil was developing a project that would combine a natural gas recovery and CO_2 capture from the gas and storage in a saline aquifer in the North Sea. Those projects would have conflicted with the regime under the protocol. So, what happened?

Well, the protocol was amended at its first meeting after entering into force in 2006 to allow for sub-seabed CSS projects subject to a stringent permitting regime that requires site assessment and ongoing monitoring. That process includes detailed risk assessment and a management framework that was agreed to as guidance that individual countries permitting the activity would have to take into account. That framework requires consideration of a number of the factors that Kipp and Dina have already identified as relevant domestically: site-selection review; risks of leakage; potential for impacts on the marine environment; and the need for long-term monitoring and management of the site.

The Parties to that agreement do not include the United States; we have not ratified the 1996 Protocol yet but it's before the Senate right now. We are a Party to its predecessor agreement and participate actively in this body. Those Parties have adopted related decisions on reporting of CO_2 streams and for sharing of information among parties about CCS projects globally. Meanwhile, that Statoil project has been online since 1996 and has been injecting up to a million tons of CO_2 anyway. I believe it's one of the five global commercial-scale CCS projects in operation.

Overall, the progress under the London Protocol provides, I think, a good example of international law adjusting to accommodate a new technology as a tool for dealing with a greater threat from climate change, while also putting in place measures to address risk mitigation considerations.

That same amendment process repeated itself just last year when a new set of issues arose regarding a provision in the protocol that prohibits the export of waste to other countries for disposal in the water column or the seabed. That issue arose in the context of a project involving the injection of CO_2 streams into a sub-seabed formation that straddled a

8. International Energy Agency, Technology Roadmap: Carbon Capture and Storage (2009), *available at* http://www.iea.org/papers/2009/CCS_Roadmap.pdf.

jurisdictional boundary, and there are also projects that are under development in northern Europe and in Southeast Asia that potentially involve transshipment by pipeline of CO_2 for disposal offshore in another jurisdiction.

For the second time, the Parties had to grapple with a potential amendment to the protocol. They looked at a variety of these circumstances where these issues might arise: transfer to a Party before injection; transfer to a non-Party; what happens if carbon migrates after it has been injected across a boundary and what if that's intentional; what if that's accidental, etc. After a lot of debate and actually a contentious vote, which is rare in these international fora, the Parties last October voted to amend the protocol again to allow the export of CO_2 for sub-seabed sequestration Parties.

The two Parties involved have to enter into an agreement that allocates permitting responsibilities. There is a provision that allows for exports to non-Parties, as long as the minimum environmental standards equivalent to those required under the Protocol are satisfied. Interestingly, China was the only Party that voted against this amendment, citing a need for further study of the technical and legal issues surrounding the export of CO_2.

Wrapping up on this corner of the world, it strikes me that this progress on resolving these transboundary movement issues, even in this limited context, might be helpful precedent for international cooperation in land-based projects involving transboundary pipelines from sources to appropriate storage facilities. It seems like a positive story about the adaptability of international legal regimes in the face of the climate change challenge.

I'll now return to the terrestrial world, to CCS under the Clean Development Mechanism (CDM) and the Kyoto Protocol. The Carbon Sequestration Leadership Forum that I mentioned at the top of my talk also called for the Copenhagen Conference last fall to recognize the importance of CCS in mitigating climate change and noted that CCS should be appropriately recognized in any mitigation and technology incentive arrangements that are part of any agreement under the Framework Convention in Copenhagen that was in October.

There have been two issues historically that have animated the discussion of CCS in the Framework Convention. One was how to account for CCS projects in national GHG inventories under the Framework Convention and the Kyoto Protocol—that issue has not been completely resolved, but a lot of progress was made on sorting that issue out with the release of the 2006 guidelines from the Intergovernmental Panel on Climate Change (IPCC). Those guidelines provide a comprehensive framework for measuring and reporting CO_2 capture from CCS projects. Essentially, they provide for a subtraction of captured carbon from national CO_2 budgets or reports, but would require parties to consider fugitive emissions from leakage in transportation in their CO_2 emission inventories.

