TRANSCRIPT OF PROCEEDINGS

- - - -

PENNSYLVANIA HOUSE OF REPRESENTATIVES

COMMERCE COMMITTEE PUBLIC HEARING

Phipps Conservatory

700 Frank Curto Drive

Oakland, Pennsylvania

May 7, 2009

12:30 o'clock p.m.

Chairman: Representative Peter J. Daley

TRANSCRIPT OF PROCEEDINGS

Reported by: Constance Lee,

Professional Court Reporter

TRANSCRIPT OF PROCEEDINGS

\- - - -

P R O C E E D I N G S

(1:00 o'clock p.m.)

MR. DALEY: Call this House committee meeting here to order being it 1:00. I want to thank Richard for his kindness. He's the executive director of Phipps Conservatory. He will make the first presentation. And also to Greg for your kindness, to the cooking staff, the chef and gentlemen and ladies in charge of the food. It's wonderful. If we could all give them some applause.

[Applause.]

MR. DALEY: We just applauded you, but you weren't in the room. Chef Lucy is on our staff, and he gave us two thumbs up. Don't ask him for his biscotti recipe because he won't tell you.

Our first testifier today -- I just want to indicate that our host today for lunch is the Pennsylvania Landscapers and Nursers Association, also known as PLNA. We want to thank them for providing us the food today. Wonderful food, and it was excellent.

Our first presenter is Richard --

MR. PIACENTINI: Piacentini.

MR. DALEY: Piacentini. Sorry. He's Italian, but I'm half Italian.

Phipps Conservatory and Botanical Gardens,

TRANSCRIPT OF PROCEEDINGS

\- - - -

he's the executive director. Thank you for the wonderful tour.

MR. PIACENTINI: Thank you very much, and thank you for joining us today. We're so pleased to have members of the House Commerce Committee here to see Phipps and learn about some of the things that we're doing, and we're really excited to have you here.

I would just like to tell you a few things about Phipps and a new project we're on. First I'd like to tell you, though, it's kind of exciting to have you here from another point of view, too.

I'm not originally from Pennsylvania. I'm originally from New York. And I remember when I was growing up learning about how the industrial revolution and how a lot of it was centered here in Western Pennsylvania, and a lot of things took place in the early 1900s, and this was the center of the universe back then.

Here we are a little over 100 years later, and I feel like we're back in the center again, and I'm excited to be in this part of the world. I think the next industrial revolution is going to take place here, and it will be a green revolution. It's exciting with all of the things going on in this

TRANSCRIPT OF PROCEEDINGS

- - - -

region.

I would like to tell you about where we fit in as far as being green. We are known or being recognized more and more by more and more people as America's greenest garden.

I would like to tell you about some of the things we are doing. I would have to go back to that industrial revolution back to 1893 when Henry Phipps, who was one of Andrew Carnegie's partners in the steel business, gave the conservatory to the City of Pittsburgh. And the City of Pittsburgh ran the conservatory from 1893 through 1993 through their parks department.

And then in 1993, they realized they could no longer afford to maintain a conservatory, so they spun it off to a non-profit organization, and it still runs the conservatory now. It's still run by the City, but it's run by a non-profit.

We think we have been very successful. When we took over in '93, our operating budget was about $1.1 million a year, and it's now almost $7 million a year, and each and every year we have been able to operate at a surplus. We operate at a slight surplus. And we have been able to use those funds as matching funds for state, federal foundation grants. So we put

TRANSCRIPT OF PROCEEDINGS

\- - - -

about $10 million back into the old conservatory.

We recognized early on that we reached a plateau with the existing facilities, and we needed to figure out new ways to improve our visitor amenities and generate more revenues. We developed a master plan that was divided into three phases.

The first was to replace the 1960's entrance with a new entrance. The next phase, what we see here, the production greenhouses, the new conservatory rental hall, our special events facility, and the third phase will be our education/research building on the lower level.

This is the first building we took on, the 1960's style entrance. As you can see, we wanted to create something that fit in with the rest of the conservatory. We ended up putting most of the building underground so only the dome shows up. So it's a perfect harmony with the rest of the old 1893 conservatory. Here's another view of it from the parking area.

What's really exciting about this is, when we first started this project, we weren't thinking about green. We didn't even know about building green. Then we learned about the whole thing called the LEED process, LEED building. We decided to go for a

TRANSCRIPT OF PROCEEDINGS

\- - - -

LEED-certified visitor center.

When we opened it in March of 2005, we actually opened the first LEED-certified building in a public garden in the world. We're excited about that.

LEED buildings are water efficient, energy efficient. They use local materials and resources. They have very good indoor air quality and things like that.

When we started the second phase, we decided to try to make our buildings be energy efficient as well. We put in state-of-the-art, new production facilities that are very, very energy efficient.

And then as we started looking at the new conservatory, which is the building to my right out here, we decided to ask ourselves, how can we make this building be more efficient? We went all the way back to the 1840s when the first conservatories were being built in England.

We learned that they built these big, glass boxes with these tiny vents at the top that is supposed to let hot air out. Then we looked all the way up to the 1990s, and we realized that in over 160 years of conservatory design, not a whole heck of a lot has changed. Still big glass boxes with tiny, little vents at the top, very inefficient buildings.

TRANSCRIPT OF PROCEEDINGS

- - - -

We decided to make our buildings more efficient. We asked our engineers to start showing us how air moves through the conservatory. We came up with this idea of making half the roof open up. The engineers told us we were crazy, you don't want to do that. We said just show us what would happen anyway, and they did.

If you look on the left, you can see a traditionally designed conservatory with a high vent and a low vent, and on the right one a conservatory where every other glass panel on the roof opens up. I know you can't see the scale in the middle, but blue is 90, and red is 100. That's the difference between the two. We saw this and said, wow, we're onto something.

So we had them change the design, and we made it so that every other row of the glass in the roof opens up. We then designed a shading system to block extra sunlight in the summer and let lots of air move out in really hot days. We put in earth tubes so we could use the ground to cool the air before it gets into the space. We put a fogging system in to take advantage of the rapid cooling.

By the time we finished this, we realized that we had just built a conservatory or a greenhouse that has no greenhouse effect. It really is amazing.

If you look at this drawing or this chart -- this is a typical week from last summer -- you can see red is the outside air temperature, blue is inside the new conservatory and yellow is the old conservatory, which shows you what happens when you have the greenhouse effect. It's hotter inside than it is outside. Here you can see the building is cooler inside than it is outside. Even though it's a high, south-facing glass wall, it uses practically zero energy to stay cool. It's all 100 percent passively cooled. We thought, wow, we really came onto something here.

We then started to look at, okay, what about heating? Conservatories are usually single-pane glass buildings, very inefficient. We figured out a way to take advantage of the shape. We left the south face to be single-pane to let the winter sunlight in so the plants could grow well in the wintertime.

We were able to double insulate the roof glass. We did things like we made our shading system so it would function as an energy blanket. We did thermal masking, and we insulated on the outside so we can capture heat during the day and release it at night. We put root heating in. Somebody found that

TRANSCRIPT OF PROCEEDINGS

- - - -

if you keep the roots of tropical plants warm in the winter time, you can turn the temperature down like you do at home with a setback thermostat.

Bottom line is the engineers estimated that by the time we finished this study, if we would have built this as a traditional conservatory, it would cost about $16,800 a year to heat. By doing what we did, it costs $2,400. And then with help from the State of Pennsylvania through the PEDA grant, we were able to get funding to put a prototype of a solid oxide fuel cell in the facility which makes the electricity for the building.

The bottom line is, by the time we finished this building and opened it in December of 2006, we had just created the most energy efficient conservatory in the world; zero cooling costs, real efficient from a heating point of view, electricity is made by the fuel cell. There's not even a close second anywhere in the world.

We're very excited about that, and we have been winning all kinds of awards and recognition, international, national and regional awards, written up in lots of magazines. We're on the cover of Eco-Structure magazine. We won first place in a national competition last November. We've really established a reputation as being America's greenest garden.

I don't have time to tell you all about all the other things that we're doing in regard to our operations. There's a lot more to the story that allows us to say we're America's greenest garden.

An interesting thing happened. You know, we raised $36.6 million to do the construction that I talked to you about. And the third phase, which is supposed to be the education and research administration building for the lower side, that's something that we thought we would have to wait a couple years to do. With everyone involved in fundraising projects before, you know once you've raised that much money, you have to give your donors and your board a rest. Because when people see you coming, they start running the other way. We said, we will take a couple years before we do anything else.

We had already been thinking about how can we make our next building be efficient, and we were thinking about collecting rainwater off the roof and putting it in the cistern and use it as a thermal heat thing for heating and cooling in the next building.

We thought about using a living machine to treat all the sanitary water on site. We can use plants to do that. We thought about collecting all the organic waste we have on site and put it into the waste digester to make methane to run the fuel cells and make the electricity to run the building. These were the kinds of things we were thinking about.

I happened to be at a green building conference in Denver in November of 2006, and I was talking with the guy who came up with the Energy Star logo that you see with the Energy Star program. I showed him this diagram, and he said to me, wow, you guys are doing a living building. I said, a living building? What are you talking about? He said, weren't you here yesterday for Jason Calen's (phonetic) keynote speech? He challenged all 12,000 people at the green building conference to go beyond LEED platinum -- LEED platinum is the greenest that you can build right now -- and build a living building. That is a building that generates all of its own energy from local resources and captures and treats all its own water on site, in addition to a lot of other things, and all these other things that you would expect to see in a LEED platinum building.

This is what I like: "Imagine a building as elegant and efficient as a flower." Wow, this kind of has Phipps written all over it. I had nothing to do

TRANSCRIPT OF PROCEEDINGS

\- - - -

with that, by the way, but we got excited about it. I came back and talked to my board about the fact that we wanted to build this new building down on the lower site where the old public works yard is, which is right below here. I told them about this challenge, and they got very excited about it.

Then I had some foundation people come by to do a site visit because I wanted them to see what they invested their money in back in 2006. We hadn't even opened yet. They went through, and they were really impressed and amazed, and several of them made the mistake of asking me, so what's next? I said, since you asked...

So I told them about this living building challenge, and they got very excited about it. They said, you can't wait. You have got to do this now. We started thinking about this, and we said this could be really amazing. We're talking about potentially building the greenest building in the world right here in Pennsylvania.

And we said, you know, this shouldn't just be about Phipps. This should be about all the great things going on in this region. I went and talked to the people at the Green Building Alliance, and we went and talked to people at the Center For Building

TRANSCRIPT OF PROCEEDINGS

- - - -

Performance and Diagnostics at CMU, and we went and talked to people at the Mascaro Sustainability Initiative at the University of Pittsburgh, and we told to them about this living building challenge and we wanted to do this here in the State of Pennsylvania. We said, would you guys want to be involved in this? They got very excited about it and said, yes, we want to be involved.

I'm not talking the kind of involvement where you go to somebody and you say, will you write me a letter of support, and they write you a letter, and you never see or hear from them again. They have been actively involved with the peer review of the design team. We couldn't have done this project without them. They're totally embedded in this project.

CMU has actually adopted this project as their whole fifth-year design studio for their architecture students. I should put Chatham University on the list, because they will be helping us design the green roof this summer.

We also said, you know, there's other great talent in this region. We decided, you know, how many times have you heard about somebody doing a project and they think of an expert that lives 500 miles a away. You have to go to New York to get an architect, and you have to go to San Francisco to get the engineer. I see this all the time with projects. I said, this should be a project that is designed and built by people in Pittsburgh and Pennsylvania. We should showcase the great talent that we have, not only in this region but in the state.

