

Clean Coal Power Demonstration Overview and Workshop Transcript

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The question and answer (Q&A) period held during the CCPI Plenary Session was tape recorded. Unfortunately, due to the poor quality of the tape, the following transcript may not always present a word-for-word interchange between participants. Although exact quotes were not always captured, as such, the information below may not reflect the true nature of the question or comment. The tape quality was good on answers for the most part. Participants may provide Mike Eastman with additional input at michael.eastman@netl.doe.gov so that the transcript can be modified to clarify the comment or question to the panel.

Eastman (aka Mike) – Following presentation of the CCPI program status (also posted on the website)

Mike:

I'm kicking off the discussion session of this CCPI session. Sir, I'd like you to come to the microphone so I can do justice to the commenter. You can ask questions, that we will do our best to answer, or just provide comments so you can go on the record. I would like you to state your name and your company affiliation so I can give due credit in the transcript process. Sir, can I have you go to the microphone? Thank you very much and we're into the workshop...

Applause

Question (Unknown):

We mentioned a moment ago goals and fuels possibility. Will you include biomass (as a feedstock)? Just how encompassing is this initiative?

Der (aka Vic):

Relative to CCPI, I'm assuming that's the context. I believe that there is a requirement in the Clean Coal Power Initiative for 75% usage of coal or coal-based fuel. So anything that you can add that is necessary to can make it work technically and economically, I think is fair game. Am I correct on that Mike?

Mike:

Yes, in the first solicitation, this was heavily debated and we ended up with a position that 75% of the energy input to the plant needed to be from coal or coal derived products, if you will. That left 25% to be associated with the materials that you referred to. I'm trying to recall if that actually was part of the congressional record. It wasn't part of the actual appropriations bill but it was discussed in some of the congressional report information and that's the requirement we ended up with.

Howard Feibus, (Electrotek) aka Howard:

Following up on the first question, there doesn't seem to be any fundamental basis for the 75% requirement but one thought that I had is to allow for mixtures of coal with biomass, in proportions that yield a greenhouse gas emission potential that is equal to that of natural gas. That, at least provides some fundamental basis for the minimum percentage of coal. It will give you more flexibility of less coal. And that kind of thinking is not a view we're pushing. That kind of thinking would allow for, I think, some distributed generation projects. And, in Mike Eastman's presentation he mentioned the concept of distributed generation. In all of your discussions I haven't seen how the concept of distributed generation can fit into the scope of the solicitation.

Mike:

Howard can I ask you a follow-up though? When you talk about distributed generation, would you just clarify for folks what you have in your mind as distributed generation?

Howard:

Yes, distributed generation really is the idea of taking power generation to the electricity load centers. In the context of an electric power system most of the plants, that people in the Office of Fossil Energy focus on, are relatively large-scale central generation. A central generation plant is something that is on the opposite end of the transmission line from the distribution substation that takes you from the distribution primary transformer down to the customer. Distributed generation would be any power source from that distribution substation down to the customers and the closer you get to the customer the more of a distributed generation system it is.

Mike:

Okay, the roadmap per se does not distinguish between a distributed generation application and a central station application. Nor did the CCPI Round 1 prescribe a minimum size. The modules in the roadmap would have flexible application, for example, the SECA fuel cell aspect is included in the roadmap. So those technologies may be suitable for distributed generation, which is not to down-play the importance of having central station power generation-scale come out of the RD&D program with these performance targets. If people can put together a distributed generation application that otherwise meets the technology roadmap performance goals in the time frames, I don't see that it would be precluded. And we haven't really done things that I'm aware of that either says "you can or can't apply." If there's a distributed generation goal that needs to be specifically addressed in a certain timeframe, that might be something that a CCPI solicitation could specifically focus on. In the past, you know that Round 1 was very broad. If we're going to buy into the concept of narrowing down the next solicitation to fit the roadmap needs, you could put arguments forward to say we need a particular technology and structure the solicitation to call for technologies that respond to that particular goal.

Howard:

A specific suggestion; What do you have as goals? For example, you have things like efficiency and a cost of electricity target. And typically what I would say about a distributed generation technology is that it may be very difficult to meet that cost of electricity target. Because as you go down in size, you lose economies of scale. But what you gain is the ability, by being close to the customer, to create additional benefits with transmission lines savings, the distribution savings, specific savings from being at the customer's site (ability to recover waste heat and to provide a source of emergency power for the end-use customer), and if you could adjust your performance target to accommodate that, that would then at least open the door to be more inviting toward the distributed generation concept.

