

**CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE**

**FINANCIAL CRISIS: IMPACT ON  
NEW NUCLEAR REACTORS**

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SHARON SQUASSONI: Well, welcome, this morning to the Carnegie Endowment. Thanks for coming out on this very rainy, cold, dark morning. We have a really interesting program for you this morning. I kind of feel like if I had any event here that said “Financial Crisis, colon, Impact on X,” we’d get a good crowd. (Chuckles.) But today we’re going to talk about the impact of the financial crisis on building new nuclear reactors. Some of you were here two weeks ago when we rolled out my policy brief, “Nuclear Renaissance, Is It Coming, Should it?” There are copies of that in the back; I think there’s a table. We also have another paper on that table back there which is a paper commissioned by Henry Sokolski’s group, the Nonproliferation Policy Education Center, on the credit crunch and nuclear power by Steve Thomas, who’s at the University of Greenwich.

I’m not going to say too much, I’m just going to introduce our two terrific speakers. First speaking will be Steve Maloney, who is a managing consultant at Towers Perrin with the Risk and Financial Services practice. Not only is he an expert in marketing credit risk, but also an expert on the nuclear end of things. He has degrees in operations research, math and physics from the Polytechnic Institute of NYU and I think spent some time in the naval nuclear, in the submarine program. Steve will speak first, followed by another Steve, Steve Goldberg, who is the special assistant to the Director at Argonne National Lab. And Steve has directed several nuclear energy studies, including the 2004 economic study for DOE that analyzed several nuclear policy options. And Steve has many long years of experience in the U.S. government, including at the Office of Management and Budget. So one administrative note: if you have cell phones or Blackberries please turn them off or put them on the silencer, and we’ll start. Thank you very much.

MR. MALONEY: The put, the – is that better? Thank you. Gazprom is the world’s largest natural gas company; they are the Saudi Arabia of natural gas. In addition to supplying the commonwealth states, including the Russian Federation, they also are the dominant supplier of natural gas to Western Europe. I had the good fortune of working with Gazprom for several years in London, and one of the interesting things of working with Gazprom is you get another perspective on energy. I think we take many things for granted in this country. This particular photograph was taken in Yamal, which is generally known as the end of the Earth. In Western Siberia, they pull gas out of the ground through the tundra. The new field that Gazprom is pursuing is in the Bering Sea, it’s called Shtokman. It will replace Yamal, which is an aging field. Shtokman is about 150 miles at sea in the Arctic. The gas is, the ocean floor is about 1,000 feet down, the gas is another 1,000 or so feet beneath that. So when we talk about energy and we talk about nuclear energy, we’re really talking about some very serious matters. And I wanted you at least to get this photograph of a July day – actually, it’s not July – in western Siberia to get a sense of the some of the issues that I think we all deal with when we talk about energy.

This is the usual disclaimer, and so our lawyers make us disclaim everything we say. Having said that, the question I’d like to pose for everybody here, for those who still have a 401(k) or still have a college fund or pretend that they may have one, is I have an investment opportunity I’d like to present to you. You have a number of places you can invest what little money you have left. You could take an equity position in this opportunity or simply loan this opportunity some money. It involves a new technology. The company that’s going to commercialize this technology has no staff

or any operating experience supervising the construction of this new technology. That's because everybody has retired and moved on to other fields. If it doesn't go well, the company may be bankrupt, in which case you will lose all your money, and in some cases this has happened in the past. And of course the last time the company tried something like this was a couple decades ago, when they blew their estimate by a small amount, maybe three to five times.

Now, just to continue this investment opportunity, it's not going to generate any revenue for seven to 10 years, so please give us some money. We'd appreciate your checks, cash will be very nice. And if you loan the money, you may see a return over that period, and if you invest in the opportunity, rather than simply loaning us the money, you may see a return if elected officials decide your investment is least-cost, provides energy security, does something about global warming, gets the Red Sox a reliable center fielder, whatever happens to motivate elected officials to do what they do. Otherwise you're not going to see a dime back for seven to 10 years, and that assumes we hit our schedule, which, like I say, we haven't been very reliable in doing that.

So with that in mind, the question I would ask all of you is, what return would you expect to see for your investment? What guarantees would you demand and, frankly, how attractive is this compared to some of your many other opportunities? General Motors, Ford, First National Bank. Tempur-Pedic happens to be my favorite right now. There are a lot of places where you could put your money, and so when somebody comes to you and says, we'd like for you or your children or your grandchildren to invest in nuclear power, this is essentially the opportunity that someone is presenting to them. I'm not saying it's a bad investment opportunity, but ask yourself, what questions would you want to ask?

Let's talk a little bit about how people typically rank investments, and this is, I promise you, the only equation I will ever present today. It's something called the Sharpe Ratio, it's been around for a number of years, and it basically is somewhat intuitive when you think about it. It says that the attractiveness of the investment – the First National Bank of Tempur-Pedic or a nuclear power plant – is directly proportional to the potential for your making more money than you might otherwise make – excess returns – and inversely proportional to the risk or uncertainty that you perceive. High risk? Not very attractive. High returns? Very attractive. High risk and high returns? We're not so sure. I want to outline for you now a couple takeaway messages that I would like to leave with you, and these are my opinions, and I don't expect anybody to agree with them.

Right now, demand for power's pretty uncertain. Long-term energy prices show no clear evidence of any upward drift, and I'll show some evidence of that, and it's a very volatile market. Utility market capitalizations, market caps, notwithstanding the freefall, that sense that we are falling and weightless, equity markets are still expensive for the earnings they're generating. Currently your PE ratios are running around 13 or 14. That's the historic average for SMP. The Dow Jones Industrial Average today is where it was about a decade ago, but household debt in this country today is double what it was a decade ago. And the downward pressures continue. Remember that

utility PE ratios correlate with long-term treasury yield, so your government is basically setting what your market conditions are, and the market will respond to what the government does.

Now, probably the utilities outperform the industrials, and so therefore when your broker says, put your money in utilities, on a comparative basis that may not be a bad idea. But the earnings of the utilities are likely to be suppressed in the years to come. Put it all together and you're basically looking at the fact that utility balance sheets deleveraging will mean that they will have a lower market cap over the next few years than they have today.

Credit markets: Placing a very high premium on risk. And even the highly rated companies, as I'll point out in a minute or two, are facing high capital costs. Bad policies right now are distorting capital markets. The window is open right now, putting cash out at teaser rates just like a zero-balance credit card that you get in the mail every morning, and many companies are basically floating their debt from zero-base credit card to zero-base credit card month to month. Long-term debt, however, starting the price at full market premiums, and they float with the London overnight rate. And the yield curves are telling us future cost of capital will be high. So this is not exactly the best time in the world to take on long-term debt.

On average, an investment with a seven-year payout will be about two-and-a-half times riskier than a comparable investment with a one year payout. So that means that if you have an opportunity to get your money out of investment very quickly, you're going to tend to want to do that because your risk is lower. Remember the Sharpe Ratio. You have a big number in that denominator, it means that the relative attractiveness of that investment will be less than something with the smaller number in the denominator. And, oh by the way, with construction projects, they place significant skew, which means a very measurable fact of potential loss. What does that mean? If you lose money, you could potentially lose big money.

These are energy markets over the past month, I apologize, I did this slide about a month ago in a conference in London. I think the message is, as we all know, West Texas Intermediate prices are coming down. We have high volatility in an oversupplied market, the Brent, which is the European equivalent of West Texas Intermediate, is also re-coupling with West Texas, which means we have a weakening global economy, no transatlantic spreads, and the Saudis cannot throttle back fast enough on their production of oil. Prices are likely to be in a 45- to \$55-an-hour – an hour – right – barrel range for some time. You're going to get your usual spikes, Gulf tensions, Dow weakness, but the end of the day, right now, if you're in the neighborhood of Cushing, you're probably buying oil under \$50 right now.

The volatilities I said were going up. Here they are for West Texas Intermediate. Interesting thing on this graph, you can see the relationship of volatilities and price really breaking into two clusters: The high volatilities are the more recent prices, the lower volatilities is the cluster of prices

in the past; same decoupling occurring in volatilities in returns. Again, we're not in the crude market, but the crude market does set the pace for energy markets in general.