The 2006 guidelines are predicated on the development in the host country of a robust permitting requirement that allocates liability between project operators in host countries, including after project cessation. Those have not yet been adopted by the Framework Convention Parties. That will require revision to existing reporting and review guidelines under the Framework Convention and the Kyoto Protocol and there's ongoing work in that direction, and there may be approval of that next year in 2010 in Mexico.

The second issue that's been in play, and really the more contentious one, relates to the question of whether CCS projects overseas in developing countries would be recognized under the Kyoto Protocol's CDM, the project-based tool for crediting projects in developing countries that could then be used for developed countries to meet their targets under the Protocol. The Parties to the Protocol have long been debating whether to allow CCS projects into the CDM.

This is a significant issue, because the question whether CDM funding will be available for projects is going to be potentially critical for the global deployment of CCS projects. Generally, there seems to be support within the Framework Convention for including CCS within the CDM, but there've been a number of concerns raised about financial issues and environmental risk issues. The financial issues have been more political historically. Will CSS projects crowd out renewables? Will they be used? Will funding from CDM be used and essentially prolong reliance on fossil fuel-based projects in developing countries?

Those issues might have been resolved in Copenhagen but, like a lot of other issues, got kicked down the road. There was no resolution of whether CDM would be included, but the Parties did adopt a decision that recognizes the importance of CCS as a possible mitigation technology. Then they itemized a number of outstanding concerns, many of which will be familiar to those who followed these issues domestically: permanence; measuring; reporting; verification; environmental impacts; how to define project boundaries particularly in a project-based crediting setting; liability; leakage in migration; how those issues relate to the project boundary; and safety issues.

And so the Parties adopted a decision that directs a subsidiary body to continue work on those issues and possibly team those up for the meeting in Mexico City in the fall. The fault lines have been largely split along those favoring inclusion of CDM (Norway, Saudi Arabia) and those like Brazil who have been concerned that CCS projects in the CDM would undermine funding for other clean energy and forest protection projects. So, that remains a work in progress.

Even if CDM were extended to include CCS, there are a lot of questions about whether CDM credits would be sufficient to bridge the high additional cost of those projects in developing countries. So, there likely would be a need for other sources of funding, and I'll talk briefly about that at the end. But right now, CDM is the prime vehicle for generating financing for carbon mitigation in developing countries, and China has made clear that they're not going to be doing CCS and paying for CCS projects on their own. It's not a priority; they're looking to international financial mechanisms to help pay those additional costs.

Meanwhile, the CDM itself is in an uncertain position after Copenhagen. There are a lot of questions that remain or that were raised in fact about what the market structure for project-based credits is going to look like after the Kyoto Protocol's first commitment period ends in 2012. I am going to make these two points about the Copenhagen Accord that are relevant to this discussion.

First, there's a lot of uncertainty about the future of the Protocol and whether in fact there will even be a second commitment period. I think people are probably familiar with the Accord by now, but basically it adopts kind of a pledge-and-review approach that compiles commitments that Parties may have adopted under national climate plans. It's conceivable that developed Parties, like the EU or Japan, could choose to extend their Kyoto commitments on top of this pledge-and-review mechanism that's set up in the Copenhagen Accord. But the United States, for one, has made it very clear that it's not going to adopt that approach, and even the EU has said that they're rethinking their approach to the Protocol in light of other countries' positions.

Secondly, the Accord is really notable for the near absence of any discussion there about the role of carbon markets and the future of the CDM after 2012. So, that raises the question, what happens to the CDM and then, in turn, what happens to CCS projects under the CDM if Kyoto withers on the vine after 2012? At least we know that the conceptual underpinning of the CDM—the idea that there will be transfer of resources from industrialized countries to developing countries to underwrite those additional mitigation costs—will continue in some form or another.

Presumably, there's going to be some kind of market for this that incentivizes these ongoing transfers even in a post-2012 framework, probably driven by demand for credits in developed country, cap-and-trade markets although, as Kipp said, who knows what'll happen here in the United States? Maybe there'll be some kind of ongoing, transformed CDM process in the future with a global project approval process. Then, the question would be, how would CCS projects be recognized or made eligible under that scheme or under eligibility requirements in these national demand centers like the U.S. cap-and-trade system?

If CDM is not going to provide the funding for CCS in the short term, briefly, what are some of the other mechanisms that are going to facilitate international deployment of this technology?