Answer:

Understood. Vic did you have anything you wanted to add?

Vic:

I just wanted to kind of go back to the mix relative to coal. The focus is trying to keep coal a strategic domestic fuel and your point is fairly well taken about one option to try to do the mixture of the fuel so that the greenhouse gas itself could be comparable to, let's say, natural gas. But eventually the issue of carbon emissions may take a turn and some time in the future we have to address that, whether it's natural gas or coal. But the primary focus of this particular program is finding ways to meet the challenge as specific to coal itself.

Jim Cobb, University of Pittsburgh:

Notwithstanding that, I would like to hang onto the biomass issue for just one more round here. Yesterday we heard from AEP that the sources of biomass are not well defined as yet and, as I mentioned yesterday, and I view that as a key issue that isn't fully appreciated and may be very important. It strikes me that one or several of these next projects might take the approach of including biomass, providing it in the structure of the project, not so much from a technical standpoint as from a business standpoint. My question to you is what might you see as the role of the U.S. Department of Agriculture and the Title 9 and other elements of the new bill which has been passed, by the way, and is out there as Title 9 Energy, that in the review process if there is an agriculturally driven portion of a project, they might be included in the review process. This gets back to a comment, any project developer that has this idea of including the alternative fuel sourcing as a part of the project, that might they include funds from USDA under programs that will be coming along over the next year or two out of the USDA entitlement.

Mike:

Let me address a couple of aspects and we probably need both of us contributing to this one. First of all, in the Round 1 projects, and there is at least one, the Colorado Springs Utilities Project, has a significant biomass feed as part of the project. So some people have taken advantage of, and a number of the projects look at, a low cost feedstock to deal with today's economics as an enabler for the project. So that certainly is something that has gone through the process and hasn't been a stumbling block in terms of them

coming into the program. You mentioned incorporating, let's just say outside reviewers, as part of the process of evaluation. We have been modifying the review process to really benefit from our experience over the years and have increased the consultation opportunity for folks outside of DOE to participate and advise DOE on its selections. Hopefully that's manifesting in better selections. So I don't see any barrier relative to that. We have involved other agencies in other solicitations looking at proposals. That's actually a pretty good idea for projects that would have a heavy agricultural input and we'll look seriously at that.

The other point I'd comment on is the funding. That's one that there are some fundamentals in the program relative to the cost share and it's a Federal cost share. So if agriculture came in, that would reduce the DOE contribution, but it couldn't be put on the other side of the equation to be recognized as a participant cost share. Now you could keep it out of the project and maybe have it be an associated program, feedstock preparation or whatever, and you could draw the boundary of the project to exclude that part and that could be handled as a separate activity. Let's say that was 90% funded by Agriculture, the feedstock preparation aspect. I could conceive of a project where they would come to us and say we're going to take this feedstock, FOB plant site say, and it was delivered by some other program but it wouldn't be part of the Clean Coal Power Initiative Project. We'd have to look a little bit at the business relationship and if the feedstock is really going to be there, and who's got control over it. But that would be a way to have it be off-budget and outside of the 50/50. But if you drew it within the boundary, then that would have to be considered as federal funding and as part of the 50%.

Vic:

I agree with him.

Mike:

Name and company please.

Alan Johnson, (unknown)

I'm not sure that my question fits into this session because I've perceived intuitively that the (unknown) goal process the (unknown). It will actually fit into coal power (unknown). That's not it. (unknown) That's not a negative comment it's just that exceptions or what I am trying to understand is how do they process (unknown) these newer concept or (unknown) process or newer concepts that are not actually IGCC. How do they begin to understand and relate to the systems? For example, you mentioned at one point that the coal power technology roadmap includes what could be viewed as the FutureGen project. But again it starts off with IGCC. I was down in Washington and heard the Secretary's announcements and everything was weighted toward the description of IGCC as the acronym for another type of gasification technology. I'm wondering when and how and where we fit in the process. Is a request for letters of interest out that says we should put in by Friday? Is that open to newer, non IGCC technologies? So we are just trying to understand what would we think of as a truly new coal concept to the ones that have not (unknown) of the 70% of the (unknown) virtually

zero emissions for mercury and (unknown) and possibly (unknown). Where do they fit in relationship to your programs or the other programs in Fossil Energy?

