NATIONAL PRESS CLUB LUNCHEON WITH DR. STEVEN CHU

SUBJECT: ACCELERATING INNOVATION TO MEET CLIMATE GOALS

MODERATOR: ALAN BJERGA, PRESIDENT, NATIONAL PRESS CLUB

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ALAN BJERGA: (Sounds gavel.) Good afternoon, and welcome to the National Press Club. My name is Alan Bjerga. I'm a reporter with Bloomberg News and the President of the National Press Club. We're the world's leading professional organization for journalists and are committed to our profession's future through our programming and through fostering a free press worldwide. For more information about the National Press Club, please visit our website at www.press.org. To donate to our professional development training and scholarship programs, please visit www.press.org/library.

On behalf of our members worldwide, I'd like to welcome our speaker and attendees at today's event, which include guests of our speaker as well as working journalists. I'd also like to welcome our C-SPAN and Public Radio audiences. After the speech concludes, I'll ask as many questions from the audience as time permits. I'd now like to introduce our head table guests.

From your right, Neil Roland of *Automotive News*; Derek Sands from Platts; Caren di Mergen [?] from *The Las Vegas Sun*; Arun Majumdar, Director of ARPA-E; Cathy Zoi, acting Undersecretary for Energy; Andrew Schneider, associate editor for Kiplinger and the Speakers Committee chair.

Skipping over our speaker for just a moment, Rod Kuckro of Platts. He's the Speakers Committee member who organized today's event. Dan Leistikow, director of the Office of Public Affairs for the Department of Energy; Mike Soraghan, energy reporter for Greenwire; and finally, Tom Doggett energy reporter for Reuters. (Applause)

The future looked bright for Dr. Steven Chu when he became the nation's 12th Secretary of Energy in January, 2009. Charged with helping to lead President Obama's efforts to combat climate change and enact a clean energy agenda that emphasized investments in alternative energy and a shift away from fossil fuels, he found early support that summer when the House of Representatives passed comprehensive legislation to cap greenhouse gas emissions and boost alternative fuel sources and uses. Then the road got harder. The Senate never agreed on a plan. Now, with the Republican Party taking control of the House of Representatives, the consensus of political observers is that such a sweeping bill is dead for the foreseeable future.

Chu and his department may have found another approach, however. Bolstered with tens of billions of dollars of stimulus bill funding, the department has given billions in loan guarantees to support new transmission and nuclear and renewable power projects in nearly every state. A personal cause of Chu's is to development collaborative relationships with international competitors whose governments are committed to the policy that Congress has failed to enact.

On November 15th on his Facebook page, Secretary Chu warned that the United States needs to work closely with both China and Japan least we risk falling behind in the race for the jobs of the future. The self-proclaimed lifelong geek is the first person to be appointed to a Cabinet post after having won a Nobel Prize, which he did in 1997 for physics. Before being named Secretary, Chu was Director of the Energy Department's Lawrence Berkeley National Lab. He's taught at the University of California and Stanford University, and researched at AT&T Bell Laboratories. He holds ten patents and has published 250 scientific papers.

He also literally walks the walk on sustainability and energy conservation. He often rides his bike to work and often walks the eight flights of stairs to his office overlooking the National Mall. Thanks for making your way here today, Secretary Chu. Please welcome to the National Press Club Energy Secretary Chu. (Applause)

DR. CHU: Thank you. I have to say a few things. First, I'm delighted to be here, of course. But also, most of my bike riding is on the weekends and I virtually always walk up the eight flights of stairs, much to the chagrin of my security, who have to follow. But anyway, what I want to talk to you today about is something that I feel very passionate about. Now, unfortunately, there was a little miscommunication and I spent Thanksgiving holiday preparing a PowerPoint, but I was told that is not in the policy so you're not going to see a PowerPoint. However, there are some slides being passed out. But I'll walk you through that.

I just should say most times PowerPoints are kind of boring, they're bullet points, speaking points, and they take away from the context of the audience. I would hope that in the future, PowerPoints can be used because they can be used to show images, and they can be used to show data. And I know data may be a new concept here in Washington, but I think it's a good one. But anyway, sorry.

So let me start. The title of this talk is “The Energy Race: Our New Sputnik Moment.” I know the analogies to Sputnik are trite and they've been used a lot. But let me suggest that perhaps this is something that should be taken seriously. So just to remind you, on October 4th, 1957, Soviet Union launched the satellite, Sputnik. About the size of a basketball, 184 pounds, and went into orbit and the orbit actually passed over the United States several times. This was a bit shocking and on November 13th, President Eisenhower responded to this by delivering a speech, a major speech, and I'll quote a little bit of it. It said, “The Soviet Union now has the combined category of scientists and engineers, a greater number than the United States. And it’s producing graduates in these fields at a much faster rate. This trend is disturbing. Indeed, according to my scientific advisors, this is, for the American people, the most critical problem of all. My scientific advisors place this problem well above all other immediate tasks of producing missiles, of developing new techniques in the armed services. We need scientists in the ten years ahead.”