When we put out the request for proposals for primary architects and primary engineers, we said we will limit it to primary architects and engineers have to come from Pittsburgh. If you're not from Pittsburgh, you can't even apply. We will give special consideration to anybody that puts together a team that is mostly from Pittsburgh and Pennsylvania.

We're really excited about it. This is top-notch people that are going to help us build the greenest building in the world, and they're truly going to be able to say, this building was designed and built by people in Pittsburgh and Pennsylvania.

Just to show you some drawings of some of the things to think about. How do we integrate all of these things related to energy and water? The building will sit on the lower site right below the tropical forest right here, the terrace, you will go onto the roof of that building. It will be a green roof. And a two-story building that goes down to the lower level. We put our floatable tanks on this building right here (indicating). I know you were at Solar Power Industries this morning. That's one of the companies that we are talking to as one of the products I would like to use here. This will all be gardens down here (indicating). Some of the things we're looking at doing is using high-performance glass maximizing daylight so we don't have to turn on the lights during the day. We're looking at geothermal natural ventilation using desiccant wheels so we don't have to turn the air conditioning on, take the humidity out of the air without having to run the AC. Photovoltaic. This is a robust building envelope.

And then with water, we're looking at doing things like using porous pavement to capture rainwater and using bio-retention rain guards also to capture water and keeping it out of the sewer systems. We're using constructed wetlands to treat the sanitary waste for the site, not only for this building but for the entire campus where all the toilets and water will all go through this constructed wetland so it will be clean, but it's put back into the ground.

We're looking at a vegetated green roof, a lagoon for capturing rainwater on the site that we can use for irrigation, and also looking at things like subsurface treatment and capture it off the streets as well.

We're also looking at linking the upper site to the lower site. Capturing rainwater off these roofs to use it to flush the toilets and actually purifying it to for drinking water. We will be focusing on native plants and showcasing a lot of different habitats that you see in all of Western Pennsylvania.

Here's a view looking from down below. The first floor will be the classroom for school programs and our research department and education, and the second floor will be the rest of our administrative offices. Here's another view looking around the site as we go around. And you can see from the upper terrace.

We also will be developing beautiful landscapes. I like to tell people what's the sense of building the greenest building in the world if no one sees it? We will create this beautiful experience. All 250,000 people that come through Phipps each year, we want them to go down and experience this building and learn about sustainability and about all the great energy things and water things we have done in the building.

TRANSCRIPT OF PROCEEDINGS

- - - -

We have gotten a lot of excitement from people on the project. It's a brownfield site. Our university friends are excited to be involved with this project. If they can say they helped build the greenest building in the world, it will help them in recruiting faculty and students.

We are talking about developing joint research programs with CMU, University of Pittsburgh, Chatham. National Energy and Technology Lab, I know they'll be talking to you later on. They just joined the project two weeks ago. They're interested in being involved in this as well, primarily from an ongoing monitoring point of view.

If somebody would build a green building and they walk away, nobody knows if they work or not. We use ours for ongoing testing and monitoring to see if they actually work and how can they make them better. The NETL is involved in it, and Green Building Alliance and Penn State.

I know our friends at Green Building Alliance are trying to attract green manufacturing jobs in this region. I know all of us are interested in seeing green manufacturing jobs come to the state. Isn't it great to say, hey, come to Pennsylvania, we have a building that was designed and built in this state.

They would be crazy to go to any other place. So it really fits in with Pittsburgh and Pennsylvania's leadership with green buildings and renewable energy.

Some of the other things we're looking at is we're trying to focus on new and emerging technologies. We're interested in working with local products. I know that Pittsburgh Technology Council has been helpful in helping us to identify local companies involved in this project. Some of the things that we have done, the glass in this particular building, this is PPG's Solar Band X 70, the most energy efficient glass in the world. This is the first commercial installation of the glass. We want to get their products in this building. We're very successful in getting national attention for the work that we do here, particularly related to green buildings, and we would like to also help focus on some of the companies in this region that are involved in the project as well.

We also insisted on having replicable solutions. We want people who see this building to say, hey, I can do it, too. We're doing a building that other people can emulate, and we're also following something called the integrated design process, which is a new way of designing buildings.

We have Penn State's PBS station is filming all of our sherets (phonetic) because we want to turn it into a training video for architects to do integrated design. Penn State wants to turn it into a TV program for national distribution on how to build green performance buildings.

I mentioned working with these various partners. We want to focus on landscaping for green buildings. We have great talent in this region. We're talking about how to make buildings green, but nobody has figured out how to integrate them with the landscape. We feel they can play a major role in that area.

That's an area where we think there will be significant job growth here at Phipps and significant job growth as a partner with these other organizations and agencies for grant money and research projects for the future.

We're pretty excited about it. It will be called the Center For Sustainable Landscapes. We are a little over halfway with our fund-raising. We're trying to raise $20 million for the project, and we have a little over $10 million. We will try to line up the rest of the money quickly.

You've heard of those shovel-ready projects.

TRANSCRIPT OF PROCEEDINGS

\- - - -

We have a shovel-ready project. We are -- construction documents will be finished on July 10th. If we have the money, we want to be able to put it out immediately and have this building open a year from September or October in October of 2010. So we're pretty excited, and it will be the greenest building in the world.

If you would like to learn more about it, I would be more than happy to tell you about it. There's some people in the audience from local companies that would like to figure out ways to help.

I'm happy to answer any questions.

MR. DALEY: Any questions?

MR. COSTA: Thank you. Richard, great job.

MR. PIACENTINI: Thank you.

MR. COSTA: I remember when you guys did the piping and were telling us about the vents and everything. I'm glad to see that it came out, and it's working properly.

MR. PIACENTINI: Thank you for your support.

MR. COSTA: I have one complaint, though. When I come over the Boulevard of the Allies Bridge, I got used to seeing that beautiful chandelier that went up in lights. The Chihuly.

MR. PIACENTINI: You mean the neon?

MR. COSTA: I know you can't afford that. I'm sure it was very expensive. When you looked over, it actually drew attention to the facility. I liked that. I was hoping you would do something else like it. I know Chihuly is way too --

MR. PIACENTINI: Maybe we can find a local artist. I have heard that from a lot people. We have another glass exhibit that's opening here on May 20th. It won't have that particular effect, but we will have a giant glass sculpture that will be lit. It would be great to get something like that. Maybe we could use LEDs.

MR. COSTA: My members and colleagues, Chihuly is a person who is world renowned in blowing glass, and the Phipps was fortunate enough to get him. It is normally a five- or six-year wait list. He bumped their list because they opened up the whole conservatory to him. Some of them looked like plants. Unfortunately, it's gone now.

How many people actually came through?

MR. PIACENTINI: Over 400,000 came to see --

MR. COSTA: That was 400,000 additional

TRANSCRIPT OF PROCEEDINGS

- - - -

people?

MR. PIACENTINI: No. We normally did about 200,000 a year. We doubled. We settled back down to over 250,000. I think we did do about 250 this year.

MR. COSTA: We got tourists. They had a meeting in Philadelphia, and they actually came to Pittsburgh to see it, and he e-mailed me back and said he was so happy that he came. It was a great tourist attraction for us.

MR. PIACENTINI: We had people from 50 different countries come to see it.

MR. KUKOVICH: You still have the Chihuly in the main entrance. It's the big yellow --

MR. PIACENTINI: We have eight installations throughout the conservatory.

MR. DALEY: We saw something, we didn't go by it.

MR. PIACENTINI: You saw some of those mock plants that he did.

MR. DALEY: They did look like plants, and it was his design.

Any other questions? Richard, thank you very, very much.

It's a pleasure and honor to be here and hear what you have to say and your wonderful presentation. I want to thank you for taking the time.

Any other --

MR. PIACENTINI: I just want to thank you all for your support. I know you have all been very helpful in getting money to us in the past, and we appreciate the support for the projects and things that we're doing.

MR. DALEY: The Allegheny County delegation works diligently to make sure that happens. We're all part of the same region, Western Pennsylvania.

Representative Longietti is a little bit north of us, and Marshall is to the west of us, and I'm to the south. We have you surrounded. You take Allen Kukovich, and he used to be to the east of you. We all want to work with you because it's really a regional asset. Thank you very much.

MR. PIACENTINI: Thank you.

MR. DALEY: Before we go to our next testifier, we have a young lady who will open up her system for WDUQ, and I'm sure that everybody listens to the jazz on WDUQ.

Doug, we'll be with you in about five seconds.

Before we start with Mr. Farnham's

TRANSCRIPT OF PROCEEDINGS

- - - -

presentation, I would like to go around the table and introduce those that are here and as part of the public record, I would like to start off with Senator Representative Governor's Aide to camp, never be able to put a medal on him. I know for a fact he's the father of a CHIP program, not only in Pennsylvania but throughout the country, because I stood shoulder to shoulder with him when we got that passed. Representative Allen Kukovich.

MR. KUKOVICH: Thanks, Pete. I think that's a fine enough introduction.

MR. COSTA: Former landlord.

MR. LUCY: Ronald Lucy, I'm with Representative Daley's staff.

MS. ALTLAND: Sandy Altland, with Representative Daley's staff.

MR. MARSHALL: Representative Marshall.

MR. COSTA: Representative Paul Costa in a small portion of the City of Pittsburgh.

MR. CALLEN: I'm Dave Callen, executive director of the House of Commerce Committee.

MR. LONGIETTI: Representative Longietti, Southern District Mercer County.

MR. HAYNES: Malcolm Haynes, I'm here representing Representative Thomas.

TRANSCRIPT OF PROCEEDINGS

- - - -

MS. ZEIDERS: I'm Destiny Zeiders with Representative Daley.

MR. CARLSON: Carl Carlson, I'll be presenting later.

MR. DALEY: Carl is two down the list.

Ladies and gentlemen, Doug Farnham is a friend of mine and the president and chief executive officer of PFBC, Environmental Energies Technologies, Inc.

MR. FARNHAM: I wanted to go first because that was a tough act to follow with Rich there.

I started with powering America because that's exactly what we're doing, working on a test program where we're taking coal and utilizing it user friendly. It does create CO2, but I think this is one of the few atmospheres where CO2 will be welcome is in Phipps Conservatory. We want to go through it piece by piece and show you our program.

When people are looking at America and power in America, it's important to recognize how important it is when you have alternative methods for power that we don't replace a power source that we need without something to replace it. That's what I'm here today to discuss is coal power.

If you look at the world's resources, you can see it's quite abundant in the United States coal, and almost half the states produce coal in the United States. Pennsylvania, you will note, has a good reserve, and Texas. I will get to those. If you look where these regions are where coal is, it's some of the most economic regions for power production in the United States, as I just pointed out. Unfortunately, Texas is heavily relying on gas, and they've had to do that for a long time. And gas went higher, right now it's not as high.

Pennsylvania exports quite a bit of its power and therefore gets the most penalties because for lack of development. We actually have to compete with the New Jersey and New York power grid, so Pennsylvania is a little penalized with its coal power that we have.

Energy demand. No matter what anybody likes to think, energy demand is going to increase. People like their energy. Conservation is great, but demand is greater.

United States is projected by 2030 to have a 24 percent increase in power. The world is expected to have a 55 percent increase in power. There are 2 billion people in the world today that do not have power that want it. Our power prices will not stabilize. They will go up. We need more resources

TRANSCRIPT OF PROCEEDINGS

- - - -

to generate power in the United States.