Vic:

Let me try to answer that for you. First of all, let's make a distinction between where CCPI's goals and directions are headed versus this newest initiative called FutureGen. CCPI, because of the nature of it, is requiring cost sharing at 50% and as Mike indicated there is this technology push versus what is, I guess, economically and commercially feasible so that they can, in fact, raise the capital and show that there is a pathway forward into deployment relative to the nearer term.

On FutureGen, that particular project is really more of a research prototype. It is, in fact, still in its formative stages but the notion, the idea there, is that this would be a living prototype that would be able to accommodate a lot of the new technologies into the future. So in that regard, it is not a demonstration per se for commercialization. But having said that, I think there are opportunities in the future, because one of things that we incorporated in the pathway for CCPI is demonstration platforms for new advances in technologies since the last Clean Coal program. This spanned a timeframe at least out to the year 2008. As an example, we plan four rounds of solicitation. If, in fact, the technology and the research takes us to a point and into the future that the industry believes is a viably commercial process and if we could demonstrate it in one of these future rounds, then of course it would be considered. Because certain things that we consider in CCPI are relative to the maturity of the technology and its prospects for getting into the commercial realm. So again, it is not excluded but I don't want to confuse the focus of CCPI and the focus of FutureGen which is research oriented. I hope I answered your question.

Follow-up Question:

How would people propose to get involved with FutureGen?

Vic:

We're still trying to put together, internally, the process by which FutureGen would move forward and the participation mechanisms that will be defined. And we hope to have that done fairly shortly. We have to move quickly because we were trying to get something kicked off within the next year or so. But one last comment, don't read too much into the term IGCC. It is intended more as an acronym but should be read more to refer to general gasification.

Follow-up Comment:

That's encouraging because that's what we keep trying to say, that our process is gasification, just a different kind of gasification. Thank you.

Mike:

Let me just provide one other follow up to that, Alan. If you look at the roadmap, it's really performance oriented and there is an opportunity there, if you can meet the performance goals with a specific technology approach, that would be on the onus of the proposer. We've tried to structure the roadmap, though it recognizes IGCC, it's really focused not so much on specific technologies as it is on performance goals. If the technology is mature enough at a certain point in time to warrant a full-scale commercial activity, then it would be up to the proposer to demonstrate how it fits in the roadmap and how it fits relative to those performance targets.

Don, (unknown)

Do we know yet how your FutureGen will go forward on the administrative road. Is it truly a competitive situation? Do we know that yet?

Vic:

We have some ideas and options that we are internally kicking around. I think we're going to have an opportunity to sort of flush it out a little further, probably within the next couple of months. But one idea is to look at an industrial consortium that would pull it together, a group of entities that could bid on such a solicitation. But again, we are still looking at various options as to what is the best way to kick this off, what is the best way to get maximum participation and what is the best way to structure it in such a way that we can define the research platforms, the flexibility into the plant, and looking at the various integration issues between the hydrogen and power production and the need to look at the sequestration aspects of the project for long-term monitoring and validation. We have a tough job ahead of us in trying to pull that together in a quick fashion but we're hoping to get that done within the next couple of months.

? Green, University of Colorado:

In looking back at the overall programs that you tried to fit in with the new initiatives, the hydrogen initiative has caused me to speak as a technical person and most of those involved with the sequestration initiative where we know we get the energy out of hydrocarbon fuel by taking it to carbon dioxide and water. Then, somehow you're going about it all in an effort to get rid of that carbon dioxide. Aren't you putting out big bets on two very long shots when there are sort of more modest goals that one should put the government funds to or at least a better fraction of them to more moderate goals that can be achieved. The climate change issue is really not going to be determined so much by what the United States does but by what China and India and other countries who are just going into the expansion of use of coal and this question has been raised by some highly technical persons in physics today as whether the proportions of the government funding being put on very high, long-term types of programs isn't too great versus things that we could do in the more immediate future.

Vic:

I think I will concede one thing that you've identified that FutureGen is a hydrogen and sequestration initiative and that is that. It is a moon shot. There's no question about that. The allocation of where we put our emphasis and balance, if you will, will always be a

subject of a bit of debate depending on where one sits and where one sees the issues. But having said that, I think there are opportunities to look at some of the more, as you call it “modest” improvements type of investments. And I think CCPI itself allows us to do that. Because if we are, in fact, successful with these technologies and their deployment into the marketplace, that’s not just the U.S. market. Because one of the things, if carbon is the issue, one of the legs of reducing carbon intensity is through efficiency. And if we’re able to show that these types of technologies are in fact competitive, and cost effective, and more efficient and flexible enough, if you will, to accommodate maybe mixtures of other types of fuels in the future, then they have the opportunity to be deployed in areas such as China and India where the use of energy is expected to increase. In China the projected use of coal will still remain at something like 75% or more. Your point has been heard before and it’s well taken.