Natural gas, same thing. Henry Hub is basically where we price our natural gas in the United States, NBP, or the National Balancing Point, is where it's priced in the U.K. There are other hubs like Zeebrugge on the continent, but all these things are showing very similar results. We're likely in a world of six-bucks per gas for quite some time to come, again, subject to spikes from the usual suspects.

Let's look at natural gas prices over the last eight years. As you can see, we've had a couple of spikes. We had the Amaranth, we had the Katrina and Rita events, but beyond that, the prices are pretty much where they are, in the eight-buck range. And again, we can see the volatilities associated with natural gas over that period of time. So with that background, that's the market you're facing when you want to build a nuke. You're looking at six (dollar) to eight-dollar gas, natural gas. You're looking at incentives to build something short term rather than long term because of credit issues, and you don't see any near-term circumstances that might change this.

So if you're looking to build a nuke, your financing conditions are challenging and you have real serious construction risks, notwithstanding one-step licensing, you still got to build one of these things. Traditional thumb rules of financing generation in the U.S., that equity mix is about 50-50. You like to get recourse financing back by a balance sheet, a really strong balance sheet, a utility balance sheet that's very strong. If you get into the rate base, you're in good shape forgetting the revenue stream. If it's a merchant plan you're looking for a PPA to lock in the revenue in the years to come. In some cases, like Sandy Creek, a coal plant that was built in Texas a couple years back, they have natural gas puts in place if gas prices drop below six bucks. Those puts were probably worth a lot more today than they were when they were purchased.

Financing capitals, considerations capital at risk for at least seven years, maybe longer, and through the entire time of construction, the constructor or the utility will be facing commodity price risks and steel prices going up and down, vendor credit risk, ENC contract performance risk, the sovereigns, both the state and the federals, doing something that may devalue your project and of course the ubiquitous regulatory risk of building a nuke. You could have two different trajectories with building a nuke: a target project, which would love to see a plant build in seven to eight years, or an overrun project and a family of curves that transition. I just showed two different graphs to illustrate that in the first few years of construction, you may not know whether you're on the blue or the red curve. And even if you're on the red curve, you may not know that with much certainty until you get around years five or six on a typical construction schedule. So by then you're pretty well locked into the trajectory you're in. So you won't know your construction risks for quite a number of years into the project.

And of course, that means that the sunk cost can be significantly different. This shows a 50 percent overrun, which is quite benign compared to the typical projects that were built in the late '70s, which saw factors of three or more. And so at the end of the day, you could be looking at an \$8 billion power plant going to \$12 (billion) to \$15 billion rather quickly. And mind you, this would be better than the last time we had a go at this.

So do the companies that want to build nukes have what it takes? Do they have the equity, do they have access to capital markets that are vibrant and responsive? And do they have the expertise to collar the tail events, protect themselves from the construction overrun risk? I'll focus on equity and capital markets for now. This happens to be Exelon. I ask you, call the bottom on the Exelon stock right now. I could call a bottom based upon the top, but presently it's not necessarily doing well from a pricing standpoint. The volatility, as you can see, is also going up as the prices are coming down.

Exelon, like Dominion, are two top-tier companies in this industry. Dominion has done a little better in terms of how its stock has come off, but again, it's facing volatility in its pricing. Let's look at the short-term debt. The risk premiums on a short-term debt are spiking, just like the Vix is spiking across the board. We're seeing the volatilities hit the utility sector as well as the credit markets. The credit markets, I think, in terms of capital markets in general, are a real problem. We have some very serious back-splatter from the Central Bank's actions today. Banks are right now lining total spreads payable on loans with credit default swap rates. In other words, they're not necessarily looking at credit ratings anymore, because they realize those may not be as responsive to market conditions as what's happening in CDS markets today. Take General Electric, an AAA rated company. They sell the commercial paper to the Fed, it overnight rates indexed at about 100 basis points. That means they're getting debt at just under 2+ percent right now. But they're looking at the long-term bonds, are looking at 350 to 400 basis points above Treasury. So they're looking at seven (percent) or eight percent for their long-term credit. This is an AAA company, a marquee company in this country, in fact in the world.

First Energy, a company in Ohio, operates nuclear power plant, happens to be where we had a blackout a number of years ago, currently has access to \$4 billion liquidity. Just a month ago, they entered a \$300 million, roughly one-year secured term note. Tied to the Libor at 300 basis points premium plus the sum of the spreads on the defaults for First Bank and the Lending Bank just happened to be Credit Suisse.

So bottom line, the ratings now are less important than the CDS evaluations and we're getting volatility in credit markets. And of course, we see the evidence of this in terms of First Energy's performance as well, this is their CDS, their default swaps. So the bottom line. We may have gone from a Fannie Mae distorting mortgage markets to potentially a Federal Reserve Bank distorting credit markets. The upshot is, we're pricing long-term debt at essentially market rate for risk premiums and for companies facing investment decisions, it's not a good time to be committing

to a risky construction program of any kind. That doesn't mean it won't get better in six months or a year or two years, but right now, all we know is where we are today.

So what would you do with your 401 K or your kid's college fund? What return would you expect to see in light of the current conditions and as the conditions are envisioned to be in your future, and what guarantees would you demand? And once again, how do those investment opportunities compare against what happens to be my favorite investment, the First National Bank of Tempur-Pedic. I appreciate your interest and your patience. If you have any questions, here are some of my contact information. Please, no letter bombs. But seriously, if you have any questions, give me a call, send me an e-mail. I'll be very happy to give you additional information to the extent that's helpful, and I enjoy debates. Thank you very much.

(Applause.)

MS. SQUASSONI: Thank you.

MR. GOLDBERG: Can we do this?

MS. SQUASSONI: Next we're going to hear from Steve Goldberg.

(Off-side conversation.)

MR. GOLDBERG: No, I don't know. There we go. Before I start, there are seats in the front here, so if people want to, or those who are standing come on up to the front of the – and –

MR. GOLDBERG: I'll just figure out where the slide show is. I just want to do the slide show.

MR. GOLDBERG: There you go. Okay, perfect. Good morning, and I echo both Steve and Sharon's welcome. A very not-so-nice day in Washington today, I guess the topic must have attracted you as well as the timing. We're about 10 days out since the election, and a lot of things are changing, and in my past I used to be in the bowels of writing transition papers, and I do remember fondly the transition between Democrats and Republics twice. One in the, when Ford left and Jimmy Carter came in, and I guess I got involved in some degree in a famous statement that was made by that time, the president that stopped reprocessing and also further R&D work on fast reactor development, the LMFBR reactor. And then of course in 1992, 1992, I actually was at OMB and did get involved in putting together the first Clinton budget, which included issues involving uranium enrichment, also fast reactors and other things. So it's an exciting time and I think it's kind of an interesting time because things are going to change. I don't know if they're better or worse, but they're changing.

I first want to thank the Carnegie Endowment for inviting me to speak today, and I hope that my talk will be of interest to all of you and we look forward to all your questions. With that in mind, I'm going to start.

I want to give you a little background to the presentation today. We did, back four years ago, we did, in collaboration with the University of Chicago – our laboratory is very connected to the universities in the Chicago area – a study with students from the university called the Economic Future of Nuclear Power, which I have in front of me here. And that study, as it's turned out, was useful because we did analyze a number of the policy options that were actually put together in the Energy Policy Act of 2005, particularly loan guarantees and production tax credits. We also looked at some other things that were not adopted, but, such as investment tax credits and accelerated appreciation, but we did it in a way that was very parametric and looked at the what-if, in terms of competitiveness of nuclear energy to other sources in the base load area, such as natural gas and coal.