Domestic energy forecast. More utilization of coal. I don't think anybody's picked up a newspaper or read an article lately that doesn't say that coal is bad and CO2 is bad. We will have to find out how to make it good and use this natural resource that we have. We will we be importing more of it. We will have to use it more wisely. We're anticipating that the growth for today is going to go over 55 percent by 2030. We're going to have a substantial growth of coal utilization in the United States.

What's been happening. Well, actually nothing. Everyone's talking. The last ten years no one's developed any sustainable power. No 24/7 power has been developed in the United States. We all talk about it. So the projection is we will all run into trouble here very shortly if we don't get a resolution and move forward with sustainable power in the United States. We are looking at what can we do in Pennsylvania to help get this legislation passed and do more clean power.

One option, of course, we can look at is wind. You can see the plains have adequate wind. You can see the coastal regions have adequate wind. If you look at Pennsylvania, we have below marginal in our wind resources. Pennsylvania has very little domestic wind industry to offset some of our power. We can look at solar. There's a solar resource map. Pennsylvania has about one-third of the power generated from solar that you can get in Phoenix. There's lots of things that you can do in buildings. Pennsylvania has a real tough time generating solar power to put on the grid for power supply.

So what do we have? We have a lot of gas and oil and coal. One-third of Pennsylvania is covered with coal. Western Pennsylvania people know that and the eastern Pennsylvania people think that it was mined out 200 years ago. We still produce about 70 million tons of coal a year while the United States produces about 1.1 billion tons.

The interesting fact is that coal has been mined in Pennsylvania for about 250 years. And in 1918, Pennsylvania mined 278 million tons, almost by hand, in the region that powered the whole nation. So coal power has always been around and has always been important, but today it's producing CO2, and it's a problem.

If you look at this chart, this is a chart from the national energy testing labs. 6.8 percent of the world's CO2 produced by man is created by U.S.

coal utilization. We have about 1,470 coal-fired plants in the United States. They produce about 50 percent of the energy for the United States. So what can we do about that?

Well, most people believe that human activity is the greatest source of greenhouse gas. The facts, the emissions are significantly smaller than national emissions. Burning a fossil fuel is representative of about 3.27 percent of the carbon dioxide that enters the atmosphere each year, while the biosphere and oceans account for 55.28 percent and 41.46 percent respectively.

Of the 3.27 percent of CO2, 6.8 percent is U.S. coal fired. Basically 2.2 percent is of the CO2 each year is caused by U.S. coal power production.

If we could increase the efficiency of our coal-fired power plants from 30 percent to 50 percent, we could use -- we will produce half the CO2. We could be down to .1 percent without capturing any CO2 whatsoever.

This is an average of this chart. It gives you an idea. The United States has the oldest power fleet, power plant fleet and, therefore, the oldest technology. Most of these people remember a slide rule, not everyone, but our power plants are basically running on the same technology. This is America, with our high-tech everything. Our power industry is 1960s.

So our efficiency is very low, comparable to India, and India has brown, dirty coal. That's why their efficiency is bad. Honestly, China is building more efficient plants and creating less CO2.

Look to the left and to the right on this chart, you can see a U.S. plant right now is about 1,200 grams of CO2 per kilowatt hour. If we had high efficiency plants, it would be around 600. Nobody wants to build coal plants, but we need to build high-efficiency coal plants. If we could get our high-efficiency plants, the high-efficiency plants, half of the coal plants could be closed. We could be generating the same power with 700 plants and using half the coal we are using than today, if we had higher efficiency plants.

This is a summary on the U.S. power generation. It's a critical juncture with a lot of social pressures, and pending legislation demands massive changes. Competing demands for energy security and climate change mitigation appear incongruent. They do not agree with each other.

The U.S. must foster new processes that

address conflicting energy objectives simultaneous. Coal-based processes combined with biomass and carbon sequestration, CCS, will offer surprising advantages over alternatives. This is why I'm here today to discuss real possibilities right here in Pennsylvania.

Pressurized, fluidized bed combined cycles is the cleanest, most efficient, solid fuel flexible, commercially viable, carbon-based power plants on the earth.

Some examples, Stockholm, Sweden, plant's been operating there for 15 years. Karita, Japan, plant, built in the late '90s, 43 percent efficient. Notice both of these are at harbors with two very, very environmentally sound countries. The Karita, Japan, plant is operating at 43 percent efficiency. It's almost 50 percent more efficient than the average fleet in the United States.

Escatron, Spain, was a waste carbon demonstration project that was done. And the Cottbus plant which utilized wet waste coal particles as fuel built on the communist side of Germany. Perfect example of the plants that we want to copy in the United States.

This is a coal receiving and storage area for the Cottbus plant. After five years of operation --

most people believe that coal-fired plants are dirty, but they don't have to be. This coal is delivered by pressurized tank cars, and you can white glove this facility, not a spec of coal to be found by anyone. As a matter of fact, they had tore down an existing plant that was quite a polluter. And there was some arguments about building this plant. They had been running for six months when they had a big protest of not wanting to start up. There was no pollution whatsoever. No one even knew it was operating.

MR. DALEY: Can I interject for a second?

We see a picture of storage containers on railroad cars.

MR. FARNHAM: Yes.

MR. DALEY: Is that fluidized?

MR. FARNHAM: It's just compressed storage. They compress -- it's so wet that it could actually combust. That's why it's under pressure. It's almost like wet wood. This technology that we have can use biomass, and that's one of the things that we're focused on. We will talk about that a little later.

Anyway, this technology integrates gas turbine combined cycle; fluidized bed with low temperature oxidation; fluidized bed with low velocity and deep

TRANSCRIPT OF PROCEEDINGS

- - - -

bubbling beds; twin spool, intercooled, variable-speed PFBC gas turbine; pressurized cycle; fabric filter and an independent steam cycle.

Coal and sorbent are mixed, injected into the concrete base into the boiler. The boiler is in a pressurized atmosphere, about 170, 180 psi. The exhaust gas is collected in an exhaust gas turbine assembly. A lot of people call that thermal pollution, and we use thermal pollution and create energy with it. So it doesn't matter that the product going in is wet to make steam. We capture the exhaust steam and turn it into usable energy. We get about 20 percent more energy efficiency by doing that.

It's world-class, high net plant cycle efficiency; lower fuel consumption, lower greenhouse gas emission, acceptance of wet fuels without sacrificing efficiency. Our western coals have an air moisture of about 30 percent. It's like putting water into fire. If you put it in a standard boiler, it doesn't burn too well, and it turns into steam and goes out the exhaust system.

In our boiler, it burns. We catch the steam and turn it into energy. Half our coal value lies in the United States as western coal. We can increase the efficiency of those plants 15 to 20 percent easily with this technology.

The coal is crushed. The sorbent, which is either limestone or dolomite, is added to it. It could be added dry or as a paste form. The combustion air is compressed in the low-pressure module, intercooled, and then compressed further in the high-pressure second module and directed to the pressure vessel. Inside the pressure boundary, the air is preheated in the cyclone ash cooler and then fed through ducts and distributed evenly over the bottom of the fluidized bed. The bed of the coal is actually a fluid. At about three feet a second velocity in the fluid and the bed is about 12, 13 foot deep.

The power cycle, the oxidation occurs in the bed, which operates at about 1,562 degrees Fahrenheit, at about three foot a second. I mentioned earlier the pressure is 12 to 16 atmospheres of pressure. Operating temperature is optimized for sulfur capture by the calcium and magnesium-based sorbet, and exhaust gas exits through two or three stages of cyclones, where 90 percent of particulates are removed. In the bed is where the tubes are for the steam. Actually, in the boiling bed there's steam turbine tubes right in the fire bed.

TRANSCRIPT OF PROCEEDINGS

\- - - -

After exiting the cyclones, the exhaust gas proceeds to the gas turbine where it is expanded and drives its generator. The exhaust then passes through an economizer where the heat is recovered in the steam cycle. The remaining fine particulates are captured in a fabric filter before the flue gas exits the stack. That's where the mercury is captured, also.

Interesting thing about this, you have heard of some problems with ash disposal. This ash -- this ash sets up as hard as concrete, has no leaching characteristics whatsoever. It has the same leaching characteristics as granite. All the minerals are trapped it in. It could be used as aggregate. In Karita, Japan, this ash actually goes directly to the concrete industry. There's zero left. That's what we want to demonstrate here in Pennsylvania.

We're hoping we can do a demonstration project in Pittsburgh, right downtown, or maybe even supply steam up on the top of the hill here. That's one of our goals. So our ash is not a problem.

As I said, the ash utilization, there's different ways we can utilize this ash. We can at least get the cost neutral for the project. We might be able to make a little profit if we align for some concrete. There's lots of different utilizations for our ash.

The emissions are state of the art. We don't have any add-on pollution devices required so we don't derate our energy efficiency of our plant.

Thermal NOx is not created. We stay below the thermal NOx creation. If we do, we have to inject a little ammonia, that will clean up all the NOx. Sulfur oxides are controlled by injection of limestone or dolomite. We talked about we get about 98 percent efficiency, and we capture it with sulfur dioxide.

We modified our test facility with all of the instruments that we can. Mercury emissions is one of the things that we're working on. We're about 90 percent capture of mercury emissions.

This is our process test facility. The test facility was purchased from Alston Power with the support of Pennsylvania Energy Department, and we operate this. The Department of Energy has a great operation agreement. We do Consol Energy research there. They're contracted to operate this facility for us.

This facility has been in operation since November '06, and we just completed our 15th demonstration test on all local fuels. It's been about a $20 million program up to date.

TRANSCRIPT OF PROCEEDINGS

- - - -

And in this process facility, we do full screening for project -- we do essential design data. We do emission control data. We check ash handling utilization. We do all the information for O & M that reflects the design of the project. We do the fuel impact model. We do operator training, risk assessment mitigation. And then we can define the proposal scope for a full-scale plant depending on the fuels we will be on utilizing.

Just to give you an idea, this is the test facility itself. On the left is the fuel storage area. That's where the fuel is prepped. The main tower, to give you an idea, is about 60, 70 foot high. It's actually a one-megawatt, non-generating powerhouse with every bell and whistle of a regular powerhouse.

I won't sit and read this to you. We do have presentations that we can hand out later.

That's our fuel prep materials put in through the scoop conveyor through the bucket elevator through pressure, and it's mixed with the dolomite, and it's fed in with a concrete pump. It's very simple. You can pump this paste in. You can stop any time you want to. You can start up a week later. It's a forgiving cycle, and you can cycle it in one hour's time, from full load to 30 percent load.

The Karita, Japan, plant, which I used as a model, is a peaking plant in Japan. That's the only coal peaking plant in the world. This can supplement solar or wind plant. Your wind doesn't sustain, so what will you do? You combine with coal plants, and you feed biomass. And if you need more, you can put coal in, and you can balance out your loads.

That's one of the problems when you're doing power that's not 24/7, you're not really taking power off the grid. We have so many reserves where our coal boilers are staying hot. You're putting up windmills, but then you pay the power company to keep the boiler hot. We need something more effective than that.

When the wind is not on, you can turn the boiler down. When the wind stops blowing, you can instantly come back up to power. T. Boone Pickens can't do that.

This is actually a chart from the test facility, and this is right off the graphic screen. This is the combustion itself. I'm not going to read it to you. It's a real nice description on how simple the feed is and how easy it burns. This is all the temperatures and the controls we do throughout the bed for this full-scale plant.