Mike:

One temporizing measure, if you will, in terms of how the investment should really be made, at least in the CCPI program that requires a 50% non-federal cost share, that nothing can really be accomplished unless the private sector is willing to invest rather heavily in any particular project. So if there were something that we were trying to buy under CCPI that no one could assemble a commercial financing package for, it wouldn’t go anywhere. The goals, I think, are achievable in the roadmap, and again that’s where FutureGen is complicating things a little bit when you start to roll in the sequestration objective in the demonstration scale-type activities. Although FutureGen really is more of a test facility. But I think if you step back from the issue of sequestration, these performance goals that the CCPI is trying to accomplish, are really trying to position coal as an energy resource that addresses the existing environmental concerns and the perceived future environmental concerns, without carbon management being a driver. Reduced SO₂, NO_x, mercury, most efficient use of the energy resources that we have, those aren’t principally driven by CO₂ management. Those are other societal needs that coal has to address in a real way. And that’s been the focus of the CCPI program.

Ed Rubin, Carnegie Mellon University:

This is a different kind of question. It’s good that there is emphasis on performance. However, we need to start thinking about environmental performance goals, more equally across the life cycle of a coal-fired plant. As we succeed in getting the plant emissions down, just a kind of reverse of role happens, the emphasis changes to a concern from emissions from other processes. For example, concerns about mining to coal transportation to the plant perhaps seeking to solve these issues with power-generating facilities. We find that one of the firms goals presented in one of the early seminars were for using the waste from mining operations and considering it in some fashion as some of the feedstock, thereby reducing the life-cycle impact of producing power from coal.

Mike:

I think that the energy cycle is important, Ed, and when I listen to, say the NRDC for example, they’re not clear as to distinguishing power generation from the full energy cycle. And in fact, as far as coal goes, they’ve repeatedly said that they view that energy from coal ((on a life-cycle basis) is the dirtiest form of energy that this country is

involved with, and they include mining and power production in the full aspect of the energy cycle in their perception and message. I think that that's a new issue for the coal energy community. The fossil program has traditionally not been involved with the aspects of bringing the energy resource to the power production site. It's just not something that's been historically part of the fossil program and certainly over the prior years, it's been a struggle to maintain a core R&D thrust with the available funds to make progress on the power production goals. To broaden the mission, if you will, with the budget pressures that were on the program would have really just diffused the effort. So, I don't think that it was feasible in the past to really do much there.

However, on the back end looking at targets, there has been a program and an objective in the technology roadmap that calls for high reuse/recycle for beneficial use of by-products and so forth, and the vision of the future plant essentially has nominally set a 100% of the by-product as useful by-products target for the future plant. The target is there on the back end. Do we have a structured RD&D program that is focused on that? Well, probably more could be done, but if you look at the picks of just the Round 1 projects, several of them are looking at the back end, trying to increase the beneficial use of the materials that are coming out of the project. Those projects were picked. I think that there is an interest at the demonstration scale to look at that aspect of the plants. And I would hope that we would continue to have that focus and people should take some encouragement that there is that look. So, I'd have to say that's how I see the current status.

Vic:

Let me add to that before you go further. Mike is absolutely correct to answer your question in the broader context of CCPI, in the research program in the back end, if you will, there are certain other issues that have to be focused on and maybe we could try to put more resources toward it in the future. The issue of mercury removal is that it has to go somewhere. If it goes into the by-products, we need to know how to separate that back out or at least get from EPA an understanding of what are going to be tolerable limits in the by-product so they can be reused.

The second thing is that in this year's budget, in the solid fuels and feedstocks area, they are looking at ways of converting some of the coal into premium products as well. And if there is, in fact, opportunities to look at what used to be called coal preparation, if the economics of that shows that we can, up front, remove some of these bad actors economically and effectively and still meet these goals, then that option has not been closed off yet either. In fact, you have to look, as you say at a life-cycle cost and life-cycle system, at what is the tradeoff of upstream removal of these things versus the back end controls.

Ed (follow-up):

Just a comment after that. I think what you're doing now makes a lot of sense. You can't run before you can walk. In terms of thinking ahead, if you get to the point where you've got a zero emission plant and you've done nothing else, would you declare a victory? You might find yourself surprised. So we need to start thinking about these

emissions and think about how to focus this round or the next round. In the next couple of years, how do we work to introduce that to your thinking?