So he took a long view of this moment of crisis. I was nine years old at the time. And that long view, which is to gear up the United States to produce a new corps of scientists and engineers, was wonderful because I was the beneficiary of that. That meant in high school I went to science programs during the summer. And when I went to college, there was money being poured into investments and universities. I got an NSF pre-doctoral fellowship when I went to graduate school because of this. I got an NSF postdoctoral fellowship when I stayed as a post doc because of this. So it was something that the United States took very seriously. Many of my scientific colleagues were trained in a similar sort of way. The United States woke up.

And so I want to make several points in my talk today. I want to say first that I believe innovation adds to the wealth of society, that's point one. Second, that science and technology are indeed right at the heart of innovation. And thirdly, leadership which we still own, in innovation cannot be taken for granted. Now, the fact that innovation is key to prosperity and progress was not immediately obvious. And Robert Solow, an economist at MIT, got a Nobel Prize for his work that showed that increases in society’s productivity were the direct result of technology development. And what he started with the premise is that no, it’s investments in capital and the capital when invested properly can in society make you build more stuff, produce more things, et cetera, et cetera. But ultimately, it would be tied to labor. And then in the long run, not in the short term, but in the long run, labor and capital would increase together in the absence of any technology development. As your workforce grows, you can produce more stuff, but that really means that your standard of living per person is going to remain fundamentally the same.

So Solow pointed out yes, that's true. But if you have technology innovation, everything can change. And in fact, what he showed, the additional wealth, any additional wealth other than population increases, will be caused by technological innovation. And for that, he got a Nobel Prize in economics.

Now, this theme has been picked up a number of times. The fact that innovation is the key to prosperity and progress was reactivated many times. A report that was issued

by the National Academy of Sciences, National Academy of Engineering, the Institute of Medicine, that came out in 2005, was called "Rising Above the Gathering Storm." It was chaired by Norm Augustine. I had the privilege of being on this committee. And its task was very simple: how was the United States going to compete in a flat world of the 21st century? And the answer, it made a number of recommendations, but essentially said attention to the intellectual capital of the United States, invest in it. You will get more wealth creation.

There was a progress report just issued very recently, in 2010, and it's titled, the title said, "Rising Above the Gathering Storm Revisited: Rapidly Approaching Category Five." And what it essentially says, it says in balance-- and it's talking about the collective society of America, the governing Congress, administration, everybody, "In balance, it would appear overall the United States long-term competitiveness outlook, read jobs, had further deteriorated since the publication of The Gathering Storm Report five years ago." And so the issue is what is really at stake and what are other countries doing?

So let me remind you. The United States has been, for well over a century, the greatest innovation machine in the world. While it did not invent the automobile, that was done in Germany, it took the invention and processed it into something that was not seen in the world before, especially the Ford Model T assembly line. And so it took over the leadership of automobile manufacturing for pretty much three-quarters of a century. The first airplane was discovered in America, the first transistor, the first integrated circuit. Optical and satellite communications, GPS, the internet, all came from the United States, all did wonderful things in terms of wealth creation for the United States.

And so I say that today, this leadership is at risk. We are no longer leaders in manufacturing. But what's even more startling, we are no longer the leaders in high technology manufacturing. In terms of a global high tech export of our country, we hit a peak in 1998, capturing about 25 percent of the market. And since that time, it has been declining steadily so now it's about 12 percent of this world market. Europe remained roughly constant during this time. Meanwhile, China from 1995 to 2008-- this graph goes up to 2008-- went from about 6 percent to 20 percent of the world market of high tech manufactured goods. So that's a fact.

And in fact, China says quite candidly, and I'm quoting from Premier Wen Jiabao in a talk he gave to the World Economic Forum in 2009, and he said, "We should see scientific and technological innovations as an important pillar and make a great effort to develop new industries of strategic importance. Science and technology is a powerful engine of economic growth. We will make China a country of innovation. We will accelerate the development of a low carbon economy and a green economy so as to gain an advantageous position into international industrial competition." So he said that in 2009. And what's the strategy?

It's actually taking it out of the playbook of the United States. In nurturing innovation, China decided to use government policies to guide the private sector into

playing the leading role in R&D. And it's the government policies acting as a slight rudder to guide the much greater investments in the private sector. The difference is that they decided to do this and they launched on a long-term plan to do this. And the first five-year plan followed, and there's soon to be another five year plan.

So what's the evidence that U.S. science and technological leadership is at risk? Well, in the United States, most of the patents in the United States were originated in the United States. But in 2009, for the first time, 51 percent of U.S. patents were rewarded to non-U.S. companies. China had gone from 15th place to 5th place in international patents during that time. The World Economic Forum ranks the U.S. 48th in the quality of mathematics and science education. China's Singwa [?] and Peking Universities are the two largest suppliers of students who receive Ph.D.s in the United States. In less than 15 years, China has moved from 14th place to 2nd place in published research articles, now just behind the United States.

Eight of the ten global companies with the largest R&D budgets in the world have established R&D facilities in China or India, or both, and 77 percent say will build in China and India. These are facts taken from "Rising Above the Gathering Storm, Revisited, 2010." And an American company, Applied Materials, recently opened the world's largest private solar R&D facility in China.