TRANSCRIPT OF PROCEEDINGS

- - - -

This is the ash collection system. Real simple, but we always have to monitor the balance of all the ash and the products. So when we design the full-scale plant, we know we have a right balance for handling that plant, too. This is our control room. You just saw some of the graphs and charts directly from this control room.

This is some of the tests that have been running. I find it quite interesting, because some of these tests go back to the mid '90s, and Alston Power ran a lot; some of these tests are ours. They were way above the curve back then, because they were already looking at the biomass. We have lots of tests of biomass. There's your oil shale, which is pretty exciting because 1,290 BTUs, but that's just about dirt. You don't need many BTUs to run this facility. In the same sense, we have one that's 14,000 BTUs. It's very user friendly for different materials. Basically, anything that you put in here that has carbon in it, you can put in for energy.

The bonus of this coal-powered plant is, it's really a waste-burning plant. It's designed to put anything you put it. You could sustain this plant by 100 percent biomass. The hard thing in this area is to get that. If you're going to do it with seasonal biomass, it takes about 1,400 acres to grow one megawatt of power. When people talk about biomass, it's got to be a reasonable place that you can get all of this biomass from. We know you can use some, but where biomass is not available, coal is.

Our next implementation steps are, we were strongly involved in the CO2 capture test. We're one of those shovel-ready projects. We have received a grant from PEDA for $600,000. We haven't used any yet. We're still saving that. When we have everything designed and just about ready to go -- I left out one step because we plan on going back to PEDA for some more money here in a few weeks, so you will see us on your doorstep again --

MR. DALEY: We will welcome you.

MR. FARNHAM: Thank you. This is the application that we're going to use for CO2 capture. Because we have our exhaust gas turbine to get higher efficiency, the Benfield process is pressurized and matches our pressure. We can actually capture CO2. We believe that we will have thermal efficiency close to 35 percent with CO2 capture. That will be the highest rate of capture, and we will prove this this fall, of any coal-fired plant with CO2 capture in the world, and we will do it right here in Pennsylvania.

And then with a little bit of luck, and we will do a demonstration product here to follow it. That's our goal.

I want to thank the Pennsylvania Energy Authority and the members of the House Commerce for having us here today.

MR. DALEY: Thank you for your participation. You have presented in 15 minutes what took me 25 years and 15 coal conferences to go to to learn in a very quick course. What you're doing is so cutting edge for everyone who is participating in terms of coal.

Let me ask you a question. I know that the Clinton foundation was interested in that CO2 sequestration. Have they made some overtures to you still, and is that moving along?

MR. FARNHAM: Yes, very well. We actually talked for the steam cycle up on the ceiling, we would like -- the Benfield power plant up there is a coal-fired plant; it's very inefficient. There's a possibility that we could build a plant locally here, a zero-emission coal power plant in Allegheny County and take the steam for Carnegie Museums and possibly right here. There's a lot of opportunities here on this hill for the steam cycle.

TRANSCRIPT OF PROCEEDINGS

- - - -

That increases the efficiency of the plant, too. A lot of people don't recognize that when you're converting coal to energy, everyone in the world is bad at it. Some are just worse than others. 70 percent of energy in the United States is being thrown away. We need to get higher efficiency. We have federal legislation that makes it difficult. We need some new legislation that says, if you start changing some of your plant efficiency, you have to go through your whole permitting. We have to change that.

MR. DALEY: You said about 98 percent CO2 sequestration?

MR. FARNHAM: We can get 95 percent captured, and actually what we would like to see, Pete, is utilization of CO2. We had a meeting this morning. We believe we can take that CO2, at least some of it, use some forms of usable algae and put it back into fertilizer so we can use it instead of just being stored.

But there are opportunities for gas recovery and oil recovery, just not real good in Pennsylvania. It might work out well for gas recovery.

MR. DALEY: The limestone bi-product is coming out, that's inert.

MR. FARNHAM: It's inert. It captures

all the minerals. It doesn't leach, same as granite. Because the way this technology is done with pressure, it's a different chemical reaction. If you take a fluidized bed plant, they're 25, 35 percent of limestone for coal, this is 10 percent. You will save a lot of money on the amount of limestone that you use.

MR. DALEY: If I could, old coal plant, you put the coal in, fire it up, and created the steam and you had power. What you're saying now with new technology, under a pressurized fluidized bed that it squeezes it and gets higher efficiency out of the coal, and with your limestone sorbent injectors, it squirts it into the mixture as it spins; right?

MR. FARNHAM: That's correct. What happens is you have 1,200 percent more oxygen is burned. It's that simple. It's doing a better job of turning it into energy.

MR. DALEY: Plus the bi-product is better, the limestone. You said it could be used for -- I know they're talking about gypsum board at some time.

MR. FARNHAM: This is different. That's soft. The gypsum board stuff is soft. This actually sets up hard. You can use it for aggregate for the concrete industry. And aggregate is getting more and more expensive. That's a great thing to get for nothing. I don't think we would have a problem to find a plant to match it for using it as aggregate.

MR. DALEY: And we have limestone cores around here like crazy.

MR. FARNHAM: Absolutely. Not going to be a problem.

MR. LONGIETTI: I just was interested in the part of your presentation at the beginning when you talked about the fact that the CO2 emissions is 97 percent -- it sounds like they're coming from natural sources and about 3 percent from burning fossil fuels.

MR. FARNHAM: Not a lot of people are necessarily agreeing with that, but that's a statement of fact, and it's footnoted at the bottom.

MR. LONGIETTI: Even with that percent, it's still significantly contributing to the issues that are being debated out here.

MR. FARNHAM: That's what people are debating. I'm just stating the facts. The coal fired amount created in the world is .22 percent by U.S. coal plants. If we can get the efficiency up to 50 percent, it will be .1 percent. I don't know how much we can affect the world climate in CO2, but that's what we can do. It will cost some money.

Honestly, I think this will go the same way acid rain went. It was a huge problem and the end of the coal industry, and I think once we put our heads together and find out there's solutions, I think it will be a very easy problem to fix. It not going to be as bad as everyone thinks. We are the Saudi Arabia of coal. It's a natural domestic energy that we need to use. We don't have to import that.

MR. LONGIETTI: Thank you.

MR. DALEY: Dave Callen.

MR. CALLEN: The whole process that you're investigating, is it going to be something that can be retrofitted onto existing baseload plants?

MR. FARNHAM: Actually, it's perfect. Maybe you get to 2,000 megawatts; smaller plants 600 megawatt and down. The footprint for this boiler is 35-foot diameter and 120 foot high, and that's a hundred megawatts. So you can go adjacent to an existing plant and put these boilers and repower very effectively.

You can also do -- have you heard of IGCC that no one has been successful with? That's because they're all trying to get the squeal out of the pig. You have a perfect plant. That's going to evolve into that, too. Where the gas from coal may be down to 5,000 BTUs, it's easy to get and makes great power. Everybody is trying to use up 100 percent of the coal resource. If you put some of that with the PFBC, it's a perfect combination.

We're actually looking at the -- there's two temperatures of gas fire, high temp and low temp. High-temp gas fire turns it into like glass. It costs more to pulverize and use the carbon in it than what it's worth. We're looking to see if we can use that. There's a Polk County one in Florida that might actually work, and we can send that charge to PFBC, and take the CO2 and send it to algae and take that algae to like Plant City and use to it grow other crops. It would be a hell of a cycle.

MR. CALLEN: To adopt something like this, is it going to be -- is there going to be some kind of mandate?

MR. FARNHAM: No, it'll just take one demonstration.

MR. CALLEN: Is it going to be profitable for them to do this?

MR. FARNHAM: Yes. With the cost of coal --

MR. CALLEN: They will use less --

TRANSCRIPT OF PROCEEDINGS

- - - -

MR. FARNHAM: They would use less coal, and it could be commercially profitable, yes.

MR. DALEY: Any other questions?

Doug, thank you for your presentation.

MR. FARNHAM: Thank you all very much.

MR. DALEY: The next testifier will be Andy Hannah. Andy is president and chief executive officer of Plextronics, Inc.

I would also like to acknowledge Chip Glamal (phonetic), our Fayette County office.

Andy, you can begin.

MR. HANNAH: First of all, thank you very much for asking me here today.

Chairman Daley, I really appreciate the opportunity to tell you a little bit about Plextronics here in the community, as well as a little bit about how we believe that we're impacting the energy technology space.

For those of you who don't know Plextronics, let me give you a quick overview. We are a seven-year-old company, so we started in 2002 as a spin out of Carnegie Mellon University. The technology that we're commercializing is the next generation of electronic devices.

Right now we think that electronics permeate our daily lives because we all carry laptops and cell phones with us that have smart attributes to them, and that's really driven by technology that we know as silicon. Silicon is a semiconductor that powers these devices. The issue is that electronics haven't permeated our daily lives yet because they're not embedded into everyday objects.

Some day you're going to go to a grocery store and that product will have a package that lights up because you can put electronics it. The barcode that's on it will be a radio code. You never have to scan. You will just put the goods in your cart, and just like E-Z Pass, you will go by the cash register, it will automatically know the price of everything in your cart. It will fundamentally change the way that we do business, because you will be able to manage your inventory significantly different. You will be able to change the prices of goods on the fly.

In order for this technology to become reality, we have to make electronics so cheap and process it so you can put it into these products, and that's where our technology comes in.

We make semiconductors and conductors that are made from inks. So essentially at Carnegie Mellon we developed a technology that allows polymers or plastic materials to carry a charge. That means they can be semi-conductive or conductive materials. You can then take that polymer, that plastic, and you can put it into a solution and turn it into ink.

You can then take that ink and put it in a traditional printer so that you can print these devices onto any surface. So you can now create semiconductors and conductors that can be printed onto the outside of a package.

Depending on what type of materials you put in those inks, you can run power through that device, and it can give off light, or it can absorb light and turn it into power. That's the idea of printed electronics. And Plextronics is a global leader in printed electronics. Just a little bit about the background. I will get to how that relates to energy in a few more minutes.

Our basic business model is that we make the inks. So we want manufacturers all over the country, all over the world to be able to print light power and circuitry anywhere. So using our ink. So they have to come back to us. Think about us as the Intel inside. You know these commercials where every laptop, if it works, if it is a good product, it has Intel inside. Same way that you'll look at every printed electronics inside, you will say that has Plextronics inside.

We now have 70 employees, and we have raised $41 million in venture and capital. We are in the process of commercializing our technology, so we have just installed an $8 million manufacturing line in Harmarville where we're scaling our ink technology so that we can show manufacturers that you can use our inks and manufacture on a large scale.

We just introduced the first commercial ink package that allows you the ability to print solar cells. If you wanted to print solar cells like you do the Pittsburgh "Post-Gazette," so roll to roll, instead of having paper, let's say you have a roll to roll to plastic. Instead of putting black ink on there, you put our inks in and you print solar cells.

One of the things -- I'm also an adjunct professor of entrepreneurship at Carnegie Mellon. One of the things we look at is how do you create the right environment for an early stage company to be successful? What we have determined is that there's essentially four critical components. One is that you need the right technology or business opportunity. Number two, you need the people. You need the entrepreneur that can take the idea and turn it into the business. Number three, you need the oxygen, which is the cash. The fourth one that most people don't think about, you need the right governmental and business environment for that company to succeed, which means that you need to have the right infrastructure to build your company, that you need government agencies that support you as you grow. We're lucky enough to be in Pittsburgh and to take advantage of the opportunities that the State, the County and the Pittsburgh area has afforded to us. I'll tell you a little bit about that in a minute or two.