Mike:

I agree with you Ed, and to just point out one other thing. The Department has, through the industries of the future program, a small interest in mining and it has been focused on energy efficiency, really fitting in with the EE mission, which is where that program currently resides. I think there are opportunities for Fossil to collaborate with that and make more of that program. There are some coal activities in the program that in the industries of the future program would reduce the profile, if you would, of mining operations on the environment, but there certainly is more that could be done there.

Rod Judkins, Oak Ridge National Laboratory:

I have two questions but I don't know if there are answers. Will the transportation sequestration and energy production project, FutureGen, be pursued as a new budget item or be funded from existing budget lines, budget item, meaning, funded from existing programs.

Mike:

Is that the easy one? That's the easy one Vic!

Vic:

Yea that is easy.

Rod:

The second is, that I believe you indicated your anticipation that FutureGen is higher risk than say CCPI. Will the industry cost share requirement be more or less or the same and, in fact, what process will you anticipate using to get input and will any information be sent out on workshops?

Mike:

One thing I'll do just to tee up Vic on this is, he is the DOE project director for FutureGen. So I'm very glad that he's here to be able to address these questions.

(Laughter)

Vic:

Your first question is, will FutureGen be funded from new dollars or from the existing budget? The FY04 budget that was submitted to Congress mentions FutureGen, not by name but that same type of project and the notion there is that we would be requesting Congress to use prior year demonstration funds to kick start the FutureGen project. Now that may or may not be enough to cover what would be the government's total investment in that project. So that implies that in the out-years, we would have to make some kind of

accommodation and a request for money to complete what our targeted investment will be.

Your second question about industry cost sharing is something that is still under internal debate. We do anticipate industry stepping up with some form and some fraction of cost sharing. The reason why we are still discussing this is that we've gotten informal feedback from industry in terms of what their views might be. Perhaps 50/50 is not something that they would like to do on a research project and that's a point that I think is well worth considering. Given that, we need to find out what is the affordable investment that the government can put up over the next 10-12 years for this project, which pieces will, in fact, be allocated to the design, construction, and which pieces will be associated with the test program itself. In addition, as you heard earlier, we also anticipate foreign interests through this carbon sequestration leadership forum as a discussion forum and opportunities for various nations and companies from these nations to participate and that could be a form of investment from their side and sharing in the research results as well. I'm not sure I heard clearly the third question about opportunities for information discussions?

Rod:

Are you going to distribute information on meetings and workshops on FutureGen?

Vic:

Yes we are, and in fact we believe that somewhere within the next couple of months we will have the first opportunity to meet with state organizations to get their input and tell them what our initial thinking is and see what comes back. And I think that's just the start of a process that will go on until which time we've gathered enough input to put together some kind of procurement mechanism, if you will, whether it's a solicitation or otherwise, to move forward on this particular project.

Frank Burke, Consol:

[What follows is an encapsulation of Frank's comments as the quality of the tape precluded a complete transcription]

The points made were, that the amount of CO₂ emissions from coal mining are very small compared to the amount from burning the coal. For CONSOL, it's less than 1%, and that's consistent across the industry, so energy use in coal mining is relatively small compared to coal utilization. Second, mining in the US is a highly regulated industry, and most of the environmental costs are already internalized in the cost of coal. Third, there is a need and opportunity for additional research to improve the productivity and reduce the environmental cost of mining, and I believe that should be part of the mission of the DOE/FE office. Comments of support were also made on language in the Senate version of the Energy Policy bill that would authorize a DOE mining research program.

Mike:

Thank you for your comments Frank. What you have expressed makes technical sense and the only thing I can impart to you, since we represent the administration and we have to support its budget, is that we would encourage you to make your voice heard louder.

Mike Mudd, AEP:

You mentioned how difficult the issue has always been with respect to the repayment. I have two questions. First of all, with respect to CCPI Round 2, are we still trying to fight the battle with OMB on repayment? And the second question is with respect to FutureGen. Is there any possibility of eliminating repayment on FutureGen?