There's other evidence of Chinese innovation, particularly in the energy field. China has installed the highest voltage capacity, lowest loss high voltage DC lines and high voltage AC lines in the world now. And it has plans for an integrated high voltage DC, high voltage AC backbone. It has broken ground now on 30 new nuclear reactors of the roughly 50 being built in the world. The United States is building two new reactors. It just surpassed the United States with the world's fastest super computer. It now holds the record for the highest speed rail in the world. The record is 262 miles an hour, but the operational speed, the schedule speed, is 220 miles an hour. And it has plans for 5,600 miles of new high speed rail. By comparison, Japan has 1,500 miles, France has 1,100 miles, U.S., zero.

China believes that it will achieve by 2020 18 percent of its energy by renewable energies. And according to the Vice Chairman of China's National Development and Reform Commission, the NDRC in China, it thinks it probably will get to 20 percent by 2020, renewable energy in China.

Okay, let me take you through examples of what China is doing. Take the coal industry in China. China used to have a lot of very old, inefficient plants. Systematically they said, "This is polluting our atmosphere. This is not good for the CO2; we're going to close them down." In 1992, it bought two 600 megawatt generators, which are called ultra super critical. That means these are working at the highest temperatures possible commercially. Bought them from ABB Consortium; ABB, a European company, and G.E. And it started operating them.

And in 1995, it established a collaboration between two Chinese industries, state funded research centers and universities in China that said, “Okay, this is what the world has. This is the best the world has to offer. We've got to understand how to do this. Can we make it better?” And between 2000 and 2004, it began to build and install and operate the first indigenous super critical plant in China. And by, I believe, 2005, it did its first export, Turkey bought one, and followed by India. It holds the world record for the highest efficiency coal plants in the world now, okay?

So now, when they started doing this, the president of the China Hunan Group, which is the largest power generating company in China, said, “We shouldn’t look at this project from a purely financial perspective. It represents the future.” Now, having said that, now they can build these power plants and costs per amount of megawatts, for example, is now equal to the super critical plants that the United States is building, not the ultra super critical ones. And it’s actually cheaper than the common coal plants that used to be made and actually are still being made in other parts of the world. So in actual fact, the cost has come down and it’s now competitive in terms of power per unit investment, but you get a lot more power per unit coal.

There's a common myth, for example, that China manufactures because it’s the low cost, cheap manufacturing and that's how it competes with the United States and the rest of the world. And so, if you look at the biggest solar photovoltaic company in China, called Suntech, it’s not according to the myth. It’s founded by someone born in China of Chinese heritage, but he got a Ph.D. in Australia at the University of New South Wales. He's a citizen of Australia. He said okay, he and his colleagues developed a new photovoltaic technology, Australia wasn't giving the right signals that they were serious about the right environment to develop this, so he went back to China. But the chief technology officer, who’s a professor at the University of New South Wales, is also a director of the Center of Excellence for advanced silicon photonics and photovoltaics. So he’s now in China.

I toured the plant. This company, Suntech, they toured this plant. It was 100 meters by 400 meters and four stories. It was a high tech modern plant that imports its raw materials, raw crystalline silicon from where? The United States. Because energy is cheaper. It adds the technologies, the doping, the metallization, all the things that make it into a solar cell in China and then it’s established factories around the world to assemble it. So what is wrong with this picture? And it’s a high tech automated factory. It’s not succeeding because of cheap labor. Not only that, its focus on driving down the manufacturing costs, of course, but it’s also set the world record for polycrystalline solar efficiency as measured by a German scientific institute, the Fraunhofer Institute, of 16 ½ percent. So it’s low cost, and it’s actually good technology.

Now, rest easy, the United States still has the record for monocrystalline and silicon technology in the world, it’s 24 and 25 percent. But, this is the threat that I see. So, America still has the opportunity to lead in a world where-- a world that will need essentially a new industrial revolution to give us the energy we want inexpensively, but carbon free, and it’s a way to secure our future prosperity as noted by the premier of

China. But I think time is running out. And I believe that we shouldn't lose sight of this and that federal support for scientific R&D is going to be critical for our economic competitiveness.

And this has occurred before. I mentioned the Wright Brothers, they made the first plane. But very quickly after that, the airplane technology migrated to Europe. And by World War I, Europe actually had the dominant airplane technology. And all of our World War I aces flew planes made in France. And so in 1915, the U.S. government established the National Advisory Committee for Aeronautics, it turns out to be a NASA predecessor, to conduct cutting edge research and to encourage the avionics industry in the U.S. And that, in part, led to a resurgence back to the United States of recapturing the lead. Now many aircraft companies, commercially it's now Boeing, but of course now we're in a race with Airbus. Other countries think they, too, can get into this game including China. China has made forays into the aerospace industry now.

There is a report that came out very recently, in the last half year, called A Business Plan for America's Energy Future. It was comprised of a committee, Norm Augustine, the former chairman and CEO of Lockheed Martin, Ursula Burns, who's the CEO of Xerox, John Dorr, partner of Kleiner Perkins, Bill Gates of Microsoft, Chad Holliday, who's now the chair of Bank of America, but former chair and CEO of DuPont, Jeff Immelt of G.E., and Tim Solso, the Chair and CEO of Cummings. So this small committee of seven people said what is the plan for America's energy future? And they noted several things.