So let me talk to you a bit about alternative energy and renewable energy. First of all, I think it's really important to understand that we have a changing dynamic in energy. And everybody knows that we're looking to try and increase the amount of renewal energies that generate power, but what people often don't think about is that over the next years, the amount of energy that this planet will need will quadruple. That's four times the amount of energy we have today we will need in 40 years.

People think 40 years is a long time from now. 40 years ago was 1970. Doesn't seem like that long ago, the 1970s. So before you know it, 2050 will be here, and how are we going to produce enough energy in order to supply the needs of the world? It will require a portfolio approach. A lot of people think too much one energy versus another. We have to realize, especially here in Pittsburgh, that it is a portfolio approach so that coal will be important, nuclear will be important, gas will be important, and renewables like solar will be important.

Pittsburgh will play an important national role in setting policy and driving investment in new technologies, because we are the home of four of the -- many of the large powerhouses in these technologies. So we need to recognize that in this area that we can have a significant voice in public policy and in the debate that's going on in Washington right now.

So let me talk a little bit specifically about Plextronics and why it's important, why we see energy as an important part of our technology.

Secretary of Energy Steven Chu said a couple weeks ago that the objective for photo-able take solar power needs to be that the products are five times cheaper than they are today. Five times cheaper than they are today. That means that current technology, while there will always be a place for it -- again, it is always a portfolio approach -- but mass distribution of very cheap solar power has to come from a technology that's different than what we use today. What we believe is that is printed solar cells. So making very inexpensive raw materials like these plastics that we use and turn into inks and use a very inexpensive manufacturing process like printing. When we make a silicon-based solar cell, a square meter solar cell, it can cost $500 to make that solar cell. Why? Because raw materials are expensive, silicon is expensive.

The manufacturing methods to actually take those materials and turn them into solar cells is very expensive. We see the bunny suits when we look at an Intel commercial. They're wearing bunny suits because these environments that they're in is almost a pure environment, getting the particles of dust down to virtually zero.

So think about if you can change it to very inexpensive raw materials or use printers like the "Post-Gazette." So you can dramatically reduce the cost. The issue for our technology, that's what we do, we dramatically reduce the cost of making a solar panel. What might cost you $500 for a silicon-based panel will cost you about $50 using our technology.

TRANSCRIPT OF PROCEEDINGS

- - - -

The issue is that we don't produce as much energy as a silicon cell does. We are a very new industry. We started our technology in the solar space four years ago, thanks to a grant from PEDA. That's how we got our start in solar energy. When I talked about the right environment to grow a business, to have an agency like PEDA to support the early stages of our growth and the continuing growth has been incredibly important to us.

We generate less energy than a silicon panel right now. That will change. We will grow as our technology will improve as we grow and as it matures, but even if we're one-third or one-fourth the amount of energy generation, if we're one-tenth the cost, the cost per electron is cheaper. The cost becomes area. If I have to use four times as much area than a silicon-based cell, that becomes difficult, because now you need four times -- so you can't put it on a house because you need too much space. Those are the issues that we're dealing with today.

Really, the relationship that we have with the State and PEDA has made a big difference for us because we have been able to have three different programs with PEDA in order to scale off our technology, not only to get it started, but to help us pay for our first R&D line and our first manufacturing line, so that partnership has been incredibly important to us.

While our technology is not yet mature enough to get on grid, so to replace a coal-fired plant right now, that doesn't mean that we still don't have commercial markets. So right now we're talking to companies in India that would buy our panels that would use them to power a light, a fan, a cell phone in a remote village for each individual hut. Something that might cost $400 a panel so that they can have light.

We just heard there's 2 billion people around the world that don't have access to electricity, which means they don't have access to light. There's a direct correlation between light and literacy. So not only would this be a great business for us to take panels and sell them into India to generate light, fan, power, we also can increase the literacy rate of the world by bringing in our panels to different regions in the world.

So that's a little bit about how we're impacting sustainable energy. Why is this important for Pennsylvania? I think some of those answers are obvious. It's job creation. We have created 70 jobs in the past few years here in Pittsburgh. Half of those jobs have been created by people coming in from outside the Pittsburgh area, and then half of those jobs from outside the world (sic). So we -- we attract the best and the brightest people from all over the world here to Pittsburgh to develop this technology. Obviously, those people spend money here, create tax dollars.

But we're also becoming an exporter of energy. One of the things that we like to think about in Pennsylvania is how can we be a global leader in terms of energy. Well, this is one way. We develop the inks that will some day be the core for solar power across the world. And it will be exported from right here in Pittsburgh, Pennsylvania.

So how can Pennsylvania continue to support companies like us? Well, we're already doing a lot of it. A lot of the programs that we have in place to develop the workforce is critical. We have a number of programs. For example, in order for solar technology really to be a major player, one of the biggest issues is actually the installation and testing of solar panels. We're taking a leading effort here at CCAC in Pittsburgh and with our local union in terms of teaching those people how to install and test solar panels. That's incredibly important.

We're also supporting innovative technology. The grant money that goes to young companies like ours, not only for research but also to scale up our manufacturing, has been a big support for us. So there's still a lot that we can do, and one of the areas is that -- this isn't directly related to energy, it's transportation.

We have a really big issue in terms of traveling internationally in this city. It's something that we need to pay attention to, because it's very difficult to travel. You have to take multiple stops to direct airline flights, very happy that we have one to Paris now. But when I send people over to Germany and they have to fly back and they land in Washington, D.C. on a Saturday, and they have to wait five hours for a next flight to get to Pittsburgh. It's not that you can't get to Frankfurt. It's when you get home after a hard week of working and you have to sit in D.C. for five hours after working all day because there are no flights, that's one of the things that we have to deal with for a growing company here in Pennsylvania.

I would like to submit that Plextronics in Pennsylvania are case studies, case studies for how you create a new company and you utilize all those four aspects I talked about; local money, talent, technology and governmental support to grow a business in Pennsylvania and how it can be supported by governmental infrastructure to grow the company.

I feel privileged and lucky that we're here in Pittsburgh and Pennsylvania, and I look forward to continuing to help this company and others to understand some of the challenges that we have to overcome.

Thank you. I'll be happy to take any questions.

MR. DALEY: Any questions from members of the committee, staff?

Great job, Andy. We're real proud of what you do. Five years ago we got word, and a few of us got together and reinvigorated the funding for PEDA. We knew that the Energy Development Authority needed some attention because the previous administration had -- it killed it, for all intents and purposes.

As the Democratic house member on the PEDA board, it's a pleasure to come out and see what we have done and how it's grown and changed people's lives and made Pittsburgh the crossroads of sort of energy development, and I want to thank you for your

TRANSCRIPT OF PROCEEDINGS

- - - -

testimony today.

MR. HANNAH: Without PEDA, we would not have had a solar program. So the success that you see coming from Plextronics will be largely from the stimulus that was provided by the government and by PEDA. I think that's really important, and people need to understand that there is a partnership that happens.

I don't believe in government money to sustain a business. I believe in stimulating and creating a competitive environment where we can compete with others in the world. So thank you.

MR. DALEY: Thank you very much.

Our next testifier will be Carl J. Carlson, Director of Government Affairs, Range Resources - Appalachia, LLC.

As can you see, there's a common theme so far, is that some of these projects, including here at Phipps, was PEDA funded, including the fuel cell that you all saw upstairs, and of course with Doug Farnham, PFBC Environmental Energy Technology, as well as Plextronics.

Mr. Carlson, the show is yours as soon as you boot it up.

MR. CARLSON: Chairman Daley, Members of

TRANSCRIPT OF PROCEEDINGS

- - - -

the Commerce Committee, I appreciate the opportunity to talk to you today about the Marcellus Shale, one of the greatest opportunities that Pennsylvania has ever seen. I'm going to go through this PowerPoint pretty quickly. Destiny is passing out one of the handouts, both of them. I'm going to skip a few of these slides just to move quickly. Excuse me.

I've worked for Range Resources in government affairs, but my history is as a geologist in the industry, and I have worked primarily in the Appalachian Basin mostly in Pennsylvania for 33 years as a geologist first and then in a variety of operations positions.

A little bit about Range Resources. It's a natural gas company, recently included in the S&P 500. We operate nearly 5,000 conventional wells. We have regional headquarters in Washington County, south of Pittsburgh. Our headquarters is in Fort Worth, Texas, but we have our roots in the Appalachian Basin.

Our company pioneered the Marcellus Shale back in 2004. And we have invested almost $1 billion in Pennsylvania, about three-quarters of that in lease acquisition and one-quarter in drilling. We employ about 200 people in Pennsylvania directly and support about 600 full-time contract jobs for the drilling and completion services. We also -- you know, the rollover effect creates several hundreds of indirect jobs.

What is the Marcellus Shale? It is an organic-rich shale that was deposited in a large inland sea that ran from New York down to Kentucky, and mud from the far offshore waters slowly sank to the bottom and a lot of organic went with it and created this organic-rich mud that got buried under 320,000 feet of sediment and got hot and started cooking and generating gas and oil. And that's a piece of the shale there in the picture. It's very dense material. The pores are very microscopic in size, and it's very difficult for fluid to move through there.

This map is just a map of all the gas shale basins in the U.S. I want to point out the Barnett Shale in the red box at the bottom with the line pointing to it. The Barnett Shale is the largest gas-producing field in the country right now. There's been about 10,000 horizontal wells drilled in that in the last eight years. And also the Haynesville Shale just to the right and the Fayetteville Shale, which are in Louisiana and Arkansas respectively, and then the Marcellus in Pennsylvania. Those four are the big four shales. Between them, we probably have a 100-year supply of gas for the country. You can see the Marcellus is by far the largest.

This slide shows the orange is what our company feels is probably the productive fairway for the Marcellus Shale, maybe 40 to 50,000 square miles. The estimates of recoverable reserve are all over the board from 50 to 400 trillion cubic feet. No one really knows. It will take a lot more drilling to nail down the estimate, and by the time thousands of wells get drilled, the technology will improve, and we'll be able to produce more and more. So I think you will see that reserve number continue to grow.

The Barnett shale, the side of it, I estimated there with that blue oval. It's about 5,000 square miles in the core area of Barnett. This Marcellus is a big opportunity.

This map just shows wells that have been drilled in the Marcellus in the last couple years. The blue dots are the drilled wells. You can see a concentration in Washington County. That's our company's focus area. We drilled about 120 wells over there. But, really, the drilling is scattered throughout the state.

Why natural gas? It's certainly more secure than foreign sources of energy, very abundant. 20 years ago, the experts thought we had maybe a 10-year supply of gas left in this country, but now people are thinking 100 to 200 years. Big change. It's domestic and greener than any other fossil fuel we have, and we're not here to ask for any kind of subsidies.

There's a lot of competition in natural gas markets from foreign sources. Liquified natural gas is going to start coming into our country in the near future. I think last year it was about two percent of the total gas supply, but a lot of foreign countries are making big investments to put in liquefaction facilities and build ships to transport that to the U.S.

There's a lot of domestic competition. The other three of the big four shale plays are clearly competing with Pennsylvania for drilling capital. And there's competition just within the Marcellus Shale with the adjoining states that have the same potential.

The Department of Energy, the Energy Information Agency believes that natural gas is going to meet most of the increased gas demand in this country in the coming years. And they believe that natural gas is going to account for over half of the new electric generation capacity between now and 2030.