Mike:

I have to admit I was surprised that modifying repayment cratered the way that it did in Round 1. It kind of goes a long ways to show how entrenched the idea of repayment is for these commercial scale type projects that are envisioned to lead to a deployment by which there is a success out there that could be shared. I think repayment is an expression for saying “Hey all the government wants to do is to share in that success.” We’ve now gone the next step of saying, “Well you can propose a repayment plan hinged on anything you’d like, plant revenues, corporate profits, successful technology. You propose it to us and we’ll evaluate it.” I think it goes back to its roots in the CCT program and it’s not like a lot of repayment has come to the department from the Clean Coal Projects, which I think adds fuel to the fire that we need a more serious repayment provision. It does derive from the early going that, yes, I think repayment is a good idea and then the evidence has been that there hasn’t been a lot of money coming back to the government for the funds that have been spent on the prior projects. Some say we need a more realistic repayment plan. So I think the short answer, Mike, barring any guidance from Congress to the contrary, given the history of where the CCPI has come from, is that it is clean coal and it has a repayment aspect to it. There will be a repayment aspect in Round 2. As to whether or not we would run that up the flagpole again to come up with another new idea as to how we might alter repayment, we haven’t really started working on the Round 2 provisions yet and this is the first outreach to say “Okay, I hear you, we’ll have to look at repayment.” We probably will, but as to what the outcome of that will be I think Congress would have a lot to say relative to the Department’s movement relative to repayment. Now for FutureGen, unless you wanted to say more on CCPI.

Vic:

On FutureGen, I need to do a real good job on something and you guys need to help me do a real good job on this and that is to let people know that FutureGen is a research project and in that regard, I don’t hear repayment for research projects. Okay? It’s not in our plans but having said that, all the concerns that Mike has raised about who can get their fingers into the process is something that is an uncertainty at the moment. But our planning is that for research projects we’ve never asked for repayment and consistent with that, since this is a research project, our going in position is, “We don’t plan to on doing so on this one either.”

Mike:

Could I have a show of hands as to if people have questions they're concerned about being taped. We're kind of coming up on ten o'clock, I could turn the tapes off. Are there folks out there who would be asking questions if we weren't more formally recording the proceedings? Could I just see a show of hands if there are? Not a bashful crowd, huh? (No hands)

Mike:

Thanks. So I guess we'll continue then with this format. It seems to be working for folks. So we have about 8 – 10 minutes left.

Steve Doyle, Advanced Steam Systems:

I'm looking at the illustration target of the new roadmap that's up on the screen and it appears to me that the advanced systems line has, for gasification, no accommodation for combustion. In the Vision 21 program funding at NETL, we're developing an advanced combustor. This combustor creates a steam and the O₂ and that combustor technology allows you to separate it naturally into a rich CO₂ stream at very, very low level of cost. It also offers a potential of much higher efficiency. It doesn't take much for describing that program but I think somewhere on the graph should allow for a representation for advanced steam systems.

Mike:

I think it's in there.

Vic:

It is. There's a combustion/gasification box. I think it's a prior one. (Referring to the chart)

Mike:

Let me refer to the chart that is in here. This box represents an advanced gasifier/combustor opportunity and this link was for the performance targets and environmental performance targets be they the traditional pollutants, the mercury, the plant efficiency, and then the economic drivers. So I'm not aware that we've precluded that. If you could come back and clarify why you feel that particular technology option is precluded that might help us. But our view sitting here is that it's not precluded.

Steve:

Mike, I'm not saying the chart has precluded anything. I'm saying that it fails to recognize the existing program and all our existing attempts to build a combustor for the gasifier.

Mike:

Ok...go on.

Steve:

But we would take fuel that the gasifier typically uses and put that into the combustor section and with that we can give you a zero emission process. And once you have a zero emission gasification process, we can have coal come in one end and electricity going out the other. The gasification section can produce fuel, CO₂, and electricity. Period. We wouldn't get anything else coming out. If you got CO₂ gainfully used and coal with methane recovery as well as other commercial applications. But we're developing a combustor for use down stream of the gasifier, not feeding the gasifier.

Mike:

Understood. And I will go back and look at the structure of the roadmap. It was not our intension to not recognize or not provide for that technology. This, the box the way it's written, is just to fit everything within the box. It's not intended to say that it has to be a gasifier/combustor linkage in any particular configuration.

Vic:

But in fact if you look carefully at that structure there, there is a light blue box that talks about integrated advanced power systems. And we don't say that that is one particular power system, it could be made up of various types, including, let's say, if it makes sense to reach certain targets with ultra-super-critical steam cycles as an example. But if we were to list every single technology in that diagram I think it might get a little bit more complex than it is already.

Mike:

Getting pretty close to the end of our time. Anybody else? Thank you all.
Applause.