I also discuss today what has changed since the report was done. I am going to be a little different than taking Steve's view. I'm going to actually be a little proactive in terms of what we could do to make the situation better for nuclear energy in a time that's very high-stress from a credit standpoint, as Steve points out. And finally, I want to just leave you with a parting thought: If we don't change the paradigm, where are we? So with that in mind, it is clear, and I want to just lay out what I think is true, regardless of what happens with the election, that we have some issues that we're going to need to deal with, which are climate change, which you've heard of in many form, and that nuclear energy is a key component of going forward. Energy security is another key issue, and we need to think of our inputs to electricity from an energy-security standpoint. It is true, also, as I think should be pointed out, that nuclear energy continues to move toward cleaner power.

If you look at the uranium enrichment process that's going on as we move forward in the United States, we're moving out of gaseous diffusion, which is a high electricity-intensive industry, with coal being the source of that power. And we're moving to much more efficient use of electricity, going into centrifuge and potentially into laser-enrichment. And on proliferation, I think I pick a point that Sharon and her organization is interested in. It's going to have a further height and focus. It's very clear as we move forward with the new administration that nonproliferation is a key issue and we're going to have to look at expanded fuel-assurance programs, something that we have, our laboratory has been engaged in, and we put together a number of papers. In fact, I met Sharon a couple of weeks ago at an MIT forum and the subject was fuel assurance.

This was basically a synopsis of the study we did in 2004, and you notice the numbers are very low. Overnight costs have gone up much greater than those, and this is just in four years. But what it does show is a couple of things that should be pointed out. One is that we assume the seven-year construction schedule, and we assume maybe as time went on, as we got to the fourth

and eighth unit – so if you got out at the first movers and moved into a standardized approach and got into lay your plans, the prices for electricity start to drop.

There are three takeaways from the study which I think are still true today, and I think Steve points out, I think, all three of them in his presentation. The first one is that risk premium paid to bond and stockholders is a very influential factor to judge the economic competitiveness of nuclear energy. That dominated the calculation and continues to document the calculation. And one has to look at two factors when they look at risk premium, one is a non-quantitative factor, the other one is a qualitative factor. The non-quantitative factor is the thing that we really don't know yet and we have not completed, and that's how long it's going to take to get our Part 52 license, the so-called one-step license that was passed back in the early '90s. And the other one is the quantitative risk, and that's the risk of default, and something that Steve brought up in his presentation. The third point is that, and it kind of reinforces what the numbers show, the success of early movers will be important indicators to all markets, including the financial markets in going forward.

What is going on in the landscape? What's going on are things such as, we don't have enough people to do the work. We have a shortage of trained craftspeople as well as engineers. We have a bottleneck in our infrastructure in building these plants. Whether they're built in the United States or abroad, we have limited large-scale forgings, our large manufacture components capability is still limited, although it's trying to expand in countries like China and Japan, and I understand that Northrop Grumman is going to be working with AREVA on a possible facility down in Newport News, and the logistics are still difficult. We don't have enough project management support.

The third point is, and I'll get to it, is that we have this issue with commodities and currency fluctuations that do make a difference when it comes to spec'ing out these plants. And as we get more into detailed design effort, it's guaranteed these overnight costs will change again. They'll probably rise, actually, as witnessed by what's happened in Finland. As we go into these detailed engineering changes, there's going to be changes in the overnight costs.

Well, if we bring ourselves to November 2008, Duke comes out and puts out an \$11 billion price tag on their two units in South Carolina, which is a whole lot larger than we ever have seen before. Clearly, it was driven by commodity prices. But let me tell you, commodity prices are like New England weather – just wait a minute and it will change. And what happened in one day, I don't know if people watch commodity prices, the price of benchmark hot-rolled coil dropped 42 percent in a day. So it's a very interesting thing to try to price out a plant when you've got these commodity prices swinging widely.

The issue though is with nuclear plants that make it very unique is that they are very long in the gestation cycle. Therefore, it's very hard to predict, even though commodity prices might have flattened out, literally, in the last month or two, it may rise again by the time we really start constructing these plants.

There was a very interesting report done by Moody's just about a year ago which I think is still true. It is clear, no matter what energy you pick, going forward, electricity rates are going to rise. It is clear our expectations for new nuclear is a bit ambitious. The costs that we've seen so far are so-called early best estimates, and the best one they pointed out, and I'll kind of translate the last bullet in very simple language – Moody's is trying to say, don't leverage it too much because the more leverage you put on this, the more we're going to hit on your rating and the more you're going to have issues going forward.

So as we move to the next step, as you well know, EPAC 2005, there was the passage of a long-guarantee program, and DOE right now is very busy reviewing applications for \$18.5 billion, and as we note today, representing those who have applied \$22 billion of loan guarantees. So we have a little bit of a mismatch between those expectations versus what we think is going to happen. But going beyond that, there is something called the credit-subsidy cost, something that I get very interested in my previous life at OMB because the credit-subsidy cost will be what the developer needs to consider when they go forward with their project. And it is tied, and I actually was listening very carefully to Steve and saying that ratings are less important and credit default swap pricing is more important. However, in a way, the credit subsidy cost criteria have been written, both by DOE and also in A-11, which is the OMB criteria, it is built on the rating process. So there is a rating process that goes into this. And at the end of the day, sometime maybe next year, all of this has to be cleared by OMB.

Now, taking all these stressful things that we both have been discussing, I kind of want to move you to what we can do to help ourselves out, to make, maybe, a difference in producing better results. Well, we do know that it is a step by step process, and step one is something we've been working on today. Step two, something that the oversight panels have been telling the government to work on in the future.

Step three, some suggestions of how we could help the situation in nuclear energy in this stressful credit crunch. And step four, something that my laboratory very much is engaged in, science-based engineering tools, which I think at the end of the day would make a difference as we move into – if we want nuclear energy to have a vibrant future, to really solve the carbon problem, for example. Well, the first one is kind of a recap of things already on the table that we're working on: standby risk insurance, loan guarantees, PTCs, we know about the extensor of Price-Anderson, and most recently, I think it was the last day of October, Dewey announced a format or a procedure or even a contract that could be signed for new licensee called the Standard Contract for New Licensees.

Having said that, though, the oversight panels have suggested that we do a couple more things. The National Academy came out in a report a year ago and suggested we really need to work harder on the so-called 2010 program, which is not 2010 anymore, but it really means the next, this

generation's three plus reactors. We need more support, not less, we need higher quality applications going to the NRC so they can move faster, and we need to be more standardized. And as you probably know that right now, I believe there are five designs being considered across the board for all these different people going into the COL process. That may be too many designs, for example.

The other thing going forward is, there needs to be a more robust structure on the back end, not just in financing but also probably in management. That's still an area that probably the new administration's going to have to tackle going forward. This is an area that we have learned in the studies our lab has been working on with the Department of Energy in the financing area and in terms of work that we did in 2004 and recent studies we are working on today overseas. We think there are opportunities for joint financing with end-users. I'll show you what you can do with a carbon cap-and-trade option and I'm going to talk a little bit about these PPP arrangements, the so-called public-private partnerships.

In the first case, I think that nuclear energy would be well-served to try to connect better with the end-users, including the plug-in hybrid folks and the people working the smart grid. It has a lot of good optics; it looks like we're expanding the clean energy jobs. Jobs are very important today – we talked about credit, but jobs is becoming an even more critical issue. It will show reduced dependency, more direct reduced dependency on petroleum products. As you know, nuclear energy historically has been more of an electricity busbar where petroleum has been a minor player, but if we could get in and show that we do make a difference in transportation fuels, it would make a difference. And the last one, which I'm engaged in directly right now in doing a study we're going to finish at the end of the year, is the connection between nuclear energy and sustainable water, particularly in areas that have water issues. And it is true that there are a lot of technologies that could be coupled with nuclear energy that could make a difference in producing water.

If we were able to do that, the prospects of financial entities moving in to this might improve. We've seen already – if you do water, for example, and you are in regions, arid regions, organizations like the World Bank are more amenable for financing. If you do a PHEV sale and the customer, the end-user, wants to buy a bulk purchase of electricity guaranteed to feed the PHEV market, that opens up the idea of a power purchase agreement, which also would help in the credit quality of a project because it gives it a lot more staying power that you have a guaranteed price and a guaranteed supply arrangement.