That if you look at the fraction of sales in an industry and how much actually gets put back into R&D, both in the public and private sector, it's startling. In the pharmaceuticals, it's close to 19 percent of total revenue sales gets plowed back into research. Aerospace and defense, 11 ½ percent. Computers and electronics, 8 percent. What about energy? .03 percent. If you look at the federal budget, the 2010 federal budget is $6.3 trillion. How much of that is on energy research and development? .14 percent, $5.1 billion. Now, the total science and energy budget in the department is 12 billion. And the trend is even more alarming. Peaking in 1979, it has been, with a few bumps and wiggles, going downhill ever since then. And although the stimulus funding provided a huge down payment of additional R&D, the question is post stimulus, are we going to return to this downward trend, or are we going to do something about it?

And so this report goes on to say that government must play a key role in accelerating energy innovation. It says, "Innovations in energy technology can generate significant quantifiable public benefits. These public benefits--" I'm quoting from the report-- "These benefits include cleaner air, improved public health, enhanced national security and international diplomacy, reduced risk of dangerous climate change, and protection from energy prices and shocks related to economic disruptions. Currently, these benefits are neither recognized nor rewarded by the free market."

This set of CEOs also went on to say that the energy business requires investment of capital at a scale that is beyond the risk threshold of most private sector investors. And

this high level of risk exasperates the historic dearth of investments in new ideas, creating a vicious cycle of status quo behavior.

Now, their industry report, I urge you to look at it, there are little snippets from these industrial leaders. One of my favorites is from Norm Augustine. And he says, "The one thing that is clear based on my own career in industry and government, is that when faced with the major challenges of high technological content in a time of austerity, the last thing one should under-fund is R&D. To do so is the equivalent of removing an engine from an overloaded aircraft in order to reduce its weight."

There's a PCAST report, this is the President's Council of Advisors on Science and Technology that has been released this morning. And it says many similar things about the need to take energy investments very seriously.

All right, so what can investment do? What we see, and what the Department of Energy is now investing in, are very exciting technologies; an affordable electric vehicle battery that could go-- allow a 500 mile range. This would be three to five times better than today's batteries. New transformative approaches for making biofuels that could dramatically lower the cost. A program that will produce abundant domestic fuel directly from sunlight. We have a program, a roadmap that says how can we get photovoltaic solar energy down by a factor of four in price? Why a factor of four? At a factor of four, you don't need any subsidies, it flies. And that's the magic number. In fact, in all the technologies, we're now developing plans, at what point do you not need subsidy? Can you get there? And if we can, we'll design programs to do that. We need to dramatically reduce carbon capture and storage costs.

We're having a program to use technology we're still number one in, and that's the use of super computers and super computer simulation to actually skip very expensive design steps and there's been already a case proven in a collaboration with Cummings Diesel and the Department of Energy labs where they actually designed for the first time a diesel engine on the computer, simulated it, and built it. And they didn't need any more prototyping. The people in the company were very, very skeptical that could happen. And it's believed overall it decreases on the cost by 15 percent. And we can do this in many other areas.

We have introduced two innovative research funding programs. One is called Advanced Research Projects for Agency, or ARPA-E, and Arum Majumdar is the director of ARPA-E, here on the dais. And what this is is a research program that is short-term, two, maximum three, years. And then you yank the chain. You've got to get a private funder to do it, or something else. And it's high risk, high reward. We are not interested in funding incremental work, we're interested in game changing work.

The example I gave you before, an electric battery that would be three to five times lower in cost than today's lithium battery, it's actually a takeoff from what is called zinc air batteries that are used in people's hearing aids today. But can you make this thing rechargeable, last a lot longer, using whatever combination of metals and oxides? And we

think that it has a very distinct possibility of giving cars that now have a hundred mile range a five hundred mile range at a third the cost. Again, they have three years to make this happen and there's a shot, a really good shot at it.

Another thing we're doing is energy innovation hubs. These are the same high risk, high reward, but then we have to recognize that some research can't be done in two or three years. It needs a bigger group of scientists working under one roof in much the same spirit as what we did in the Manhattan Project, in the development of radar, and in many of the groups at Bell Laboratories that were developing technology. And for that reason, I like to call them little Bell lablets (sic). But for other, wiser people who are good at public affairs, decided energy innovation hubs would have been a better name. Anyway, that's one example.

You look at the way a plant makes chemical energy. It takes sunlight, it takes water, and it uses sunlight and energy to split the water into hydrogen and oxygen. And it takes carbon dioxide and reduces the carbon dioxide and builds a carbohydrate that we can then turn into a sugar that can turn into a fuel. Or, we can eat it, also a fuel. And so the question is, can we design using nanotechnology, something that begins to replicate what a plant does, but we have an advantage. We have access to materials that the wet biological world doesn't have access to. Therefore, we can in principle design something better, just as when we learned to fly we started by looking at the way large soaring birds flew. And the Wright Brothers plane actually had these big wings that warped around and that's how they-- just like large soaring birds, but they used a gasoline engine instead of muscle power.

And now today's jet engines use materials that nature can't produce; single crystals of metal in the turbine blade, as an example. So the question is can we do this in artificial photosynthesis with the design, make it ten times better in a plant, skip the hydrocarbic, go from water to oxygen, hydrogen, carbon dioxide, to a hydrocarbon fuel. It's been around for a while. We decided that in the last couple of years, there's been enough advances in science and nanotechnology that we have a shot in maybe five, ten years, this can really happen in a cost effective way. And so an energy innovation hub has been started to fund that type of research.