The first one is the World Bank Trust Fund for CCS deployment in developing countries. This was established last month, and it's designed to help developing countries finance CCS deployment. Norway is likely going to be the main contributor. They've already put up $6 million or so, which is a drop in the bucket compared to the $1 billion to $2 billion that we talked about earlier, but the fund is still in the early planning stages, so a lot of the details remain unclear.

The second one is the new Copenhagen Green Climate Fund. One of the real successes coming out of Copenhagen was agreement on financial pledges from developed countries and the mechanism to operationalize those pledges. That set up an initial kind of quick-start fund with $30 billion available from now through 2012. Those are supposed to support immediate actions to help curb emissions and help communities adapt to the effects of global warming. A lot of pressure will be focused on taking that funding for adaptation to the least developed of developing countries. It's unclear whether any of that would be available to support CCS deployment. Long term, those numbers are going to rise up to $100 billion per year by 2020, again, with the same objectives of supporting the needs of developing countries, and it's also unclear how CCS would be considered eligible under that new funding stream.

Some bilateral projects are providing current funding for various CCS demonstration projects overseas. There are a range of cooperative activities through the Asia-Pacific partnership that I imagine EPA is involved in, and other projects to improve capacity, for example, regarding site-feasibility assessments, etc. The EU and the United Kingdom both have relatively ambitious bilateral partnerships with China aiming to commercialize or develop and construct a demonstration plan in China later this decade. And the EU has pledged 50 million euros for that project, a significant down payment but, again, really nowhere near the amount of money that the IEA has identified as necessary in order to jumpstart the deployment of this technology overseas where it may be needed even more that it is here.

IV. Audience Questions

John Pendergrass: First, how much CCS do you anticipate will occur on federal lands as opposed to private land? Second, from a layman's perspective, it's hard to believe that CCS is a reliable long-term global solution. Has anyone done the analysis on what the United States and China, both heavily reliant on coal, using CCS as a long-term solution for all their coal plants, would do to the environment? Aren't there significant risks of earthquakes, water contamination, or other effects given the amount of CO_2 involved over the coming decades from China?

Dina Kruger: As a general matter, there has been a lot of work done to try to characterize some of the potential risks that could occur from geologic sequestration. The IPCC did a report a few years ago that looked at the suite of issues within the United States. DOE has a lead on the major research and development in this area, but when our Offices of Air and Water at EPA started working on this back in the early 2000s to look at the issues, we tried to get a picture of the things that could happen and to try to understand how one would ensure that they didn't.

If this becomes a major climate mitigation strategy, there will be a lot of CO_2 injected underground, volumes that would dwarf the injection that's been done in our UIC program to date. So, you have large volumes, and the CO_2 that's being injected is both buoyant and viscous. Its characteristics are such that there will be a larger area of review for a site; there will be special issues around the well mechanics and

well integrity. We'll need to be preparing to understand both how to predict where we think the CO_2 plume might go and then to be able to track it underground.

That said, CO_2 is actually nowhere near as toxic or hazardous as many of the things that are actually injected underground today in our UIC program, and we have what we believe is a very good track record under the SDWA with managing injection safely. We believe we have a good handle on the water risk in the United States. As we started this process, we reached out to DOE, the environmental community, and a number of stakeholders to get a sense of what they thought the big risks were, and we began to focus our attention on the places where we thought there was the most concern.

I think, at the end of the day, the IPCC concluded that sites that are properly selected and well-managed should be able to store safely and securely this CO_2 for a long period of time. We need to make sure that our regulatory framework would provide the incentive to the site operators to select and operate their facilities in that way.

K. Russell LaMotte: I do want to address the point that the questioner asked about whether this was a long-term global solution. I think that the answer is probably that it's not a permanent solution but that it's viewed as a bridge toward alternatives that will allow us to get on a different energy pathway and emissions pathway. The alternative that exists right now in the short term is probably not going to get the volumes of sequestration or CO_2 out of the atmosphere that we need to in the relatively short time frame that the scientists have said is available to us in order to address climate change, particularly in China.