This is coming out of our report in 2004, but it's probably true today. If you disregard the numbers, per se, because the number in the lower left is probably low, because now coal and gas fired have gone up in price. But you look at the delta with and without greenhouse gases, there's a huge delta difference between the two. When we did our analysis, we did not assume an embedded carbon price of so many dollars per ton, we rather did it based on what we understood the technology that you need to sequester and capture the carbon would require, the transport, and

eventually the storage. And the storage costs are not insignificant. So we did an estimate back in '04; it may be a little bit out of date, but there is a dramatic difference between the two.

And if, for example, the government decided to have a carbon policy of some sort of a cap-and-trade, it could very well be that they take 50 percent of the revenue – and this is just an illustration – and invest it in R&D, and the other 50 percent would go back to the generator as cost avoidance and that would be a big boom to nuclear energy because it could underwrite 25 to 50 percent of the investment cost. So there is, there is some real attraction. Carbon has a bigger hit on the effectiveness of a going forward on the value of nuclear energy than probably the loan guarantee does today.

The other possibility, something called the power purchase – I'm sorry, the private-public partnership, kind of a pseudo-TVA. I don't know if people know, but TVA was created in a time not too different than today, back in 1933 when we had job problems. We had issues in our banking industry, and we created these government entities, pseudo-government entities. And I did an example – for example, if we get a fully loaded plant at \$8,000 a kilowatt – which is probably high, but maybe not too high, and the capital cost share was 40 percent of the fully loaded cost.

The loan guarantee basically could cover about 20 percent of that, or about \$640 a kilowatt, but if you did the PPP, which is basically where the government picks up and takes half of the risk, essentially, that could rise to \$1,600 a kilowatt. So the PPP would have a bigger impact on some of these costs than right now the loan guarantee does.

The fourth step, and the one that I think that has the greatest staying power and the one that to me needs to be developed in parallel with everything else, is really expanding our science-based engineering tools. You see a picture in front of you; that's our new computer capability. We'll have it in our laboratory. It's the Blue Gene/P, and the goal here is that we can simulate basic processes. And, frankly, the way the regulatory process is set up in nuclear is we have margin on margins on margins, which are very necessary because of uncertainties.

We do PRA analysis. We do a lot of things that require – Steve and I were talking about Appendix R, for example, equipment qualification. There were a lot responses to that – were responses on top of responses on top of responses. If we were able to pinpoint more exactly behavior in the scientific way of basic processes, we could start brining some of these so-called premiums down a bit, maybe bring these capital costs down in return. It does require a more robust relationship with the resource organizations, the regulatory community and the commercial entities.

And another area that I believe would have great impact is materials. Materials are really the kind of holy grail for solar power, the holy grail if we ever did hydrogen, the holy grail if we do – when we go forward with batteries. It is also important in nuclear because of our aging issues on material degradation. It's true when we put fuel elements together. If we are able to get smarter and

better materials it would make a difference. What you see before you are carbon nanotube dimensions, and those carbon nanotubes are used very directly for our thermal electric power generation possibilities. So we're doing a lot of research at our Center for Nanomaterials.

I have a few conclusions and then I'll give you my final thought. Nuclear is needed if we're going to make a difference in our climate change. We're going to need to do all four things, as I described earlier, to make a difference. That includes getting a start on our early movers, having more collaboration on generation three licensing, thinking about these alternative financing arrangements, and moving out on science-based engineering. And I think the key to all this is that we have a viable and vibrant future, which means we need to attract – and I think our lab tries very hard in this regard – the best and brightest engineers and scientists that we can find, that we can bring into the field.

To leave you with a final thought, I think we're all in the game together, including our friends at the lemonade stand because we're all worried about whether the next bailout – where it's coming and where it's going, and as I kind of leave you, this issue has hit everybody, including my old profession, when I used to be a lemonade salesman, and I think the prices are dropping and they're actually looking for bailouts as well.

Thank you very much for your attention.

(Applause.)

MS. SQUASSONI: Thank you, Steve and Steve. We can leave that cartoon up. Let's start the question and answer session. While you're gathering your thoughts I might take the prerogative of the chair and pose one or two. To Steve Goldberg, what do you think the prospects are for increasing the loan guarantees?

MR. GOLDBERG: Well, this is a very good question. First of all, let me – can I step back one moment, Sharon, and ask about the 18.5 billion (dollars) so people understand? And I'm going to talk at this point from my knowledge of the subject, not so much where the laboratory views are because we don't really do much in loan guarantees.

From my own professional background, the \$18.5 (billion dollars) is an amount of money that gives you a sense of how many projects you can finance in the aggregate, and if you look at the Duke estimate, there aren't too many. (Chuckles.) It doesn't really deal with the actual scoring of the costs that if you have to pay a credit subsidy – for example, when Standard & Poors did a quick estimate for a typical 1,000-megawatt plant and they assumed a BB or BB- rating for the security, they came to a calculation of roughly \$280 million for the credit subsidy costs. That's the first – it's not necessarily when it will happen, but that's sort of an illustration. That number is independent of the 18.5 (billion dollars). That's where the developer of the project has to come up with that

amount of money to go forward with the project. So the 18.5 (billion dollars) is simply a number that's out there from the standpoint of how large the project should go.

Now, back to Sharon's question. My sense is it's going to be difficult to raise that number because it's competing with other priorities probably going out there. We've got so many more now than were there when they put the 18.5 (billion dollars) number in the first place and it's going to have to be a sense of the Congress – the Congress is going to have to deal with it. I know the authorization is through appropriations, which are not exactly – you know, they're one year or, if we have a CR, another year, but they're not indefinite.

So we've got an issue here where nuclear will have to balance out its priority with everybody else, so I can't really render a judgment yes or no to answer your question, but I can say it's going to be challenging.

MS. SQUASSONI: Steve Maloney, I have – I don't know if you have a comment on that.

MR. MALONEY: Well, yeah, I think Steve mentioned the competing priorities. One that I don't think was considered was the fact that Steve and I are forming a bank – (laughter) – at the end of this session, and I think that's a very high priority that our bank get some subsidies and liquidity. We are in desperate need of liquidity. I'm sorry.

MS. SQUASSONI: My question for you: You said – which I thought was really interesting – in your presentation that the banks aren't looking at the credit ratings of these big nuclear companies, but rather at the – let me see if I can get it right – credit default swapping.

MR. MALONEY: Swaps, yeah. I think what I was saying – and if I misspoke, I apologize. I think what I was saying at the moment, the banks are providing loans to utilities and companies like GE, which is AAA rated, tied pretty much to the pricing of the swaps plus some risk premium. Now, that's what they're doing today. Whether they will continue to do that, it's unclear. However, I think – my own personal view is that the rating system has clearly failed quite a number of investors in the last few years and I presume that there will be some revision to the rating system, to the NSROs whose function it is to provide ratings. So what happens going forward is unclear, but at the moment the swaps are pricing the risk.

One other thing which I might add is that as part of the ongoing revision to the ratings process – I know that Standard & Poors, for example, is considering extending its capital adequacy model from what had previously been focused on risk capital associated with PPA, the purchase power agreements, to the more generalized trading and credit risk functions associated with energy procurement. And the net effect of this will be to require energy companies – utilities for example – and companies that have an active role in the energy market to have adequate risk capital to

accommodate the credit and market risks that they face, not unlike the risk capital that banks must also carry.

And so the net effect of this will be – and I think we’ve seen some evidence of this in the last few months with some companies – potential downgrades from perhaps a BBB-plus to a BBB, equity haircuts, all of which work against the market capitalizations the companies must take forward in financing any generation, nuclear or otherwise.

MS. SQUASSONI: Let me ask this question because I don’t – and then we’ll take questions from the floor – I don’t recall doing that well in finance in graduate school. Going back to GE, which is an AAA rating, what you are saying, because of this adaptation of the market, is that their loans are actually more expensive than their AAA ratings would suggest?

MR. MALONEY: Otherwise indicate.

MS. SQUASSONI: Okay.