So, we face a choice today. Will we maintain America's innovation leadership, or are we going to fall behind? And I would say let's seize this opportunity and we really can't afford not to. So in closing, let me say that there are some differences between what I call this Sputnik event and the Sputnik event of 1957.

As was noted in the introduction, while we're competing, there is an opportunity to also collaborate. And we have much to collaborate with China, India and other countries. Why? In the next two decades, China is going to be building a new infrastructure of buildings, cities, roads, transmission lines, equivalent to the entire infrastructure of the United States. In 2030, what India will look like in 2030 doesn't exist. Eighty percent of what it has today, what it will have in 2030, doesn't exist today. Eighty percent of its infrastructure is yet to be built. And so these countries present new

markets, they also present a laboratory, okay, we can test it, this is going to work. While our infrastructure is largely grown, it's a replacement because our population, although growing, is not growing the way India and the mass migration of Chinese people from the farmland into cities, is not occurring. So there's an opportunity to work with China and India.

And so, in this Sputnik moment of today, I urge we do two things. We should formulate sensible, long-range energy policies that have bipartisan support to guide the private sector of the United States. China's doing this, it seems to be working. We should do this. Long range policies. And what about increasing the support of energy research and development? Why? Well, in research and development, private investments don't usually recoup the full value of the benefit so companies are reluctant to do some of the early stage research and development. And, quite frankly, a lot of the new technologies could displace an embedded way of doing business and could be met with resistance. Therefore, the government has to say, "This is the path we should be going in for our long-term future prosperity," and we have to do that.

And let me emphasize that wealth creation is driven by innovation and it is not conserved quantity. That if we collaborate with China and India, we both come out better for it. So with that, I will stop and take questions. (Applause)

MR. BJERGA: And thank you again for speaking with us today, Secretary Chu. We have numerous and high quality questions from our audience today, and please feel free to keep them coming in. Our first question from the audience, during his 2008 presidential campaign, now-President Obama referred to a new energy economy as "my number one priority." In the past two years, Congress has passed healthcare reform, financial reform has also passed, the stimulus bill passed. An energy bill didn't pass. Are you disappointed?

DR. CHU: Well, of course I'm disappointed. But, I think the thing is that we're here now, I don't think there's a lot of good that can come of saying I'm disappointed. Therefore, what? Therefore you stop trying? No. I'm hoping that the United States can recognize the economic opportunity that virtually all of Europe, western Europe has recognized, and developed countries in Asia have recognized, and the developing countries around the world are beginning to recognize. I think it's so important. America, I am optimistic, will wake up and seize the opportunity. And when it does, it still has the greatest innovation machine in the world.

MR. BJERGA: Much of your strategy for solving the climate change problem, such as setting the economic stage for the embrace of nuclear and carbon capture and storage, for example, is based for a price on carbon, it's based on having a price. Now that it is looking almost impossible for Congress to pass something like that which would set a price on carbon, are you concerned the economics for fixing the climate are now impossible?

DR. CHU: Well, I think the price will be placed on carbon eventually worldwide and we're going to go forward with what we can do now. Now having said that, it is certainly true, carbon capture and storage, if you have a stationary emitter like a coal plant, a gas plant, a cement plant, to the immediate micro costs of that industry it will always cost more to capture the carbon and store it. That's equivalent to saying that if you're a city and you, again turning to an abstract debate as to whether you want to treat the sewage or just dump it into the river, the immediate lowest cost is to dump it in the river. It's cheaper for you, but it's not cheaper for the city downstream.

And so the total integrated cost of the effects of doing this are much, much cheaper. If you say, "No, it's better to treat it at the source and eliminate that," and so we-- this is why there should be a price on carbon. Nuclear, I think we're still hopeful that it can actually get to be cost effective if you can show that it can be built on time, on schedule, that it can hold its own. But also remember that one of the drivers we're trying in wind and solar and all these other technologies, is we think it can be cheaper than fossil fuel.

MR. BJERGA: What is DOE's role in the international meetings on climate change that began today in Cancun? Can the U.S. meet the pledges it made in Copenhagen?

DR. CHU: Well, I think the answer is yes, of course we can. I think it requires, again, bipartisan will and support to do this. Now, I'm, as pointed out, was I the geek or the nerd, I forget, or something like that. But in any case, my task, and the Department of Energy's task, is to develop and nurture the technologies, to help industry go in the right direction, to help them nurture those technologies because in the end, when push comes to shove, when the rubber hits the road, this is what's going to allow us to do what we have to do.

MR. BJERGA: I think the intro in the clips had you as a self described geek. Are you sticking with that assessment?

DR. CHU: Sure, I'll stick with that. (Laughter)

MR. BJERGA: For many years, U.S. graduate programs in the hard sciences have drawn large numbers of foreign students and U.S. innovation has benefited. Changes to U.S. immigration policy post-9/11 and rising economic opportunity in home countries are leading more such students to return home after earning their degrees. What can the U.S. do to offset this trend and its consequences for U.S. innovation?