It's very difficult to build coal plants. I think three to five years is the permitting period. Nuclear, I don't think anyone knows. These gas plants can be permitted and on line in about nine months. They can be small plants out at the end of the grid where power is needed. As far as subsidies, natural gas is by far the cheapest, requires the least amount of subsidies, particularly compared to the renewables. Per megawatt hour, it's far lower than the wind, solar and refined coal. Not that we're opposed to those. Like the earlier gentleman said, we need a portfolio of solutions to meet our energy needs.

Compared to coal and oil, gas is about 40 percent less CO2 emissions, 80 percent less nitrous oxide and no sulfur or particulate emissions. There's a great opportunity for fueling vehicles with natural gas. There's 8 million NGVs worldwide, but only about 150,000 in the U.S., so we're way behind in that area. Compressed natural gas is about $1 cheaper a gallon on an energy-equivalent basis than liquid fuels.

Our energy -- the oil and gas industry has traditionally had a big impact in Pennsylvania, about $7 billion a year of economic impact, and it supports about 26,000 jobs. This is according to a PA Economy

League study from last year.

The Marcellus industry has invested about $4 billion in the Marcellus in the past two years, again, about three-quarters of that in lease acquisition. And investment this year will be down somewhat because of depressed energy prices, but, you know, it will still result in some increase in drilling from last year.

I think Pittsburgh is going to become a real energy headquarters and benefit from a lot of the Marcellus development.

A lot of rural Pennsylvanians who we're leasing lands from will become wealthy people. A single well can generate royalties of up to $2 million per well. That money will roll over into the economy.

We're frequently asked what the economic impact will be in Pennsylvania? It's difficult to project particularly the timing, but we looked to the Barnett Shale in Texas, and from 2002 to 2008, The Perryman Group has done an economic study for the last seven years and found that it created 132,000 new jobs in Texas and currently generates about $14 billion into the economy. Those are big numbers, and those are things that Pennsylvania really needs.

Unfortunately, this is just a slide that shows natural gas U.S. production on top. The pink line is the current natural gas rig count, which has dropped 55 percent since last September when it peaked at over 1,600 rigs. It's now at about 740. There are a lot of idle rigs and a lot of people on the sidelines right now.

This represents an opportunity for Pennsylvania, because if we can draw some of that equipment up here, the economics in the Marcellus Shale is probably better than most of the other oil and gas places in the country. We can really get a jump-start, and you can see some of the equipment moving up here already.

Natural gas prices has dropped from a high of $13 from last July -- last month closed at $3.32. So we're almost at a quarter or what we were last summer. Very volatile market. It will be back. We're suffering from the whole economic recession.

Talk briefly about the drilling process. First step is, of course, is to acquire leases. We go out and negotiate individual contracts with landowners. They're private arrangements that usually involve an upfront payment of cash to reserve the right to explore and then a share -- a royalty share of the production once that's established.

TRANSCRIPT OF PROCEEDINGS

\- - - -

A lot of geoscience goes into our work in advance of drilling. We use a lot of three-dimensional seismic, where we go out and put shock waves into the ground and reflect -- measure the reflections coming back and get a subsurface picture of the rocks down there.

The drilling process requires larger rigs than we've used in Pennsylvania historically. This is one of the brand-new rigs that just showed up about a month ago at one of our sites. It is -- it's called a walking rig. It's the only one in Pennsylvania. And it can -- we're drilling multiple wells on the same pad right now, which I will show you in a minute. This rig actually has feet on the four corners, hydraulic feet. They can move that entire rig with the mast standing and with all the drill pipe hanging in mast just like it is there. They can walk 15 feet away and drill another one. It saves a lot of time and money in teardown and set-up.

This is really what it's all about with the horizontal drilling that we're doing. The well on the right is a vertical well, and we run steel casing all the way to the bottom and then pump water and sand under high pressure and create a hydraulic fracture, a network of vertical fractures in the rock. From a vertical well you can only create one set. On a horizontal well on the left there, you can see that you create many sets of those fractures and open up a lot of surface of the rock and get commercial flows out of this type of shale. That's why we do what we do. We think this Marcellus will evolve into almost 100 percent horizontal drilling with very little -- we go to all this work to drill basically an eight-and-a-half-inch hole all the way to the bottom, cement a string of about five-and-a-half-inch casing all the way to the bottom, and that produces the gas.

A lot of issues. A lot of concerns about water, groundwater contamination, really unfounded reserves. Pennsylvania has very strict requirements on how to case these wells. This is a quote from Bob Watson, a well-known professor for Penn State, "The simple reality is that stimulation" -- meaning the hydraulic fracturing -- "does not impact groundwater bearing zones." That's absolutely true. It's just physically impossible.

The horizontal drilling, the yellow represents the pad that we set up to -- and can drill -- this shows six wells off the same pad. So you have a pad of about three acres with one access road and one pipeline, it's going to drain this area of about 500 acres.

If you had to do that with vertical drilling, which is represented by the purple boxes, you would have to drill about 24 wells to do the same thing. We can do it all with one pad and temporary disturbance of about two percent of the surface area. It leaves a very small footprint.

Typical select timbering, which we have done in our state forests for many years, is about eight percent surface disturbance, so we're way below that. Sorry.

Just a couple pictures of a drilling rig here to give you an idea. This is during the drilling. This is about a three-acre pad. With the newer rigs, we will probably get that down to about two acres per pad. You can see in forested areas, it doesn't leave a big footprint.

The hydraulic fracturing, this is two wellheads on the same pad that we're fracking (phonetic) together. As I said, we pump water under about 10,000 pounds per square inch pressure along with sand to create the fracture. The sand packs back into the microfractures, you flow the water back, sand props the fractures open and it allows the gas to come out one bubble at a time and reach the surface.

TRANSCRIPT OF PROCEEDINGS

- - - -

This is a frac job from a helicopter shot. We have about 25,000 horsepower of pumping equipment out on the site. You know, some people think that this is what's left when we're done. This is not what's left. This costs about $400,000 a day to keep that equipment out there, so it's not there any longer than necessary. About four days to do one of these jobs.

And you can see on the far left side, you see that aluminum pipe going off the location. That's how we bring the water onto the site during the frac job. It comes from one of these freshwater impoundments that we build, and it gets there through these irrigation pipes. When you see these pipes, they're temporary, but they are saving about 1,000 truckloads of water if you had to truck the water up to the site. It's great savings on the roads and inconvenience.

Once the frac job is done, you flow back the water. You put the well into production, and the gas flows through a buried pipeline to the market. The footprint on the producing site is much smaller than the site that you see during drilling. This is a typical horizontal well site. On the right is the wellhead. In the center is a small gas/fluid separator, and then you have three tanks there to hold the water. The water trickles out for years after.

TRANSCRIPT OF PROCEEDINGS

- - - -

This is a reclaimed site. The tanks are off the edge. This is a site that shows during the operation and after on the same site. You can see that -- even when there's a high wall cut to grade off the location, that's all put back, and topsoil is replaced, and it's reseeded, and you can farm right up to the wellhead. It's a very small footprint.

We work with a lot of regulatory agencies. Obviously the DEP regulates most of our activity, Fish & Boat Commission, Susquehanna River Basin Commission, Delaware River Basin Commission, they all play a part in different areas.

This is the gas shale primer that I passed out. This was recently published by the DOE. They commissioned it. It involved the Groundwater Protection Council, the National Energy Technology Laboratory and ALL Consulting. It answers every question that you ever had about shale drilling. It addresses a lot of the issues that people have raised and how they're handled safely.

Water is a big issue that you've read about in the media, how much water these frac jobs use. It's not a significant amount of water compared to other uses in PA.

It's about $4 million to frac a well. If we

TRANSCRIPT OF PROCEEDINGS

\- - - -

assume that the Marcellus Shale reaches double the peak level of drilling that was achieved in the Barnett Shale last year, if we did 6,000 wells a year, it would be 20 times what we expect to drill this year. We would use 60 million gallons a day of water, which would be about half a percent of total Pennsylvania water use, which is over 10 billion gallons a day.

The SRBC, Susquehanna River Basin Commission, estimates that at double the Barnett Shale level of drilling, we would use less than half the water that we use on golf courses and ski slopes. It's just a matter of perception.

The frac chemicals that we use has been a big issue. Of everything that goes down the well, 90 percent of it was water, 9.95 percent sand, and 1/20th of one percent is chemicals in very dilute concentrations. A lot of the chemicals are ones that we're exposed to in our everyday life. We're constantly working to find greener and more environmentally friendly formulas.

I've read articles where we're using 300 different chemicals to frac these wells. That's not true. There may be 300 chemicals available out there. We use four or five to frac these shale wells. These are the chemicals that we use. I'm not going to go through all this, but it shows the common uses for the same chemicals that we use every day.

When the water flows back, it picks up some dissolved constituents from the rock, primarily salt. If you ask DEP, they will tell you that that is their primary concern. It's not any of the additives that we use; the concern is the salt.

When you put the conventional treatment for produced water in PA is to drop out the heavy metals and dump clean saltwater into the river and let it dilute to a safe concentration. DEP would like to end that practice in time, and we agree with them that that can be achieved, and we're working closely with them.

How much salt is it? Well, PennDOT puts 750,000 tons of salt a year on state roads. That doesn't include the municipalities. That equates to about 3,100 of these Marcellus Shale gas wells, and that all runs into the ditch and into the river.

PA streams can handle a lot more salt safely before they reach any EPA limit of aquatic life impact. We are working with DEP on a lot of different technologies to reduce the amount of wastewater, including reusing the water, which is our preferred method.

Our process does create some inconvenience. It's a construction process. It's dirty and continuous around the clock. We have noise and lights. We have occasional bad actors in the industry, but probably not so many in the Marcellus. At $4 million a well, these are not small companies that are getting involved in this.

MR. DALEY: The other drillers before you, there were some bad actors.

MR. CARLSON: The ma-and-pa-type companies would try to cut some corners. I don't think you will find that with the bigger companies. We have invested so much money, we can't hide what we're doing, and we have to keep coming back. But the main thing about the inconvenience is that it's temporary.

What about the roads? We do damage the roads. A lot of secondary roads in PA are dirt or original dirt road and they have tarred and chipped them for years. They have no base under them. You bring this heavy equipment in, and it does damage. We're legally liable to repair the roads. We have spent about $3 million the last two years doing it. We always leave the roads as good or better than they were. I believe that in the long run our industry is going to improve the road system in a lot of rural PA at no cost to taxpayers.

We're in the very infancy of the potential of this Marcellus. We will drill maybe 300 wells this year. There's a lot of jobs and wealth creation to come and a huge economic boost. The development will last for many generations.

Some regulatory and legislative issues. You know, DEP originally was concerned with the Marcellus Shale, and they put in some permit steps in the permit process that were problematic. We worked real hard with them in the last six or eight months and worked through a lot of that stuff. Pennsylvania does have adequate regulation.

This wastewater strategy that they have announced is a little bit troubling, only from the standpoint of how fast we can get there. Legislatively, there's 23 new bills so far this session that impact our industry. Some of them are a little onerous, some of them we're in favor of, some of them are just a lack of understanding. The constituents in some areas are throwing up red flags without understanding, and our industry hasn't done as well as it should in getting out in front of that.

TRANSCRIPT OF PROCEEDINGS

- - - -

What we need to grow is predictable and science-based regulations. We're all in favor of that. We just need to not regulate based on emotion.

We need a business-friendly climate that will attract more producers. We need to get more competitors up here to drive the cost down. We had a rig break down here a couple months ago, we had to wait three days, while we're paying $50,000 a day standby, for a mechanic that knew how to fix it to come up from Texas. We need to get 100 rigs running up here so we can get mechanics up here. We need machine shops that run around the clock to do oil field work so when things break, we can get them fixed. It's just going to take a higher level of activity to get there.