MR. MALONEY: At the moment the money velocity is near zero in terms of commercial paper. Obviously that’s not sustainable, but whether the government’s actions are cause or effect, reinforcing or simply correlated, it’s clear that the cheaper loans are available from the federal government today and the banks are applying what they see to be the risk premiums associated with the uncertainties that are evident in the market. And just to put things in context, however, the last time we saw the VIX, which is a measure of volatility in equities, at levels that we’re at today was in the aftermath of 9/11, and obviously the VIX came down. The market was closed for a week or two, as I recall, and then the markets reopened and the VIX eventually came down.

So to also put this all in context, we go through these patters. These are recurring patterns that our economy suffers – periods of high volatility and such. Whether this is a systemic change or simply the latest crisis I don’t presume to guess, but at the moment this is not necessarily a great time to go out for a long-term loan.

MS. SQUASSONI: Okay, thanks. I’ll take a question from the floor over here, please.

Q: (Off mike.) Oh, I’m sorry.

MS. SQUASSONI: Oh, please identify yourself.

Q: Yeah, Arthur Pilzer with Bechtel Financing Services. We know that the DOE loan guarantee program is really the only game in town right now for building nuclear in the United States. Most of our G-8 partners are also considering building new nuclear – the British, the Italians

maybe, even maybe the Germans. Are any other governments considering a DOE-like or similar type program to jumpstart the financing of nukes in the G-8 that you know of?

MR. MALONEY: I'm unaware of any. Steve, you may be a little closer to that.

MR. GOLDBERG: When we did our study in Europe, there are some folks that are working that. Now, it is clear, for example, EDF in France, in their going forward they're doing their plant – they have a plant out in Flamenville. They're in a more PPP category where they get some government support already in the process of their investment. The U.K. recently did a kind of – when Tony Blair was the prime minister, and it has continued with Gordon Brown, they did a review of nuclear energy and they really do need to replace their aging plants. And they are considering – I know they're looking at siting processes that are more streamlined. They're also considering – I don't think there's anything on the books now – new financing tools.

I don't know if they're going to duplicate our loan guarantee, but I will say Kyoto is now in place in Europe, and that has some impact on their decisions. And if you recall my slide I put out in the presentation when we did our analysis of carbon – with carbon policy, without carbon policy – that when we did our study in Poland, for example, just for Kyoto Phase I, not Phase II, it does help nuclear to some degree, in the neighborhood of five to eight percent on the busbar cost. So even though they may not have an overt loan guarantee out there, because of Kyoto it does help support choices on nuclear energy in Western Europe.

MR. MALONEY: Steve, would it be fair to say, however, that the Brown government has not made a final decision?

MR. GOLDBERG: Yes, that's correct.

MR. MALONEY: There is quite a bit of controversy over this right now.

MR. GOLDBERG: That's correct also.

MR. MALONEY: Okay.

MS. SQUASSONI: Let me follow up just with a more general question. How unique is the U.S. market in this respect, because when you look at 30 countries potentially looking at nuclear power, there are questions about whether the market, the electricity market in those particular countries are regulated or – you know, those kinds of things. Is the U.S. market unique?

MR. GOLDBERG: Well, there's no one U.S. market. I think that's a fair statement. We have – you know, federalism is alive and well in electricity. You know, TVA is TVA and –

MR. MALONEY: ERCOT is ERCOT.

MR. GOLDBERG: And then we have the Western Power market, which is something – I'll tell you, back in the early time of my life, every year we put out the idea that they'd have to get federal – commercial rates for their loans and every year it gets turned down by Congress when I was at OMB. So there's subsidization going on all over the United States. So it's not a common U.S. market.

It is true – if you go to merchant plants in the United States, there is similarity with those merchant plants and what is going on in pockets around the world, and there are merchant operations going on. So we could make some apples to apples comparisons on the merchants. When you get to regulate it, it gets kind of skewed depending on the regulatory process. But, Steve, you may want to add to that.

MR. GOLDBERG: Yeah, I would say that certainly the U.K. is very different from the French market, if you look at electric power markets, and they have an interconnector which provides the capability of swinging power between the continent and the U.K., which creates some interesting dynamics given the fact that they have a system operator in the U.K. and the French market is a bit more dispatch oriented.

So I don't think you could say that – and of course PJM is very different from, you know, other markets in the United States as well. So I do think it's hard to generalize. I do think, however, that where there is some unique aspects to our market compared to other countries, it's that small changes here tend to get magnified in other countries and so the dependence of other countries on our economy means that you have a ripple effect into those economies that can be amplified. You have both the first-order effects within their own country and then of course the decline in earnings. And of course we also have the currency effects, which have another important factor. So these are very coupled dynamics and I believe that the amplifications can be particularly severe for some countries.

MS. SQUASSONI: Miles and then Steve – let's take two questions at a time – and then we'll do Charles and Henry.

Q: Miles Pomper from Arms Control Today. This question is for Steve Goldberg. I guess I'd like to challenge one of your presumptions that nuclear is necessary for climate change. You're making that assumption rather than – you know, as you say, if climate change is so important, but the tax on or put cap and trade and let's see how nuclear does. I mean, I don't see why we need to do things on top of that if our goal is to deal with climate change. So if you could defend that argument.

MR. GOLDBERG: First of all I want to say hello, since we communicate with each other on a blog. I don't know if people read the Bulletin of the Atomic Scientists, but I'm in a group with five – four others – and Miles and I, we're doing a blog, one after the other after the other, so I'm responding to Miles and he's responding to me.

MR. MALONEY: Are you the Red Sox and he's the Yankees?

(Laughter.)

MR. GOLDBERG: Yeah, maybe that's the response, yeah. The Red Sox aren't going to do too well next year, by the way.

Anyway, the assumption that nuclear energy is necessary to deal with climate change, okay, I'm not the expert. I will deal with the Socolow famous wedge. I think that's a nice place to go back to, although others may not agree with that either. And if you go even – I think McKinsey did a nice curve also, that came out about a year ago, that also says it. Okay, you take nuclear out of the equation and then you have to make everything else perform better, faster, et cetera. We at our laboratory do all the things that are needed. We do our efficiency work, we do work on the battery, we do work in clean coal, we do work in working on the grid, we do nuclear. So we're trying to work across the board.

Now, the thought I have – and I'll say it's a personal thing – is that why I say nuclear energy is important is that carbon control is important. If you take that as the going-in position, that we've got to get our handle around carbon control, then we need to be thinking, how are we going to get there? And the pathway to get there without nuclear, taking it out of the equation because effectively nuclear will not be there in 2050 or so, since these plants, like Steve and I, we're aging and we're not going to be here maybe in 2050.

MR. MALONEY: We're timeless.

MR. GOLDBERG: We're timeless, okay. It really puts stress on everything else, and I think that's where I'm coming from, Miles. And I think that stress is at a level that's so high that I don't know if we can get there from here, and I think therefore, even those – I'll quote John Holdren – even those like John Holdren believe that nuclear has a role here to play, but it's got to be in a safe, sustainable, cost-effective way. And I think a lot of your question might be actually based on the fact, has nuclear proved itself being safe, sustainable, cost-effective? Can it handle its waste? And that's the area that I think is a question that we have to deal with, and I think that's maybe what you're really asking.

Q: What I was saying is why doesn't the market sort that out once you put the carbon tax on?

MR. GOLDBERG: Oh, yeah, in fact I think it does work itself out to some degree if you put a carbon policy in play. It will work its way that people will make the cost-effective economic choices. And our analysis that we did in '04 is a carbon policy has a more dramatic impact on fuel choices than almost everything else.

MS. SQUASSONI: Thank you. Steve, in the back.

Q: Steven Dolley with Platts. I think – and this is for everybody on the panel – pretty much ever since the 2004 Chicago study we've been seeing in the various analyses the same laundry list of risk variables. Everybody pretty much seems to agree on what they are. But when you drill down, some of them are hassles, some of them raise costs, some of them raise risks; some of them are potentially show-stoppers, and I'm thinking here specifically about ultra-large forgings. Right now, pretty much only Japan Steelworks can do that. There are only so many hours in the day and so many places in line and so many assembly lines there. I know AREVA has some initiatives underway; other people are looking at things.