DR. CHU: Well, one of the recommendations of "Rising Above the Gathering Storm," but also many, many reports is that when a student comes to the United States, gets a Ph.D. in science and engineering and does well, staple a green card next to the diploma. Because in actual fact, what happens in graduate education in science and engineering in the United States, is that grants pay for it. The United States is investing in these people. And if they do well, you do not want to encourage that investment to go

back. And you're quite right, things are changing. They come to the United States to get an education. Why? Because the research universities in the United States still are the best in the world, bar none, and that's recognized. But, if they come here, get an education, get a Ph.D., do a post doc and then go back, as a young person then we, the United States, have lost a great deal.

It's also pointed out in "Rising Above the Gathering Storm Revisited," that the majority now of people getting Ph.D.s in science and engineering are now foreign-born. Now, the good news-- there's always some good news in this-- the good news is that if I look across the country in the last three or four years, especially, the young people are waking up to the energy and climate change problem and that is drawing them into science, just as in my day this little 184 pound thing going beep, beep, beep across the United States said, "Oh, maybe I should go into science and engineering." So, the young kids now want to go back into this. This is a good sign. And so I think it's important that the government, federal government, the state governments, to recognize this is a good sign, take advantage of it. Because in the end, this will be a cornerstone for economic prosperity.

MR. BJERGA: Just before this program began, we started seeing news reports that President Obama may shortly be announcing a pay freeze for federal employees. One of the issues that DOE has been attracting topnotch scientific talent. Are you aware of any discussion of a federal pay freeze, and how does such an action affect your efforts to recruit quality scientists?

DR. CHU: Well, I'm aware of an action and will see how that unfolds because this ultimately has to be also approved by Congress, so we'll see how it unfolds. But I think in terms of the ability to attract quality people into the DOE, surprisingly a number of people have been willing to take cuts in pay. Cuts in pay a factor of two, four, ten, to live in a fishbowl, if you will, because they feel it's that important. And so, Arun, for example, was elected a member of the National Academy of Sciences-- engineering, rather, when he was 42 or 43. He's still in his 40s. He had to resign from UC Berkeley in order to come work for the government. So, he gave up a tenured position. So it's not as though he were, well, a scientist losing his gaz (sic) and his better years are behind him, might as well work for the government. No, he was entering into his incredible years of high productivity, and we've got a bunch of others like that.

So it's tough and you have to be kind of a little bit crazy and a whole lot patriotic, but we can still get some people.

MR. BJERGA: Some Republicans in Congress have intimidated that they may try to rescind some Recovery Act funds. What would that mean for the Energy Department and your efforts?

DR. CHU: Well, I hope they don't. I think that these the Recovery Act funds in the Department of Energy are an important down payment to what we have to do. And the real question, as I posed in my talk, was certainly after the Recovery Act, you can't

spend at that rate. We're looking very hard at how we can use our precious resources going into the future in order to go forward. And again, I think this fundamentally is a bipartisan/nonpartisan issue. It's all about economic prosperity.

MR. BJERGA: Also among the new Republican majority in the House are several fairly vocal climate change skeptics. Given the increasingly vocal voice on the climate change debate and criticism of climate change science, do you anticipate that you will be going back to fighting the climate change debate itself rather than pushing for solutions to it?

DR. CHU: Well, I hope not. I think that if anything over the last half dozen years, the evidence has gotten more compelling. But I think sometimes you get a little bit sideways on this debate if you say, "Have you proven with 100 percent certainty that this is happening and some bad things, as what you say, what the climate scientists are saying, are happening?" And I maintain you don't need 100 percent certainty. You know, 80, 90 percent, and maybe if half the bad things that happen with 80 or 90 percent certainty is enough to say, "Okay, how do you want to plan your personal life?" Let me use this as an analogy. You just bought a home, electrician comes in and says, "You know, the wiring is shot. It's frayed, you got to replace the wiring." "How much is it going to cost?" "Fifteen thousand dollars." Well, you're strapped, you've just bought the house. How can you replace the wiring for $15,000?

So what do you do? You get another estimate. Okay, another estimate. Well, I don't know, but the next new electrician says, "You got to do it because it's going to be bad if you don't." Okay, do you shop around for the one in a thousand electricians who say it's okay? Not really. Do you actually go and say, "Well, okay, that's a threat. But I think it's more cost effective if I just make sure my fire insurance is up to date?" Your family's living in the home, it could burn down while they're asleep. You bite the bullet and say, "I'm going to do this."

But, it isn't even that. What I'm trying to tell the American public is that this is an economic opportunity. So it's not even though you have to make this expenditure. You're making an expenditure because in the long run, for the future economic health of the country, and that future's not 20 years in the future, we're talking one, two, three years, you got to make these investments.

MR. BJERGA: You addressed China and its own alternative energy development in your remarks. Many of the new green technologies that you mentioned depend on rare earth materials whose mining and processing China now dominates. What research or development is the Energy Department pursuing to develop U.S. capacity to produce either those rare earth materials or alternatives to them?