As I said, they're doing a lot to transform their energy economy, but they are not going to be moving away from their continued heavy reliance on coal in anything close to the time frames that would be required in order to dramatically shift their emissions pathway. That's just the reality that we have to deal with using these available technologies, even though they may not provide a permanent solution.

Kipp A. Coddington: I just wanted to clarify the statement that it might not be a permanent solution. In terms of the safety and security of CCS as a technology, I think it's safe to say that all available experts that have looked at this believe it will be safe and sound for well-sited and well-regulated sites, and these certainly will be some of the most heavily regulated sites known to mankind.

If you look at the sites in which this has been occurring, it's important to keep in mind that, in many respects, this technology is quite old. If you go up to the Permian Basin, they've been injecting CO_2 for enhanced oil recovery for 30 years, and if you look at the safety record of those operations in comparison to other industries, for example, the evidence is quite clear from an ocean perspective, for example, that enhanced oil recovery operations are safer than other comparable operations in the oil and gas industry.

If you look at the other injections that have been occurring now for a decade or more, such as the Weyburn Project and Sleipner, there's a mountain of data available from now heavily monitored sites that prove up the security of those operations. And companies like Schlumberger, for example, or Halliburton, and others, will sell 3D seismic technologies, all sorts of high-tech technologies where you can go down and see in a computerized way where the material is underground and the slow rate at which it is moving. There's a high degree of confidence that this technology is going to work. I do believe it is viewed as permanent. Once it's going down, it is not going to come back up. Indeed, I think if you tried to get it back up, that would be a problem.

In terms of the future of oil and gas and coal, if you look at estimates from the Energy Information Administration, the department of the New Energy and Industrial Technology Development Organization, and the IEA, no one is predicting loss of use of coal or oil and gas and other carbon-based fuels for the foreseeable future. So, while other technologies and energy sources will of course be coming online, we're all going to be heavily dependent upon coal and oil and gas. We're quite confident CCS is going to be a permanent storage answer for those sources.

K. Russell LaMotte: Right. I didn't mean to question the permanence of CCS sites as such, but rather that I think everybody would agree that the further deployment of CCS technologies for fossil fuels should not divert ongoing research and development of alternative energy technologies that over time may provide alternatives.

John Pendergrass: I want to return and see if anyone has anything to say about the first question about how much CCS you anticipate will occur on federal lands as opposed to private.

Kipp A. Coddington: Late last year, the U.S. Department of the Interior (DOI) issued a study on a legal framework for storage of CO_2 in federal lands. Obviously, I think, the Bureau of Land Management and the DOI collectively own something like one-quarter or one-third of the real estate in the United States. Clearly, a federal role here is going to be important. I am not aware of a study that has said specifically, in terms of quantities of stored CO_2, what percentage might go on to federal lands, state lands, or private lands, but I think the federal role here will be key for a wide variety of reasons.

Late last year, Texas approved a law to look at offshore storage in the Gulf of Mexico in state waters. There's an effort underway in Texas to look at a sub-seabed storage opportunity in state waters in the Gulf of Mexico, so you also have to remember state lands as well.

John Pendergrass: If we were to assume that there was a storage project that injected CO_2 and then the mineral owner wanted to mine, what's going to happen as they disturb that stored CO_2, and who is going to be responsible for the loss

of that storage and dealing with whatever physical or legal issues arise?

Kipp A. Coddington: I'm not sure that scenario would ever occur. There are probably 200 years of case law in the states under oil and gas provisions where these sorts of issues have been vetted. It almost goes back to the early days of Blackstone law as to property rights and how you sort competing uses in a way that is environmentally responsible.

Those issues are being thought through by the states now in the oil and gas codes, and entities such as the Interstate Oil and Gas Compact Commission have made some recommendations as to how these issues are to be resolved. But the simplistic answer is that it's legally highly unlikely that a storage site is going to be penetrated in a way that would impair the integrity of that storage. Or, if that is allowed to occur, the oil and gas industry is so good that they can drill through all sorts of subsurface formations now and isolate the CO_2 with a wide variety of seals and the like to ensure that there is no loss of containment.

John Pendergrass: Thank you. I want to thank Dina Kruger, Kipp Coddington, and Russ LaMotte all for your participation today. I think it was an excellent, informative program, and thank you to the panel.