But what I'm interested in, from the financial analyst perspective, is are the differences in these variables being effectively weighted – i.e., are some of the ones that can potentially stop a project being weighted more heavily? How is that being weighed? And from a financial market and analyst perspective, are there views of things there that can be taken to mitigate these risks, given you can't just throw up an ultra-large forging factory overnight or even in five years?

MR. MALONEY: Yeah, it strikes me that most of the analyses I have seen done have been best-estimate analyses. Even when they provide a range, in my experience the range tends to be a somewhat limited range, limited by a number of assumptions that they consider and other assumptions they don't consider. The difficulty to me that any analyst would have is how do you project forward five, seven years? What will happen with coupled, complex projects in uncertain markets when we have a very difficult time giving, in a market sense, a prediction of energy prices a year from today in electricity markets, particular for some very liquid markets?

And so I'll just say that my own view is that I have a lot of skepticism in terms of the estimates, the standard error about those estimates, for all the reasons and then some – all the reasons you've mentioned and then some. That doesn't mean that it's an insurmountable problem, and I don't want to leave the impression that I'm just saying that it's a world of woe. I'm simply saying that it's a lot of challenges out there but if you're serious about trying to solve the problems, you have to take, I think, a very realistic view of the risks that you're facing and come up with perhaps a more robust approach to managing them. Otherwise we're almost akin to basically securitizing a lot of mortgages and putting them on the market, assuming that the risk is manageable and the market can absorb it.

So I think you're right about the forgings. I think you're right about some of the constraints in the supply chain. I think Steve pointed out many of the concerns associated with the labor pool. I would say the organizational maturity of today's electric utility, many of whom no longer have the engineering departments they once had, many of whom no longer have the construction management teams they once had. To manage a vendor, a quality vendor like any of them out there right now who are E&C contractors on nuclear projects, many of whom have never really been through this large, complex undertaking, and to have an accurate estimate of risks and risk mitigation measures I think is probably the biggest threat facing the nuclear industry today going forward.

MS. SQUASSONI: All right, Charles Ferguson in the back.

Q: Charles Ferguson, Council on Foreign Relations. A question to both Steves. And seeing as it's the political town and we just had the election, how does the election of Barack Obama affect the prospects for nuclear power? I mean, during the campaign he, unlike Senator McCain, did not specify a goal number of reactors. He did not rule out nuclear power and he did say his biggest concern was cost. And he raised the question of whether all that billions upon billions of dollars would be better spent on perhaps other technologies: wind, solar, smart grid. But, you know, it gets to Steve Goldberg's point about coupling the smart grid and the electric car industry more into the nuclear industry. Perhaps that could be a winning strategy to get Senator McCain and President Obama to support nuclear and have a Republican and Democratic coalition.

MR. GOLDBERG: Charles, I didn't give you that question, did I? (Laughter.) I guess I need to answer it since our laboratory is in the state of Illinois. And we're euphoric about our senator there being elected. And it was a great – I wasn't at the rally – but there was a great rally there at Grant Park not too many days ago. The answer is – and I'm going to go back to the fact that – I don't think we know the answer and I think that's something that is being developed in the process and, you know, living through this change before, as I said earlier, when I was – I hearken back to the 1992 election, and there was definitely a different view about nuclear energy than their predecessor, when George Bush Sr. left and Bill Clinton came in and Al Gore came in.

And I did notice there was – there were changes, but I have to tell you, there were changes but there were also things that were ratified and continued in the new administration. And one I can think of – if Anne Neely's in the audience, then she will attest to this – both administrations strongly supported the AGU agreement, for example, with the former Russian Federation in the interests of nonproliferation. So there are areas where I think we will not see much change. I do believe – and Charles pointed out – that nuclear – if it were going to be vibrant and be – connect better to a degree with the way I think the overarching policy that's going on with the new administration.

The connectivity with, you know, the clean cars, the hybrids, the grid, and doing things in a sustainable fashion, because I think the area of sustainability will be a very key area that, to some

degree, was captured in this administration in some of its projects, but it will be even more emphasized in the next one. And our laboratory doesn't know where we're going, because we're waiting for the new people at the Department of Energy, but we do believe that the projects that hold the most promise are the ones that can continue and carry forward in a very strong way.

I do want to address one thing: I know the question there was on forgings, but I believe the bigger pinch point than forgings – because, somehow, money and time can correct forgings – but money and time doesn't always correct lack of skill, and we've got an issue here in the university business here in the United States where we need more strength in science and technology and brighter people coming in to field the playing field of nuclear energy as folks like Steve and I leave the workforce. So I think that's the one that money and time doesn't always give you and that risk, although not very easily quantifiable, is a risk that's out there for making nuclear energy a probability in the future.

MS. SQUASSONI: All right, Henry is next.

Q: Thank you very much. Henry Sokolski, the Nonproliferation Policy Education Center. First, thank you for holding this really timely event. The first thought would be, there seems to be, right now, a trade-off perhaps, between urgent pain in the economy and long-term aspirations – I'm being gentle. There is a paper that is out there that my center commissioned. It's by Steve Thomas, who will be giving this paper next week in London.

And he characterizes the choices for Obama to be, roughly, benign neglect, build, perhaps, three plants with the 18.5, or – and I quote – “cave in to the nuclear industry demands for a blank check,” or what I call federalizing or making nuclear part of the federal infrastructure, which, I think, was the gist of a lot of those recommendations. You make all sorts of integrating moves. The question I have for the two panelists is, do you think the market investors would feel more confident with the Department of Energy officials trying to figure out what the default rates would be than bank analysts? (Laughter.)

MS. SQUASSONI: Steve?

MR. MALONEY: The quick answer is, what GS level would do the analysis, but, you know, I don't know what the market would say or do. I'm only providing my observation of what the market is doing and I think one of the lessons learned from the mortgage-backed security – the securitization idea – is that relying upon ratings does not necessarily give you a true measure of the risk premium. I think if there is a – there's always a positive upshot, although you may not realize it until after you get hit by it – that one of the positive upshots, I think, is the recognition that you can actually get a market price for risk.

And, you know, there are – I’m not showing for any organizations – but there are incentive markets, Hollywood stock exchanges, varieties of predictive market systems that are out there that will price the likelihood of something happening, from the Red Sox winning next year, which is, of course, you know a very important thing, to certain candidate getting elected or not elected. I believe that even Hillary Clinton had a low probability of winning the election going into October. So the market will still place a value on things and I believe that, you know, you could possibly get a government agency to take on some of those responsibilities. And I think the market will either elect to play and value it or elect not to play.

I don’t want to draw the analogy too closely, but many of my friends who used to say, in the old Soviet Union, they used to pretend to pay us and we used to pretend to work. And one of my concerns when you begin to disconnect reality from what the mass of people really feel is that you end up with some unintended consequences that can be very serious and prolonged. So I don’t know what the market would do if the DOE was valuing things, but we’re seeing some evidence right now, when the central bank starts valuing things.

MR. GOLDBERG: Sharon, I’d like to add, just very quickly – Henry’s question actually gets into the heart of something that I – in one of my slides, I talk about credit subsidy cost and I went back and looked at one of the notes to it. There is a process that goes on here that the credit ratings do come into play by the outside credit agencies and I think, hearing Steve’s point this morning, maybe the credit swap pricing should be put into play here – they’re more relying on the rating agencies. But it’s done on a project-based approach, so it’s a project-specific rating to gauge the probability of default and recovery.

Now, the assumption I gather would be that there would be an outside rating of these projects, they go into the so-called bureaucracy, but then it comes over to another level of scoring that goes on under A-11, which I used to do at OMB, and I do believe in my own mind, that process is actually a workable process. So I’m not as pessimistic, maybe, as some others, thinking that there’s going to be some giveaway in this process. There will be an accounting given on the value and the risk that those projects will have, and that will be metered out in this so-called credit subsidy cost process.

Now, the question comes up, once a credit subsidy cost is out there, how is it going to be dealt with? And there is some risk that Congress, because they believe a project’s so important to their district might appropriate funds for that project so that the developer doesn’t have to pay for that cost. That’s where I think – might be the area where you might see where the market gets kind of skewed – by the virtue of an appropriations action, which could occur in the future. So I just wanted to make that point.