DR. CHU: All of the above. I think that was a wakeup call that if you depend on a single supplier, with China producing roughly 95 or more percent of the rare earths around the world, and you have a single supplier, that you run a risk. And so there has been a mine in California that's been shut down and we're in discussions with them to

help them start up again. There are a number of forays-- rare earths are not that rare. What is at stake, however, is that you have to be very careful in how to mine them, and so how to mine them in an environmentally responsible way. And so we're working on that. Many other countries have gotten concerned and are looking at other places for supplies. But we're also going deeper than that. We're also looking at ways to use them more efficiently, but also technological ways to get the same benefit of the rare earths. And it depends on whether it's used in electronics for very high efficiency motors or in displays for flat screen TVs, and a number of things, looking at alternative substitutes.

Because what has happened is in some of these rare earths, the price has gone up by tenfold. And that in itself is worrisome. And so we are doing a lot in terms of exactly what you say, looking for substitutes.

MR. BJERGA: Also on the topic of energy independence, you do a lot of work with the USDA, especially on ethanol projects with a focus on next generation fuel, cellulose, ethanol forms of that production. This December 31st, there is a tariff and a subsidy for corn-based ethanol that are up for expiration. This question from the audience asks do corn ethanol subsidies still need to occur? And do trade protections for corn-based ethanol need to continue in the current energy climate?

DR. CHU: Well, let me just say that what the Department of Energy, because this is a complicated economic issue as well, and what the Department of Energy, as you said, is focusing on is corn-based ethanol is a good way of getting it going, realizing that Americans can drive their vehicles using agriculture-based fuels. But we are primarily focused, as you noted, on developing the new technologies that can supersede ethanol made from starches, sugars like corn. But we're also focusing on ways that we can actually go beyond ethanol. Ethanol is not an ideal transportation fuel. Gasoline, jet fuel, kerosene, mostly kerosene is in jet fuel, and diesel fuel are much better things to use. They don't require changing the infrastructure. And so one of the things we are focusing very much on is how do you take biofuels but make direct substitutes for these fuels that can be stuck and blended in any ratio directly into the gas tank?

Let me just add that because of this, we've actually started some, I think four years ago, but before my time, when I was Director of LBL, three bio energy research centers on the same rubric as these energy hubs. Get a whole bunch of really smart people, say "Go, this is your task. Come up with dramatically new technologies." And within six months after the startup, one of these centers, they took e. coli, a simple bacteria that you find in the gut of your stomach, and put in whole new metabolic pathways so that when you feed e. coli sugars, they will actually produce direct substitutes for gasoline diesel fuel and jet fuel.

When they reported this discovery in *Nature* magazine, I called up the director, this was a friend of mine, I had some role in helping this thing get going. I said, "Okay, Jay, that's great. What do you need to make it commercially viable at pick a price? So, any price, $80 a barrel?" He says, "Well, it's got to be within 80 percent of what we think is the organism can produce and we're not there yet. And sugar has to be at this price."

But by then, by the time it got published a private company has already picked it up and is running with it, try to optimize it. And the scientists who did the basic research are saying, "You know, this could actually work. We can find out in a year or two, so let's do a little bench top prototype production thing to see what are the things we need to figure out."

So again, the idea that you get really, really smart people trying to solve a problem, not just publish a paper, is the way we've got to go. And so we see also good evidence of that coming along.

MR. BJERGA: This is sort of a mash-up of two questions, which is always dangerous to ask. But we'll give it a go here. Both questions from the audience. The administration has indicated a desire to pursue development of nuclear, but also a position against dumping spent fuel at Yucca Mountain. How off the table is the Yucca project? And assuming that it is, how does the administration plan to deal with the lingering issue of nuclear waste or disposal as it's giving out billions of dollars to the loan credit guarantees to nuclear projects?

DR. CHU: Well, first there's two things. First, we believe that it's the right and proper thing to do to restart the American nuclear industry. We believe that this is not only good for going to decrease our carbon emissions, but we also think this is good technologically, it's good for us economically. The United States used to be the leader in this, but it's, again, one of those things we've lost the lead in. The leadership is now in France, it's in Japan, it's in Korea. And now China is going in such a big way that has plans to build four nuclear foundries for the castings in China.

I think the problem of the nuclear waste is a problem that actually fundamentally I think can be solved, but it's both a scientific problem and a political problem. The political problem is you've got to engage very, very early and make it-- the people in the area want to want it to happen. And you might say, "Well, how can that be?" And we actually have an existence proof. There's a low level waste repository that we run in New Mexico. Initially, the people were a little bit worried about this, because they're worried-- so you stick this stuff under the ground in a salt formation. It has a disadvantage because once you stick it under-- you mine down to the salt formation. The salt formation has been proven to be stable for tens of millions of years. So even in that time, the continents are drifting around, this is okay. You can radioactively date that.

And so the downside is after you stick it in, the salt oozes around it, encapsulates it, you can't get back at it. Well, that wasn't in the original requirements at Yucca. This is actually what you want. Don't you want it to kind of ooze around and can't get back at it? So the thing has been operating now for ten years. There's been no accidents, it's been done very safely. It's an income generation for the communities around it. And so, I think one has to do that.

So the story has two parts to it. One is that there may be better strategies, better ways of approaching it. And that's why there's this blue ribbon commission that's looking

into this. That the nuclear regulatory agency has already said we can keep the storage where it is now, in dry catch storage, for 50, perhaps even 100-plus years. So the commission's task is tell us technically what we should be doing. It's not a signing commission. Tell us technically what are the best options? What type of storage do you want? It could be a dual thing, it could be interim plus permanent disposal, it can be lots of things. They're free to decide what to do. But knowing that you have 50 years. That we're not in a crisis situation. And so we can do a much better job this time. And so that's the task of the commission.