It's not a surprise that our industry is not in favor of a severance tax. I thought I'd throw that in. Particularly at the lower gas prices, we think that tax right now, the governor's proposal would only generate about $38 million or 35 percent of the expectation.

The other big shale-producing states, Texas and Arkansas, in particular, have discounted their severance tax rate way down to encourage the drilling of shale wells. If those discounts were applied in

TRANSCRIPT OF PROCEEDINGS

- - - -

Pennsylvania, it would only generate $4 million this year and $10 million next year.

We think the taxing in this industry, when it's very early in its life, is just sending a bad message to the investment community. We are competing for capital in other states and other countries. We want to get this up and running. We think that the Marcellus Shale will bring a lot more revenue to the State coffers by encouraging its development than by taxing.

We suggested that leasing public lands would be a good way to generate money faster. I won't delve into that. I showed you that the footprint for drilling in the forested areas is very small, and the revenues could be very substantial.

That's all I really had to say. I appreciate you having me here to speak. I'll try to answer any questions you have.

MR. DALEY: Carl, I thank you for your presentation.

MR. MARSHALL: Two questions, really. One you just mentioned, and I've heard in the past that you have to bring trained workers from Texas or other sites. I had a constituent that was recently laid off from USAir, and he wondered what training he would need and where he would get this training to be able to work in gas field production like that.

MR. CARLSON: Well, the fieldwork is generally on-the-job training. It doesn't require any kind of special training, high school education. Beyond that is good. We do have well tenders that have college degrees, but it doesn't require that.

We're working real hard with different workforce development groups to try to get adequate curriculums into vo-tech schools and community colleges. That's going to take a little time to get there. We should be trying to import curriculums from Texas and other places where they have the jobs that we need up here.

I can tell you that, for instance, the drillers, the drilling crews up here, when they first came up here, it was all Texas guys. After making a few trips up here from Texas, especially in the winter, those guys said, I'm not going anymore. A lot of those guys have been replaced already by local people, I would say about half of the rig crews in Pennsylvania.

MR. MARSHALL: The other question, with the horizontal drilling, and if you can capture 500 acres in one well, why do you need to move 15 feet?

TRANSCRIPT OF PROCEEDINGS

- - - -

MR. CARLSON: Each of those legs -- there was six double pitchfork pattern of six wells. They're each separate well bores. The technology is to do it all out of a central well bore, but it's very expensive to do that. It's cheaper to drill six individual well bores on very close spacing.

Do you follow what I'm saying?

MR. MARSHALL: Yeah.

MR. CARLSON: The vertical sections are all 20 feet apart.

MR. DALEY: The graphic didn't represent anything to scale. It was just a graphic.

MR. CARLSON: All those wells were all at the same starting point.

MR. COSTA: First, I have an easy one for you. Are you aware there's a nuclear technician on the "Simpsons" named Carl Carlson?

MR. CARLSON: So I've been told. I don't watch that show.

MR. COSTA: When you initially drill the line and you pump the water, once you do the initial drilling, the water is no longer an issue; is that correct?

MR. CARLSON: That hydraulic fracturing is a one-time deal.

TRANSCRIPT OF PROCEEDINGS

\- - - -

MR. COSTA: You establish the pump, how long is that pump active?

MR. CARLSON: The wells actually flow on their own pressure. There's about 3,500 pounds per square inch in the gas pressure down there in the shale, so it pushes the water back out of the hole and flow it back. Then it just starts flowing gas on its own. Those wells will probably last -- we're not sure. We're guessing 30 to 50 years. They decline the whole time.

MR. CALLEN: You don't need a continuing fracturing?

MR. CARLSON: No, no. One time at the beginning. You drill it, you frac it, you reclaim it, and it sits out there and it flows for 30 to 50 years.

MR. MARSHALL: I've heard about refracking. Is that during the same process?

MR. CARLSON: I've heard that, too, but I'll be honest with you, it's virtually impossible to refrac a horizontal well. In that lateral hole, you shoot a bunch of perforations at the end of the well bore, and then you hook up your pump trucks and pump the first stage of that fracture, and then you set bridge plugs and seal off the end of the hole, and then you perforate another section of the hole and frac it, set another bridge plug, and perforate another section and frac it. You do this about ten times, and then you knock all those plugs out of the hole and flow everything back together and produce them all together. So you could never isolate those individual stages again, because you've got perforation all over the pipe.

I've heard that mentioned, that you frac these wells over and over, but it's just not true.

MR. DALEY: Representative Longietti.

MR. LONGIETTI: Everybody says our source of energy is our energy of the future. Your materials talk about 57 percent of the new capacity for 2030 will be natural gas. The gentleman on coal, he shows us a chart, natural gas peaks at 2016 and goes down after that.

MR. CARLSON: I saw that. Our source was the DOE's Energy Information Agency. We were using the 2009 report. I saw that his was the 2008 report.

MR. LONGIETTI: Yeah, 2008. Just curious.

MR. CARLSON: Maybe they have not factored in all of the reserve potential of these gas shales in that earlier report. I don't know. But I honestly believe we're going to need all of these sources.

Energy, if we're going to maintain our standard of living -- the rest of the world is trying to catch up with us. They're going to really start catching up.

MR. HAYNES: I'm interested in the workforce capacity of cultivating this gas. You said you're expecting 300 wells to pop up this year alone.

MR. CARLSON: Yes.

MR. HAYNES: How many workers?

MR. CARLSON: Each continuously run rig will support about 150 full-time, direct jobs and then maybe a 1.7 multiplier for indirect jobs. So by the end of the year, we're expecting about 25 rigs to be running in the state. So 25 times 150 is --

MR. DALEY: A lot.

MR. CARLSON: About 4,000 jobs, direct jobs.

MR. DALEY: 3,000.

MR. CALLEN: But you said there are a lot of contractors who are being --

MR. CARLSON: We contract everything. All we do -- we're like the general contractor. We subcontract the drilling, the fracking, all the earth work.

TRANSCRIPT OF PROCEEDINGS

- - - -

MR. CALLEN: Then there are other things like machine shops.

MR. CARLSON: Really, that 150 jobs per rig does not count any kind of manufacturing. We're running three miles of pipe in each well. And there's no reason that that can't be manufactured in PA. John Sherman wants to manufacture.

MR. MARSHALL: Just on that line, the casing and the pipe, how much of that is imported, and how much is American made?

MR. CARLSON: I think it's mostly American made, but it's not Pennsylvania made.

MR. MARSHALL: I had a meeting with a group -- I had a mill shut down in my district because there's boat loads of pipe sitting in Houston that's imported from China. When Range Resources -- do you --

MR. CARLSON: I'll check on that. I don't think we're buying any foreign pipe.

MR. MARSHALL: That's good to hear.

MR. CARLSON: There's no reason why we can't manufacture the drilling rigs and a lot of the other production equipment as well.

MR. DALEY: We want to talk to you after. We have a constituent that wants to put a facility in

TRANSCRIPT OF PROCEEDINGS

- - - -

Allenport. He has a stainless steel operation at the Wheeling-Pitt.

MR. CARLSON: Okay.

MR. DALEY: Any other questions, Representative Marshall?

MR. MARSHALL: That's it.

MR. DALEY: Thank you very much, Carl. Good to see you again.

MR. CARLSON: You, too.

MR. DALEY: I will give you a call first of the week.

The next presenter is Thomas Sarkus. He's a senior management and senior analyst for U.S. Department of Energy's National Energy Technology Laboratory from Pittsburgh and member of Tom Ridge's Junior Management. He's the main guy.

Tom, good to see you.

MR. SARKUS: Yes, it's been a while but always good to be back.

Work on the computer here for a minute.

Good afternoon. It's good to be back. I guess I don't really need the mike. For those who aren't familiar with NETL, the National Energy Technology Laboratory, we maintain five facilities. Pete mentioned the one here in Pittsburgh. We also

TRANSCRIPT OF PROCEEDINGS

- - - -

have facilities in Morgantown, West Virginia, Albany, Oregon, Houston, Texas, and Fairbanks, Alaska. NETL spearheads fossil energy research in much the same way that the Department of Energy's National Renewable Energy Laboratory, or NRAL, in Golden, Colorado, does a similar function for renewable energy research.

As the lead lab for fossil energy within the Department of Energy, our mission includes clean coal technology and carbon capture and sequestration.

I just came today from an international conference that was just adjourned at 1:00 at Station Square, and we had over 700 experts from around the world addressing carbon captures and storage, over 180 technical presentations and another 80 poster sessions. So if you ask, is there anything happening in terms of carbon capture and storage, there is a tremendous volume of activity and information happening in that field.

For example, I learned at the conference that to date about 150 master's and doctoral theses have been issued pertaining to fields in carbon capture and storage. Who is jumping on this activity? Some of the top universities in the world, really. MIT, Stanford, Carnegie Mellon were in abundance at this conference.

TRANSCRIPT OF PROCEEDINGS

- - - -

NETL is a large lab. We have a lot of smart people, and I borrow many of my slides, but the next five are Sarkus originals, if you will. Consider that fossil fuels account for about 85 percent of the energy that is consumed in the United States, and our economy is -- our energy economy, I often characterize it as a three-legged stool. Of course there's oil or petroleum, we use that predominantly for transportation fuels. Natural gas we use primarily for space heating in residential, commercial and industrial applications, and coal, the third leg of that stool, we use primarily for electricity.

In fact, I believe it's over 90 percent of the coal that's burned in the country, something like 94, 93 percent, and these numbers fluctuate from year to year -- is burned to generate electricity.

When I started -- when I was a junior manager a long, long time ago, if you would just kind of look at this part of the left part of the graph, two trends were apparent. One is that coal accounted for about half of the electricity generated in the country. I've been charting these numbers for a long time now. Fast forward to today, and those two trends still persist. Really not much has changed over that time.

A lot of people throw around the fact that about half of our coal comes from electricity, and they kind of make another mistake in assuming that half of the power plants are coal-fired power plants, and that's not true. Less than one-third, about 30 percent of our power plants, are designed to burn coal.

So I ask you why is it that less than one-third of the power plants in the United States generate approximately half of the electricity. Look at what's happening with natural gas. 40 percent of the capacity is generating approximately 20 percent of the electricity, and so on. With nuclear, nuclear is kind of like coal. They're squeezing more electricity out than the capacity might otherwise indicate.

Briefly what -- what's -- what's happening here is that these numbers reflect the operating costs for each energy source. Coal and nuclear are cheap plants to run. They run in what is called baseload operation. Things like natural gas, as we will show you on the next slide, tend to be more expensive.

I agree with the previous speakers that we need all of these energy sources, and my prediction and really the prediction of every credible energy expert that I know, is that in 20, 30, 40 years' time, we're going to look around, and no matter how aggressively we have pursued solar, wind, coal, gas, nuclear, at that point we're going to look around and say, you know, we think we need more energy. We're looking at tremendous demand growth happening, and you just can't get there unless you deploy and aggressively deploy a portfolio.

When you look at natural gas, those plants -- and we built a lot of natural gas plants in the 1990s and early part of this decade -- they're cheap to build. They can build them fast. They're the cheapest to operate and to maintain, but what kills them is the fuel cost. So on average -- these are EIA statistics. On average, electricity from natural gas is twice as expensive than electricity from coal. That's why you max out the coal plants and why we generate as much capacity from them as we can.