MS. SQUASSONI: All right. Thank you. I have seven people on the list right now, so I'd like to take two questions at a time and then have responses. So Jim, you're first and then this gentleman in the front.

Q: Hi, Jim Riccio, with Greenpeace. Steve Goldberg had cited Pacala and Socolow as a reason for expanding nuclear to address climate change, but Pacala actually says if there were one wedge he would reject, it was nuclear, because of proliferation. And that seems to be echoed by Sharon's paper of two weeks ago. So I was hoping you could address the proliferation risk of expanding nuclear power in order to address climate change.

MS. SQUASSONI: And then, hold on – the second question –

Q: I had a follow-up question to about three questions ago, but I guess.

MS. SQUASSONI: That's okay, but identify yourself.

Q: Oh, I'm sorry. Ed Davis, Pegasus Group. This is directed to Steve Maloney and that is the notion of cap-and-trade system and having enhanced nuclear energy economics would make nuclear energy more viable. And I guess the question I would have is, it wouldn't seem to take away the front-end risk. Steve, you've talked in a very detailed way about all the front-end risk in terms of construction risk and the labor risk – in terms of all those front-end risks – those risks aren't going away, even if you had a carbon credit. And I was just wondering what your view was, even if we had a cap-and-trade system, what the relative economics might be?

MR. GOLDBERG: Okay, on Jim's question on the nuclear nonproliferation issue and – by the way, I wasn't – on the wedges, I didn't really – I took it as a structure, I didn't actually go to the opinions of the host who put it together. I'm just trying to figure out in my own mind how much each has to contribute so that we can meet the goal. On the nonproliferation issue, it is correct – that is a huge issue. And one in which – needs to be strengthened and we need more to do across the globe and it's going to be, I'm sure, a big issue for the new administration.

And I kind of referred to it in the fuel assurance discussion, and clearly, if we're going to make a dent in that, we're going to have to come up with projects and programs that are both making sure we forego reprocessing and enrichment in countries that are kind of – we're worried about. But moreover, we need to come up with a system, which we don't have now, that can deal with take-back of spent fuel, for example, and those are the kind of areas that still need to be worked out. So, to some degree, I do understand where you're coming from and we have to work harder in that area.

MR. MALONEY: Ed, to your question on the cap-and-trade, I have some experience in pricing CERs in Europe and so I – that is going to perhaps provide some basis for my comments on

cap-and-trade. The challenge, I think, that cap-and-trade is like many of the other assumptions that go into the valuations of a nuke that might come online in seven to 10 years is what the nature of that market is for emissions trading and what types of developments occur over the next seven to 10 years that might transform what our economic – what's the phrase – carbon footprint – happens to be.

And so I think the challenge of trying to price the benefits today is you're pricing the benefits of a market that was – in our experience to date, has been thinly traded. It is very volatile, has been very volatile, for which we have, really, not very much information. And therefore, it poses, notwithstanding everyone's forecasts of how the world will be, great uncertainties about the volatility or uncertainties in valuations will be. And this is something that would not materialize for some time to come; the benefits would not be realized for some time to come.

And so consequently, whereas I hear a lot of commentary that cap-and-trade will somehow rather level the playing field or provide a benefit, I don't doubt in someone's forecast, based on best estimate, ignoring all uncertainties of something that won't happen for quite a number of years for which we have no measurable experience, I just find it kind of remarkable that we're able to come up with some pretty good estimates of the benefits of anything under cap-and-trade. (Laughter.)

That's not a shot at cap-and-trade, it's just an uncontrolled experiment, and like all uncontrolled experiments, you can hypothesize what the benefits will be, but until you actually get in it and real people operate in a real market, it's very hard to estimate with precision what the benefits will be; I think more people will be surprised by those benefits, both to the plus and the minus, than what I think they see today. We'll look back on many forecasts and find them to be quaint and amusing.

Q: (Inaudible, off mike.)

MR. MALONEY: I see no evidence to put a benefit on it.

MS. SQUASSONI: There was a question all the way in the back – the young lady with the red hair, and then following will be Michele Boyd.

Q: Good morning, I'm MaryAnne McReynolds from the Health Oversight and Government Reform Committee. And I was wondering, in light of the intersection both with the financial concerns and with national security concerns, what kinds of congressional oversight initiatives could most effectively bring the aims that you both discussed into perspective for the next administration?

MS. SQUASSONI: Okay, and then Michele.

Q: So you got pushed back on the question of if we need nuclear power for climate change, so I'd like to push back a little bit on the question of if we need nuclear power for energy security. First of all, there was a question earlier about loan guarantees, which I find very fascinating – they're not doing loan guarantees in Europe, but they're offering our utilities loan guarantees. So France and Japan, through the governments, have said we'll cover some of the other part of the loans that aren't being covered by your government. Why is that? Not because they're being altruistic; it's because they're the companies that are building the reactors, and they're the companies that are going to get the jobs. So, related to the jobs question, S&P recently came out with an interesting report that concluded that, actually, most of the jobs are going to go to the Japanese and to the French; so it's not a jobs program either.

And, finally, the question of uranium mining. Last year, we imported – I think it was last year, or 2006 – we imported 90 percent of the uranium that we used in our reactors. And it is true that we are looking at new uranium mines in this country, but there's been a huge pushback from the Navajo nation not to do uranium mining on their land, and that is where most of the uranium comes from in the United States, so if you could address the question of energy security, I would appreciate it, thanks.

MS. SQUASSONI: So first on the congressional oversight, yeah.

MR. GOLDBERG: Okay. Well, this is not my expertise, MaryAnne. The things that I think congressmen will have to deal with – I think congressman in the center there is – is as we move, now, into a new part, going forward, the energy policy acts that have been passed – we probably should look back and see the effectiveness of those energy policy acts – both the 2005 one, which set up a lot of these programs we've been discussing today, not only in nuclear, but also in renewable and clean coal, such as loan guarantees. And also, we should be looking at the effectiveness of the most recent one that, I think, was passed in 2007, that is starting to set up these miles-per-gallon requirements, the so-called CAFÉ requirements, and its impact on the auto industry, the U.S. auto industry.

So there are a number of things that, you know, we could start by saying, how have we done so far, where have we learned from the past and what do we apply to the future? It is clear that a lot of the policies that were enacted by Congress over the last three or four years have been to the great degree segmented to certain industries. It doesn't appear like it's a national program where we have to meet a mandate of some kind. So that's something probably you might look at. And nuclear has to be in that mix somewhere in the discussion.

Regarding going to this energy security, that is a good question, because it is correct that to say that we are – we don't do anything in the United States anymore. We don't build anything, we don't manufacture, we don't – I mean, it's, what you're describing, what's happening in Japan and France, is true across a lot of sectors. I mean, between what we buy from China and Vietnam and

so forth. So the issue of jobs and where we create our jobs needs to be done in a very thoughtful, and in a way that makes sense. And I do know that there are technologies being considered in the United States, one being the American Centrifuge Project in Ohio, for example, which has been promoted as a jobs program for U.S. workers. So there are areas where, you know, things are, people are proposing projects that are directly connected with energy security.

As far as the uranium issue is concerned, I'll just make one last comment. Uranium mining hasn't really been in place in this country for a long, long time. And moreover, half of the energy, nuclear energy that we produce in this country is coming from blended-down high-enriched uranium from the former Soviet Union, so that the issue of uranium mines doesn't really play in a great degree in the current mix up going to 2013. Uranium mining really is driven by economics, and the economics is still much better to mine uranium where the deposits are richer and easier to get to. So it probably won't be awhile, it will probably be awhile before we have coming back a very vibrant uranium mining industry in the United States.

MS. SQUASSONI: Let me just put a plug in for my Carnegie report, which is the longer version of the policy brief. It'll be out soon, I take a very close look at this issue of energy security and, you know, what's hype and what's reality. We have three more questions. I'd like to take Pierce and Spurgeon and then I believe there was a question. I think the person in the back was third. Okay. Thank you.