Now having said that, and this is the realization that it's solvable, would you say let's not do anything for the next 50 years until we prove-- no, not really. There's lots of things. We say, "Okay, If we think about it, this is going to work. We know it's going to work. Let's move ahead and then restart our nuclear industry." Again, it's important also the United States restart, not only for the economic issues, but also for the nonproliferation issues. The United States is still one of the leaders in fighting for nonproliferation. And the fact that if we're a player in the civilian nuclear industry, that will help us a lot as well. And so there's a variety of reasons, both economic, world peace, a lot of reasons why I think we should become players.

MR. BJERGA: One topic that has not been discussed in great detail today has been energy efficiency. What do you see as some of the most promising initiatives in that area that DOE or other researchers may be pursuing?

DR. CHU: Well, yes energy efficiency. I'm so glad you raised this. As you may know, I'm often fond of saying it is the lowest-hanging fruit. It is not only low-hanging fruit but is actually something that we are pushing very, very strongly. Cathy Zoi, who's the Assistant Secretary for EERE, now acting undersecretary for the energy section of the Department of Energy is here. And we're pushing very hard to show that you can actually-- energy efficiency means saving money. And if it really means saving money, then it should-- this is something that should be-- should happen by itself. So it isn't happening by itself. Why isn't it happening? You look at the things, whether it's capital and initial investments, whether it's ignorance, whether it's a lot of things, habits, to change that. But we do firmly believe that energy efficiency is the fastest, quickest way to make us more competitive, save money that would go into our pockets, that would go back into the economy, many, many things. And it's ultimately going to be saving lots of dollars and lots of carbon.

So this energy efficiency is something very big, especially you think of cars. We can do better there. But buildings is a very big deal. We think you can build a building that can decrease the energy consumption of a building by a factor of four in ways that would pay for itself so that it pays for itself in, let's say, a quarter of the lifetime of the building. And we start an innovation hub to actually show that you can design these using computer-aided design, that it can be built in new buildings, especially retrofits may be a factor of two, and demonstrate that if you do this, you actually save money. And once you begin to demonstrate this, we hope it just takes off by itself because all of a sudden you realize.

However, there is something that you have to be very conscious of. You have to be willing-- for the first point, factor of two, just the better design, no more additional money. Just know the current technologies that exist today and right off the bat, no additional money, you're saving energy. The next factor two will require additional investments and the question is are you willing to invest in the lifetime of a 60-year building to get a payback time in ten years? If you say no, then you can't do some of those things. And so that's something that investment in the long-term is one of the issues that we have to overcome in our thinking of investments.

MR. BJERGA: We are almost out of time, but before asking the last question, we have a couple of important matters to take care of. The first, to remind our members and guests of future speakers. On December 2nd, we have Muhtar Kent, the chairman and CEO of the Coca-Cola Company. And our first luncheon of 2011 will be on January 12th, where Gail McGovern, head of the American Red Cross, will discuss one year after the Haiti earthquake, progress and challenges.

We'd also like to present our speaker in commemoration and appreciation of his time today, with the National Press Club mug. (Applause)

DR. CHU: Thank you.

MR. BJERGA: And I know we're running a little bit over time today. But for our audience's enjoyment and to get a better sense of Steve Chu, the man, we have one final question. So, you have a Ph.D., you have your Nobel Prize in physics, you're leading a Cabinet department. A lot of people would come with the assumption that you're pretty smart. As many of us know, having lived and worked in Washington for some time, we know there's a lot of people in Washington who maybe aren't so smart. Present company excepted, please, how does the Secretary of Energy and a Nobel Laureate deal with people who just don't get it in Washington?

DR. CHU: First, please tell my mother that I'm smarter than she thinks. (Laughter) No, I don't think you go into any job with an attitude like that. I was a professor for many, many years and my attitude, always, and when I was working at Bell Labs, sometimes I would have an idea and management, I'd go and talk to them, "I want to do this." Kind of look at me, "No." And my reaction was constantly, "Okay." Not, "Oh, I'm smarter than they, therefore we know what's going on." Then I'd say, "Okay," I went back and I said, "Hmm, what didn't I explain right?" And then I'd go back and say, "Okay, this is what I think." Now, once I went back three times and my then boss's boss kind of looked at me and he says, "Steve, if you're going to argue about wanting to do that experiment, I got better things to do." He actually let me do it, but never mind. He wasn't thrilled, but I always come in with the attitude of if you don't succeed the first time, try again.

Or, they can try to convince you they're right. That's part of this discussion. I could be wrong, okay? So you have this give and take. Now, the final part of this, this

guy turned out to be a very good friend of mine that I've known for 35 years now, 32 years. And he's now in the Department of Energy. He's director of the Office of Science, so he forgave me.

MR. BJERGA: Well, thank you Secretary Chu. And thank you to the staff of the National Press Club. And thank you to the staff of the Energy Department that scrambled in the PowerPoint situation. And thank you all for coming here today. This meeting of the National Press Club is adjourned. (Sounds gavel.)

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