Another common error that people make in analyzing the energy situation is when they think of coal, they think of this black rock. And you naturally start thinking these Molly Maguires and where does this coal come from. It comes from backwards places like Western Pennsylvania and West Virginia and Kentucky and Wyoming. But that's where you sort of make a mistake, because this is not just about coal.

TRANSCRIPT OF PROCEEDINGS

- - - -

I was visited for about a day last year by a reporter from the "Washington Post." And he asked me, he said, could America survive without a coal mining industry? You know, in this economy, maybe not. But in better times, it's arguable. The coal mining industry generates total revenue of approximately $25 billion a year. So when the economists throw around numbers in the trillions, it's not that -- it's not a huge number. We probably spend another $10 billion a year to transport that coal to the power plants on railroads and trucks and barges. So, basically, the electric power industry spends $35 billion a year, on average, to purchase coal.

That industry, the power industry then goes on and turns every dollar that they spent on coal into $5 worth of electricity. So coal is the raw material, but electricity is the added value product. $175 to $185 billion a year worth of electricity generated from coal, that, I would submit to you, is the industry that this country cannot survive without.

If you take that one step farther -- and I'm a chemist and a lawyer, not an economist. If you take that one step farther and think, what is this electricity being used for and what kind of value are those electricity users adding to the economy, because

TRANSCRIPT OF PROCEEDINGS

- - - -

electricity is not just consumed in our houses. It's consumed by every business and factory and industry in the country. You're coming up with a number that is fairly substantial.

And as you see here, this map shows not where the coal is mined but where the coal is burned. And many of those states don't have much, if any, coal, but yet they're very dependent on the electricity that is generated from coal burned in their borders.

This map is a little harder to read, but it's very important. We have average numbers showed for each state, and the top number is the average cost -- the average retail price of electricity in cents per kilowatt hour. The bottom number is a percentage. That's the percent of the electricity generated in that state that comes from coal.

So what do we see? We see the lowest price of electricity occurs in the Pacific Northwest. They have a lot of hydropower. We really don't have significant opportunities to build huge, new dams anymore. We don't have tremendous hydropower opportunities. They have already been largely developed.

The next lowest prices are the states shown in green. You will see a trend there. The percentage

TRANSCRIPT OF PROCEEDINGS

- - - -

numbers for coal there are pretty high. Now, the next highest are the states shown in yellow. What's happening there, because Pennsylvania is in the yellow? There's a couple of states here in the yellow. What you're seeing there is that the percentage you're getting is a little bit lower, and these states predominantly have a mixture of coal with natural gas and nuclear capacity. Texas, a lot of gas and nuclear mixed with their coal. Illinois, they mix gas and nuclear in the coal. And so does Pennsylvania.

The highest cost states are the ones shown in red. A lot of the opposition, the environmental opposition to coal -- and usually, you know, it comes in from media outlets -- you look where those media outlets are, they're a lot of times in those red states.

This is from the early release, and these numbers are changing a little bit. The point I would make is not so much that people are showing pie charts with different numbers on them. The point you have to keep in mind here is that the pie charts are growing. So that 22 percent of 113 quarts is a little bit more than 22 percent of 100 quarts. You have to sit down with a calculator and chunk those numbers out.

TRANSCRIPT OF PROCEEDINGS

- - - -

In terms of air pollution controls, and environmental concerns are the Achilles heel of coal, they're well known. What we have seen in -- and it's happened a lot here in the Pittsburgh area as well as across the Commonwealth is, there's been an evolution. The first pollutant to be addressed was particulate matter or soot and then sulfur dioxide and then nitrogen oxide and then mercury, and then the next one is carbon dioxide. I don't want to get into the debate about whether global warming is happening. I think that horse has left the barn, and we are looking at climate change controls of some sort in the not too distant future.

But when that happens, we're looking at a problem whose magnitude really dwarfs any kind of pollution control that we have dealt with before. The sulfur dioxide scrubbers -- and Representative Daley knows I spent the first half of my career working on scrubbers -- $15 million tons. We're looking at 6.3 billion tons of CO2 emission in this country per year. It's not an unprecedented scale, but it is very large compared to what we're used to dealing with.

One of the technologies that is well suited to dealing with carbon dioxide is IGCC, or Integrated Gasification Combined Cycle. And I had the distinct

TRANSCRIPT OF PROCEEDINGS

- - - -

privilege of managing and supervising the Department of Energy's co-funding of the only two coal-based IGCC plants that are operating in the United States. There are six worldwide. These are the two that were built; one is in Indiana, and the other is in Florida.

Now in terms of tackling CO2, you can really do three things. You can switch to less carbon-intensive forms of energy. These are things like renewables and nuclear. You could also pursue things like energy efficiency and energy conservation. And the third route is to continue using fossil fuels but do something with that carbon. For example, store it geologically. Again, all of the credible energy experts and studies that I have seen assert that you -- to reach any sort of climate stabilization scenario, you must employ all three of these mechanisms. You cannot stabilize climate with any one of these or with any two of these. You need all three, and I'll go so far as to say in roughly equal measures.

I have a video, and we'll skip over that.

Let me ask, do you understand what we're dealing with when we talk about geologic storage of CO2? We would capture the gases from a power plant, we would then compress it into almost like -- the technical word is called supercritical fluid. It behaves a lot like a liquid because it's so highly compressed. And then you would inject it into the earth to a depth below of about 2,400 feet, because at those depths, the temperature and pressures are sufficient enough to keep it in a liquid-like state.

Now, we're not injecting it into a large cave or cavern. We're injecting it into small, tiny pores that exist in between the grains of a rock like a sandstone. However, the sandstones can be hundreds of feet thick, and they can extend in some cases for hundreds of miles. When we first started looking at this, people questioned whether there was enough of these tiny, little core spaces under the ground to hold much of this gas, and in point of fact, there is.

I mentioned before the United States emits approximately 6 billion tons a year of CO2 from all sources. About 36 percent of that, or 2 billion tons, comes from coal-fired power plants. The remaining two-thirds comes from petroleum and natural gas sources, everything from our homes and our cars to the factories that we work in. So these are the storage capacities estimates from an atlas that NETL has prepared, and I brought the second edition of that atlas. If you wanted to know how much storage capacity we have in, for example, these saline formations, you would take the low estimate, perhaps, and divide that by six. That would give you how many years of storage capacity we have. Or if you just wanted to store the CO_2 from coal plants, you would divide it by two.

What you see here, these are huge numbers. We're talking hundreds of years of storage capacity, maybe even thousands of years. Given we only have approximately a 200-year supply of coal, it really is not an issue whether we have enough storage capacity. I won't go as far as to say that we're going to continue using coal for the next 200 years. I think what's really in play in societal debate is we will probably continue using coal in the next 50 to 100 years.

Why does it matter that we have so much extra storage capacity? It gives us the ability to go in and select the very best ones. This is about geology. We want to get this right. With that much capacity, I think we do have the latitude to go in and select sites where the CO_2 can be stored safely and securely and relatively permanently.

Let me know if I'm going too long.

MR. DALEY: If you could wrap it up in

about five minutes. We're running -- we only have so much time in this facility. We're about 10, 15 minutes over now.

MR. SARKUS: Enhanced oil recovery that you need to look at. CO2 on the open market goes for approximately $30 a ton. Each ton of CO2 that's injected into a depleted oil field -- and there are many of those in Pennsylvania -- can generate an additional two to three barrels of oil. I haven't checked the price for a barrel of oil. The last time I checked, it was a little over $50. The economics are there that this -- this can be a great incentive.

Now, if we injected it into the ground, is it going to stay there? This is a schematic we filmed in the North Sea where they extract natural gas from here. However, there's a lot of CO2 in the gas, so they strip it out. Norway has a CO2 tax. So to avoid the tax, they inject it into a different formation about a mile away from the drilling rig. These are seismic plumes. These are taken every couple of years. Here we have the CO2 plume (indicating). You see that it is staying intact, and it's staying underneath what we call a seal or cap rock formation. That's the second piece of sequestration. One is this porous formation that you inject into. The second piece is a nonporous cap overtop that basically keeps the CO2 in place.

NETL has a series of seven regional partnerships across the United States, because the geology is different in the seven regions of the country. I'm sure you're aware that Pennsylvania Geological Survey belongs to Midwest Regional Partnership. They've got some good studies on the geological surveys web site.

We're now just starting on nine large scale tests, and these are the locations of those tests. The first one, which is the one shown in Illinois, just started drilling in February and will complete drilling later this year. So the next couple of years, you will hear a lot about this project, and you will see a lot of data coming out.

One thing about coal-fired power plants, when I first started early in my career, I went to a senior person and I said, I see all these projects that developers say they're going to build and I notice some of them don't get built. How many of them are really going to get built? He said, no more than about half of them, Tom. The real number is probably closer to 20 or 25 percent. This is not smoke or mirrors. The problem is, a large coal-fired power plant is a multi-billion-dollar investment these days. It's a lot of heavy lifting, and a lot of things can and do unravel with those kinds of projects.

I will close with a mention of NETL's budget. Our carbon sequestration R&D program has an annual budget of $150 million for fiscal 2009. We have an additional $50 million focusing on water issues pertained at carbon capture and storage. That's not counting the stimulus package, which includes $3.4 billion for fossil energy. Basically, that $3.4 billion will be focused on things pertaining to carbon capture and storage, and most of that will be managed out of my office at NETL.

With that, here's some contact information, and I'm always happy to make myself and NETL available for questions, and you're always certainly welcome to come back and visit us.

MR. DALEY: Thank you, Tom. Dave and I were saying how significant your presentation was. It's a shame that some of the other members hadn't heard it.

Can you make me a copy of your slide presentation? What I will do is I'll make sure all of the members of the committee get it, and we will get a copy of the transcript, also. I think it's very

TRANSCRIPT OF PROCEEDINGS

- - - -

important that they hear and see what you have to say. You probably should have been moved to first in the scheme of things as the first presenter, as opposed to last presenter.

Any questions?

MR. CALLEN: Tom, the big problem that I wonder about is how do you transport the CO_2 from existing plants to sequestration plants?

MR. SARKUS: We have a couple --

MR. CALLEN: Do you need pipelines to do that?

MR. SARKUS: We have a couple problems in this country. I mentioned enhanced oil recovery. CO_2 is injected in a hundred locations in this country for enhanced oil recovery. The problem is, despite all the CO_2 in the atmosphere, we don't have enough CO_2 that we actually -- we don't have enough of what we call commodity CO_2. So for some of our experiments, we're trucking CO_2 across three states. I can tell you what the bills are for something like that.

Now, down in west Texas, they pipeline CO_2 800 miles, pipeline probably because it's cheaper for the larger volumes, and in west Texas they pipeline CO_2 800 miles from natural sources in Colorado, Wyoming and Utah. It's extracted from the ground and

TRANSCRIPT OF PROCEEDINGS

- - - -

pipelined 800 miles. There's no technical limit on how far you can pipeline this.

There is an economical limit for power plant applications which is believed to be on the order of 200 to 250 miles. Your power plant doesn't have to be right over a reservoir. It just has to be within economical distance.

MR. DALEY: Thanks, Tom. Thanks, everyone, for attending.

This meeting is adjourned.

(Whereupon, the hearing was adjourned at 3:14 p.m.)

- - -

C E R T I F I C A T I O N

I hereby certify that the foregoing transcript is a true record of the House Commerce Committee Public Hearing on Thursday, May 7, 2009.

The foregoing certification does not apply to any reproduction of this transcript in any respect unless under the direct control and/or direction of the certifying reporter.

____

Court Reporter