Q: Pierce Corden with AAAS. One of the things about nuclear power as it's laid out is that you're not going to have a kilowatt-an-hour of energy available from the new cycle for eight or 10 years. So you say, and just all the upfront costs. If you look at some of the other technologies that are coming along, wind and solar, let's say, you can have kilowatt hours in place incrementally, sort of microscopically, if you will, and cumulatively over the next eight or 10 years.

If you look at all of the economic factors that you've addressed in terms of energy security carbon – hard to evaluate economically the proliferation one, but let's just say you cost out the value of safeguards. And you look at those in the nuclear area and look at them from the standpoint of the subsidies, what the taxpayer pays and what the rate is in terms of what the consumer pays and try to do a delta of those compared to what you would get by investing in renewables, solar and wind, let's say, can you, is it feasible to get any handle at all on that delta?

MR. GOLDBERG: Do you want me to respond now, or what?

MS. SQUASSONI: Yeah, we'll just be brief for the back of the room, I think that's easier.

MR. GOLDBERG: All right. I do, I have some number of wind energy clients, and I am also very familiar with the photovoltaic technologies. I think your point about doing a zero-out is an interesting, would make an interesting thesis. And I'm not against, you know, graduate theses,

they're very good. I'll say that some of the realities in wind energy is, it is, as you pointed out, subsidized. The locational issues, the volumetric risk are quite significant. You have what's called a shaping risk, which can be very quite significant. You have a significant basis risk in terms of where the wind energy is and where the demand is, and it's a rather complex problem, but you can price it and you can price the risk, both volumetric and market risk. I suppose you can do the same thing for all things, and that's pretty much what markets do.

The problem, I think, that everybody has is that I don't think – my own personal view is, I don't think anyone's single analysis is necessarily vibrant and robust, and so I have more confidence in clear market signals absent distortions and constraints, and necessarily selecting one technology over another as a reasonable mix, because I think that one of the intended consequences of distorting market signals is that the market signals are distorted, and control systems don't behave well. They tend to hunt or they tend to drift when you introduce bias of various different kinds. The short answer is, I don't know what the answer would be, and frankly I don't have much confidence in any one analyst, GS-11 or higher necessarily is going to be any smarter. But I could be wrong.

MS. SQUASSONI: Thank you. Spurgeon?

Q: Spurgeon Keeny, Council on Foreign Relations. Could the panelists briefly summarize what is the status of proposals to proceed with nuclear power in this country, and in any of the cases, has the thinking got to a point where, aside from hoping for government subsidies or guarantees, have any other proposals explored the availability and cost of market financing?

MR. MALONEY: You want to summarize the plants – (inaudible, cross talk) – at the NRC website?

MR. GOLDBERG: Yeah, yeah. I think there are a lot of folks who are in the game, actually, a lot of projects, a lot of sites and a lot of companies. I think the driving force, quite apart from the fact that this is an expensive proposition and it's going to take a long time – Steve talks about all the risks in there – but there's another risk that these companies are facing if they don't hedge their bets, and that is, they don't know what carbon policy is coming down, they're worried about where they are relative to their demand, particularly in areas that still are growing, as the baby boomers move into vacation areas or second homes or their property, as they sell their property in the Northeast and go into the South, for example.

So there is this whole area of needing to expand their mix of choices. So that's what I think is really in the game here. Now, the prospects of where this is all going is really dependent a lot on federal policy. I mean, whether it's on loan guarantees or it's on spent fuel or it's on what happens to the nuclear regulatory commission in how quickly it will process these licenses. So federal policy will be in place almost on every arena and deterministic on how well these plants will do once they

get into the cycle. As far as the issue of market financing, maybe Steve can add something to that, because you're in the market.

MR. MALONEY: Yeah. I think that most companies that are in the game right now are basically trading options. You take a position, you file an application, and the value of the option of going forward, including the value of the option of your pressure vessel in the queue – you can monetize some of these things. So it really doesn't cost very much to trade in the options markets, and I think most of the companies right now are effectively trading in the nuclear option market.

I think Steve is correct that the carbon policy and federal policies will have a significant effect of tilting the table in one direction or another, but I think if at the end of the day the companies lack the capital base or the core competency to execute on a nuclear construction program and they elect to fold the hand just basically liquidate their positions in the option market, then my only comment to Steve's point about the carbon policy is just, it means that to me that they pay the carbon tax and they pass it on to the ratepayers. And so at the end of the day, the avoided cost of the carbon tax – call it what you want, but it is a tax – simply gets passed on to the people who go to work every day and now have one more tax that they have to pay.

As far as the shifting demand goes, I do agree that as demand shifts, it does place a premium on generating technology that can be locally placed and/or supplemented that can be deployed very quickly, compared to technology that is placed far away from the demand or takes longer to construct.

Q: No one has really a sure opinion, yet, option on market financing, at this point.

MR. MALONEY: I haven't seen anybody go much beyond the forgings and getting their applications into all the federal commissions and agencies, nor would I expect that they would go forward until they get a license. I'm reminded when I was in the FCC auction process about 10 years ago, there were many people who weren't even, who didn't have the adequate financing to deploy two gigahertz telecommunications, wireless telecommunication system, until they won the auction. Once they had the auction, you know, they won in auction, they won a BTA or an MTA, they're able then to turn around and seek financing, both in terms of investors as well as, in many cases, vendor financing for the build-out.

MS. SQUASSONI: Yeah. I would just add, there have been 19 applications for these Combined Construction Operating Licenses, but there have been no decisions yet, and so these companies have all put in about, I think, 100 – I think it's about \$100 million –

MR. MALONEY: Roughly.

MS. SQUASSONI: – to do this licensing process, to give themselves the option to build. But we're still, we're still, we don't know if they're actually going to build them, although there have been a few that – I think UniStar has ordered some ultra-heavy forgings. So that's an additional investment.

MR. MALONEY: Yes.

MS. SQUASSONI: Okay. One last question.

Q: Okay, my name's Michelle Marchesano from the Partnership for Global Security. I have a pretty basic question to close this off with. The events of the last few months in the global financial markets, have they affected the projections of global nuclear growth? Because a lot of the risks that we've been talking about are ones that we've known about for awhile, whereas what's been going on in the last few months was largely unanticipated.

MR. GOLDBERG: Yeah. Michelle, let me try to answer that. You know, I don't think there's one answer to your question. I think it's a function of where you are and where you want to be. If you're in China right now, or India, they've got a, you know, a situation where they're going to have to bring in nuclear as quickly as possible. So I think they actually may be insulated from some degree from this crunch, and it may actually work to their somewhat advantage because a lot of the steel and other components which would have gone elsewhere under there may actually move into their domicile.

So for some countries, they're moving ahead. In the Middle East, for example, there is interest in the GCC area, the Gulf Cooperation Council Countries, to move forward. They've got issues with economics and water, and so they probably are continuing their path going forward. Now, where we see, I think, issues, and Steve has brought them up very well today, when you go into the developed countries where their plans going forward are more nuclear, whether it's us or U.K., Japan, the credit crunch is having an impact, and –

MR. MALONEY: Yeah, no. Bear in mind that in Japan, this is a country that imports a substantial amount of LNG, Liquefied Natural Gas. And so at those prices, a lot of things become very viable. I think what, to your question that, what are the impacts on the market, well, GDP is slowing, therefore a lot of your forecasts that you are going to continue growing at a certain rate, you're now dialing back. Consequently, for some places, you're hitting the wall a little further out in time than you might otherwise have anticipated. I think that's probably the short answer in terms of near-term effects of the current conditions.

MS. SQUASSONI: Yeah, the silver lining may be that if the commodity recession may cause commodity prices to go down, which will make nuclear cheaper, but, you know, if you don't have the electricity demand, right –

MR. GOLDBERG: Commodity prices are bricked, but they're very volatile. Very volatile.

MS. SQUASSONI: So thank you all for coming out and thank you to both our panelists, I thought they were terrific presentations, really sparked a lot of questions.

MR. MALONEY: Thank you.

MS. SQUASSONI: So thanks very much.

MR. GOLDBERG: Thank you.

(Applause.)

(END)